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# Japan Report

(FOUO 25/81)

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POLITICAL AND SOCIOLOGICAL

## LIBERAL DEMOCRATIC PARTY'S 'FACTIONAL STRIFE' UP-DATED

### Tanaka-Fukuda Rivalry

Tokyo YOMIURI SHIMBUN in Japanese 2 Feb 81 p 2

[Text] The "Tanaka-Fukuda rivalry" by the two former prime ministers, Tanaka and Fukuda, is about to surface from the undercurrent of what seems at first glance a calm "very stable political situation." Since the Tanaka-Fukuda battle in 1972, these two have taken the leading roles in the political strife as long time rivals and now these two are important pillars supporting the Suzuki government. On the occasion of the large increase in the Tanaka faction at the end of last year, sparks have begun to fly over such issues as the primary election, factional revival and the resulting reshuffle in political circles. With the confrontation between the "Tanaka shadow" and the "Fududa shadow" as the backdrop, Prime Minister Suzuki's strategy of groping for a long term government while maintaining a balance between these two has become intertwined, and the relationship of these two will be an extremely important factor coloring the political situation--from the party and cabinet personnel changes expected in the latter half of this year and the end of Suzuki's term of office as president in November of next year to the decision on the Lockheed incident.

### Prime Minister's Strategy of Maintaining Equilibrium Becomes Entwined

"Primary election." Regarding the primary election, former Prime Minister Tanaka insists that "the primary election be continued for the sake of party members who paid five years dues of 10,000 yen per year." At its executive council meeting in January, the Tanaka faction decided on continuation of the primary election, rejecting the thinking of the leaders, Chairman Nikaido (LDP Executive Council chairman) and Vice-chairman Ezaki (former minister of MITI). It is said that the former prime minister's (Tanaka) voice of authority was behind it.

It was understood that the Tanaka faction decision was aimed solely at a "containment" of Economic Planning Agency Director Kawamoto who is proudly being Number One in acquisition of party members support. However, there is no doubt that this faction (Tanaka faction), which flaunts itself as the largest faction in the LDP, is very conscious of the existence of former Prime Minister Fukuda who regularly advises Prime Minister Suzuki to take decisive steps on discontinuation of the primary election.

Visit to Reagan

As soon as the Reagan administration came into being, Executive Council Chairman Nikaido visited the U.S. twice--at the end of last year and for the presidential inauguration in January, and he held talks with the Reagan team and leaders of the Republican Party, and boasted "I was able to establish a wide channel of communication with them."

The Tanaka faction plans to put forth Executive Council Chairman Nikaido a foreign minister in the next post-Suzuki cabinet reshuffle, and his U.S. visit was to prepare the foundation.

However, former Prime Minister Fukuda will also attend and address the Japan-U.S.-Europe conference to be held in Washington at the end of March. President Reagan, who knew this, expressly mentioned in his recent telephone conversation with Prime Minister Suzuki, "I understand former Prime Minister Fukuda will be coming shortly, but I would also like to meet with you soon." The rumor has quickly spread that "former Prime Minister Fukuda is going to carry 'Suzuki's personal letter" as a special envoy." (LDP source)

Former Prime Minister Fukuda, who intends to visit the U.S. with his wife, is full of enthusiasm even though playing innocent with "this is a honeymoon trip," but at the present stage it does not seem that he will carry a personal letter since several U.S. visits will come one after another, the foreign minister in March and the prime minister in April. However, there is a deeprooted view within the LDP that "Chief Cabinet Secretary Miyazawa, who disliked the Tanaka faction's Reagan approach, set up the Fukuda trip to the U.S. as an official visit. It was understood that those around Suzuki recognized the Reagan administration "attached importance to Fukuda" and are trying to maintain a balance between Tanaka and Fukuda.

Opposition Party Reorganization and Factional Revival

Former Prime Minister Tanaka and Council Chairman Nikaido place a high value on the movement toward making a new party--a concentration of centrist power by the Komei Party, the Japan Democratic Socialist Party (DSP), New Liberal Club and Social Democratic League. They put their hopes in the movement of the Komei Party and DSP, saying "our country's political situation will be stable if there is the tri-polar structure of the LDP, centrist bloc and the socialist-communists."

On the other hand, former Prime Minister Fukuda and Science and Technology Agency General Director Nakagawa are very close to Kasuga, permanent adviser to the DSP, and it is a matter of common knowledge in political circles that they regularly exchange opinions. It is said that Kasuga is aiming at a reorganization of the political world which will include the right wing of the Socialist Party and, in the event of a split in the LDP, part of its conservative wing. This subject comes up often in his meeting with former Prime Minister Fukuda.

There are also some in the leadership of the Tanaka faction who look with anxiety on former Prime Minister Fukuda's closeness with Adviser Kasuga, even though they say "there is no one in the LDP who shows any interest in Kasuga's thinking, although Mr Fukuda and Mr Nakagawa may be interested in it."

Analysis with the Party

"Because Mr Tanaka hustles, the sleeping Mr Fukuda (his political opponent) will wake up. It seems that recently Mr Miki (former prime minister) has also been in contact with Mr Fukuda. So if Mr Tanaka becomes too strong, there is the possibility that the Suzuki faction, plus Miki and Fukuda, will join together." (Senior member of non-faction group)

"The fact that Prime Minister Suzuki looks up to Mr Fukuda is also a public pose. Behind the scenes, he keeps in contact with Mr Tanaka." (Key member of a leading faction)

The views vary, but it seems the "uneasy relationship" of Tanaka and Fukuda will continue to smolder in the future.



## Fukuda Influence on Suzuki

Tokyo MAINICHI SHIMBUN in Japanese 2 Feb 81 p 2

[Text] Fukuda's Influence on Suzuki

The fact that Prime Minister Suzuki places importance on former Prime Minister Fukuda is conspicuous. Especially with regard to diplomacy, it is said that Suzuki listens to Fukuda's advice so much so that there are those who say "it may be said he 'leaves diplomacy to Mr Fukuda.'" This tendency can be seen in the intra-party management, such as on the question of continuation or discontinuation of the LDP presidential primary election, and it is certain that dissatisfaction has started to appear in the Tanaka faction, the other side who supports the Suzuki regime and whose relationship has always been close to Suzuki--- "the prime minister is maintaining too much balance (between the Tanaka faction and the Fukuda faction)." It has been six months since the Suzuki regime came into being. It seems that his aim is to shift the power distribution without destroying the balance of power of the "whole party structure" in order to establish his "own self-dependent Suzuki government" before the budget committee discussions of the first ordinary session of the Diet.

The prime minister has maintained very close contact with former Prime Minister Fukuda on the diplomatic questions since the beginning of the year, such as the prime minister's tour of the Association of Southeast Asian Nations (ASEAN) and the reconstruction of Japan-Korea relations after the end of Kim Dae-jung's trial. As for the prime minister's visit to the U.S. planned for April, it is thought that he will entrust his personal letter for President Reagan to Mr Fukuda who will make a U.S. visit before then.

Mr Fukuda places such great importance on Southeast Asian diplomacy that he is called "ASEAN's Fukuda." He is an Asia authority known from his "Fukuda doctrine." With regard to the prime minister's recent trip abroad, it is said that he has had prior contact with Mr Fukuda so much so that it was called "a continuation of Fukuda diplomacy." Fukuda has broad channels of communication with Korea and with the U.S. Republican Party camp; so he is a good adviser for the prime minister whose weakness is diplomacy.

Prime Minister Suzuki's posture of giving importance to Fukuda can even be seen in intra-party operations. At the end of last year, those around Fukuda said, "on the question of the LDP presidential primary election, the prime minister has had contact with Mr Fukuda who is an advocate of discontinuation and there is no major difference in their thinking." It is said that Fukuda himself understands that since the circumstances are such for the prime minister who advocates "peace politics" that he has to place importance on consultations with all factions, it is difficult to take immediate action on discontinuation.

As for the LDP presidential primary election question, it is closely entwined with the battle for successor to the LDP presidency--what will happen after President Szuuki whose term ends in November of next year, that is, will President Suzuki be reappointed or will it be either Nakasone or Kawamoto, or will it suddenly go to the new leader group, such as Chief Cabinet Secretary Miyazawa, Chairman Abe of the Policy Affairs Research Council or Noburu Takeskita. Since it is said that "there is no great difference in thinking: between Suzuki and Fukuda, that is Fukuda's major influence on the prime minister who originally was an advocate of continuation. The relationship between the two has been good from the beginning. The view is now held that in this recent honeymoon there may be a second coming of the "Ohira (Suzuki)-Fukuda coalition" which was the key to the birth of the Fukuda cabinet in 1976.

There is the viewpoint that the prime minister's strengthening of the "Fukuda closeness" coincided with the time when the Tanaka faction exceeded 100 members in number last year and caused all manner of shock within the party. The LDP leadership complained, saying "the growth of the Tanaka faction will not be pleasant for the prime minister." It is natural that even though Prime Minister Suzuki had an extremely close relationship with the Tanaka faction until now, it would not be comfortable for the prime minister who has his own faction.

Likewise, the growth of the Tanaka faction has caused anxiety since last fall to the prime minister and those around him who are planning for a cabinet reorganization---"let's hope this does not become the cause for a crack in the whole party structure." Either way, there will be no difference in the "potential threat" to the president's faction.

It should be seen that at this point the importance the prime minister places on Fukuda does not go beyond the limits of intra-party balance. It means that "because the Tanaka faction is strong, the balance can be maintained by the prime minister drawing closer to the Fukuda faction." Moreover, it must be understood that since the prime minister's political management until now has often been referred to as a "lack of leadership" or "a party leadership," the prime minister's aim is the establishment of "his own administration" with a Suzuki coloring at a time when six months of his term in office have passed and he is strengthening his self-confidence with his first trip abroad.

The more the prime minister who has been consistently close to "Tanaka" and sometimes a "part of Tanaka" in the "Tanaka-Fukuda battle" which has always been the undercurrent of intra-party strife since the presidential election of 1972 (Tanaka vs. Fukuda) draws a line between himself and "Tanaka" and shows a closeness to "Fukuda," the more he gives the impression of "being independent."



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MILITARY

## INCREASE IN DEFENSE INITIATIVES REPORTED

### Competition for Contracts

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 1 Jan 81 p 9

[Text] The Defense Agency's FY 81 equipment budget prescribes a procurement of many large front-line equipment weapons, which the defense industries interpret as a momentum toward quantitative expansion. International opinion is also working toward promoting a fully equipped Self-Defense Force, and all in all, it is certain that the importance of electronics technology will be furthered. Taking this opportunity, the positive posture of the general electrical machinery makers in commercial competition has become more apparent since the latter half of last year. This year the defense industries are likely to engage in the most exhaustive defense order contract contest ever held. In this climate, major makers headed by Mitsubishi Heavy Industries have consolidated their position to engage in a "Competition in Pursuit of Quality." "It is the improvement of technological standards that makes it possible to obtain more orders" (reporter, Kawabe).

Since the latter half of last year, Hitachi-Nissan Motor and Ishikawajima Harima Heavy Industries-Toshiba, the two groups of four companies that represent the Japanese assembly industry, have been striving to set up swiftly a joint development system for defense equipment technology. "With major industries as an axis, we must expediently upgrade the standard of weapons technology" (Tomio Tanatsugu, chairman of the Japan Weapon Industry Association, incumbent vice president of Toshiba Corporation). This is the basic concept and it is anticipated that these groups in their organizing activities will begin dealing in earnest in the new year.

The year 1981 can be called a cornerstone for the defense industries. The Defense Agency was able to determine the view of the administration to take positive action to procure front-line equipment, the weapons used for actual engagement with a confronting enemy, during the compilation of the budget for the new fiscal year. In conjunction with this, the speed of procuring large equipment is also likely to be accelerated. Furthermore, the Mid Term Defense program (MTDP), which is the Defense Agency's basic concept of equipment procurement and standardization will be ready for reform this year.

The current IOE was decided on in May 1979, with FY 78 as a base for the period FY 80-89. The new IOE, called IOE 81, reviews IOE 78 and also envisages programs for the next 5 years. Accordingly, each company "will try to integrate the IOE into its own development projection, and get ready for an all-out sales battle" (a person in charge of operations at a major equipment maker). He added that the new models of missiles, torpedoes, mines, aircraft and high-speed naval vessels to be named in the programs "will ultimately be determined by the Defense Agency, but they will also be influenced by the competence of the person in charge of defense operations on the manufacturer's side.

This does not mean, however, that the industries are blessed by only a tail wind. In August last year the Defense Agency discontinued the procurement of the domestically developed C-1 Transport in favor of changing the model to the American-made C-130 Transport. The aircraft industry interpreted this decision to be schematized something like this: America's request for Japan to reinforce its defense capability + the trade in balance = import of American-made weapons.

"The standard of independent technology must be raised considerably lest a similar case spread to other weapons" is a concern still lingering in the industries. Although the defense industries appear to have favorable winds, the sentiment that "this is the year to work for technological improvement" is enhanced by the backdrop as described above.

The electronification of major equipment such as tanks, escort ships and combat planes have advanced yearly. How to cope with this is the "big job for makers to address" (Kenji Ikeda, an executive director of Mitsubishi Heavy Industries). Mitsubishi Heavy Industries determined last year "to seek the enrichment of their technical skill with a view to stressing electronification, and to continue to do this in the future" (same person). Kawasaki Heavy Inudustries and Hitachi Shipbuilding and Engineering, as well as machinery and equipment makers such as Teijin Seiki and Tokyo Precision Instrument, are all setting up an "Electronics Reinforcement Plan."

Corresponding to these moves, electrical machinery and equipment makers which self-confidently say "electronics is the leader in modern industrial technology, and the same is true in defense technology" (Tanatsugu), have intensified their desire to deal with defense technology, with the major makers as central figures. Nippon Electric Company (NEC), Hitachi, and Mitsubishi Electric, the three major electric machinery and equipment companies, have altered and augmented their corporate structures one after another since last summer, aiming at strengthening the defense operations and technology departments. Among them, Hitachi installed a Defense Technology Promotion Headquarters (chief of the headquarters, Susumu Isa, executive director) and investigated a concrete business expansion policy, and consequently agreed to a joint research setup with Nissan to advance into the rocket control field, in contrast with the past practice geared to electronic sensors, which claimed the majority of orders received.

The Hitachi-Nissan group will add Fuji Heavy Industries to the group to seek a futrue primary contract for missiles. Fuji Heavy Industries, which has been secretly desired for a primary contract for missiles, will be greatly "reinforced" by forming such a common front with top general electric machinery makers. Meanwhile, Toshiba and Ishikawajima Harima are also eager to set up a cooperative relationship, and a definite joint research project will be formed before the end of this year.

The percentage of the cost of electric machinery and equipment to the unit price of equipment is approximately 40 percent even in the case of tanks, for example the type 74 tank (current major tank model of Self-Defense Force), in which power is deemed life and soul. With the new model to be developed (commonly called type 88), the percentage is estimated to be about 50 percent. The rising wave of electronification and the grouping of other makers to counter the top defense maker, Mitsubishi Heavy Industries, are the two elements which will be delicately intertwined in the future movement that is to be broadened in the world of industries.

On the other hand, in the commercial competition for 1981 orders, the Defense Agency will complete the basic plan for renovation of BADGE (base air defense ground environment) by summer, and the post-BADGE commercial competition at an estimated scale of some 250 billion yen will at last be fought in earnest. The Defense Agency completed preliminary investigation in the United States by the end of last year, and the basic and detailed design will be unveiled to the makers as soon as the plan is confirmed, although it is expected that the initial schedule of decisionmaking on the basic plan by next spring will be delayed.

Major computer makers such as Fujitsu, Hitachi and NEC are assuming that "key machinery and device technology can later be converted to civilian use high-performance technology" (Fujitsu), and are collecting information to prepare for the commercial competition. A man connected with the industries predicts: "American makers' technology may be adopted in the stage of basic planning and basic design, but a policy favoring domestic products will be laid out for detailed design and manufacture of the machinery and devices."

In addition, for domestically developed equipment, the primary contract maker for the development and production of the MTX (next term medium jet trainer), estimated to cost a total of 250 billion yen, will be virtually picked by the end of this year. Kawasaki Heavy Industries, Fuji Heavy Industries and Mitsubishi Heavy Industries, the three major makers, are due for the final round, but the industries view this as a duel between Kawasaki Heavy Industries and Fuji Heavy Industries. They may say that Fuji Heavy Industries invested more funds for preparation of installations for the development, but it is very difficult to say which of the two companies has the greater advantage at the moment.

In the field of naval vessels, the focal point is the outcome of the AS submarine tender, a 3600-ton standard displacement class, and the missile escort ship DDG, a 4500-ton standard displacement class. Kawasaki Heavy Industries aims at the AS model as a start for "reentry" into the field of surface vessels. It is "the best opportunity for surfacing" (Yoichi Madono, director of naval vessel operations) for Kawasaki Heavy Industries, which has been partial to receiving orders for submarines. With the DDG, Ishikawajima Harima is determined to cut into the orders monopolized by Mitsubishi Heavy Industries. Furthermore, in FY 82, it is very likely that the Defense Agency will procure hydrofoil high-speed missile craft, and Hitachi and others are about to take assertive action in anticipation.

The most competitive market will be in missiles. Battles will be fought continuously over the primary contract for a "portable SAM," a portable surface-to-air missile, over the license and domestic production of "Sidewinder," an air-to-air AIM-9L, and over the receipt of orders for post-Nike missiles. The missile companies--top missile maker Mitsubishi Electric, Mitsubishi Heavy Industries, Kawasaki Heavy Industries, Toshiba and NEC, which is putting everything it has on only receiving orders for guidance and control systems--are all sharpening their teeth trying to get the new models.

"Nowadays, the Americans are showing their cooperative attitude toward Japan by granting most advanced technology such as missiles and torpedoes" (Yoshikazu Oyama, director of first and second defense operations, NEC). The Defense Agency also admitted a total reversal of the American attitude compared to the trend perceived up to last summer, and reasoned: "The new trend is the result of the enhancement of closer Japan-U.S. cooperation and the rise in Japanese technological standards" (Atsuhiko Bansho, technical adviser).

Setting aside the Japan-U.S. cooperation, the upgrading of Japanese technological capacity has brought bargaining power (negotiating ability). A typical case that demonstrates this phenomenon is the domestic production (initially to be procured by import) of the AIM-9L, with which the F-15 fighter will be equipped under license.

Furthermore, the major electric machinery and equipment companies have started to show their genuine interest in defense orders, and the "major defense companies" of yesterday, such as shipbuilders and heavy industries, can no longer remain unconcerned, because "it is predicted that we will enter an era when those satisfied with being nominally the primary contractor will lose actual leadership to the company that is in charge of key sections" (Tetsu Senga, adviser for the Defense Production Committee Council, Keidanren). Top makers contend: "We do not intend to make the race for orders rough and tough for everybody" (Zenji Umeda, president of Kawasaki Heavy Industries, and Toshimasa Mitsui, vice president of Mitsubishi Heavy Industries), but the technical and operational staff's sentiment boils down to: "We need to unfold a technological race and therefore an exhaustive battle for orders will be waged. Otherwise, no future outlook is in sight."

A director of Mitsubishi Heavy Industries in charge of defense operations, said: "The defense equipment budget increase does not simply mean that we concentrate on competing for quantitative expansion of orders to be received. If the domestically produced equipment standard is low, imported equipment will take over the market. To the same extent that the Defense Agency is eager to expedite replenishment of major equipment, the American and European weapon makers are hungry for the chance to sell their products." In sum, in appearance the defense industries have entered "the age of expansion of work volume," but in reality they are about to see an earnest opening of "the age of improving technological capability."

Research and development expenses are the key point for independent technology development. The Defense Agency's budget for FY 81 calls for appropriation of some 30 billion yen, but those connected with the industries agree that "this is too little." In particular, the budget bill was formulated, after all, emphasizing the appropriation for front-line equipment, which resulted in "short changing the research and development sector" (Tetsu Hara, administrative vice minister of the agency).

The research and development expenses for the Defense Agency have been changing in the last few years and come to 1.2 percent of the total defense budget. The same ratio in European nations and the United States amounts to 3-10 percent. The defense industries strongly complain, saying that "the ratio and the yen amount are less than that allocated by a single company, Toshiba" (Tanatsugu). To give an example, Japan Telegram and Telephone Public Corporation appropriates 2-3 percent (over 70 billion yen in FY 80) of the business expenditures for the research and development budget.

In the defense industries, subcontracting parts makers called venders have more stringent business income and expenditures than the assembly (final fabrication) makers. They say: "Since often a company's own funds are advanced for the development of new models, average venders operate without any real profit" (association of the weapons industry). The entire industry is likely to get a headache due to the lack of research and development expenses, but in the days ahead the burden will continue to be felt more keenly by the venders than by others, just as before.

This year, warplane makers will shift to full-scale domestic production under license of the F-15 and P-3C, two great models, involving activities from the manufacture of parts to finishing the entire craft, and the CCV (control configured vehicle) trial model, for which the basic design was completed last autumn, will be made by remodeling the initial craft, the T-2, a high-class trainer. Makers of other sectors also have a pile of long-term research and development projects. They are PGM (precision guidance missiles) such as torpedoes and bombs with control and guidance systems including missiles, anti-electronic fighter equipment and devices such as FCM and FCCM, new tank models and 200mm class large caliber guns. In spite of the problems they have, the industries appear to be going full-speed ahead toward enrichment of technological capacity.



## Antiaircraft Defense System

Tokyo NIHON KEIZAI SHIMBUN in Japanese 6 Jan 81 p 1

[Text] The Defense Agency has consolidated the policy of developing BADGE X (next term base air defense ground environment), a key air defense preparation for Japan, primarily through domestic production. The current BADGE system was imported from the American Hughes Corporation. This is the first time that the agency will switch to the development of air defense key equipment through primarily domestic production. The Defense Agency plans to procure computers from domestic production, and to develop data processing software in Japan partially with the cooperation of the United States. In FY 81, the system design will be completed, and makers will be selected for development. Procurement will commence with a total of 200-300 billion yen from the FY 83 budget. Domestic development of the BADGE system, which commands advanced technology, has become feasible since it is judged that the internal electronics technology has progressed rapidly, contributing to a Japanese competence that matches America's. This can be recognized as a symbol of the supremacy of the Japanese information industry's technology standard.

This FY 81 budget bill which was passed on 29 December last year approved the BADGE investigation expenses. The Air Self-Defense Force has firmed up a plan to send an investigating party to the United States as early as this spring for reinvestigation of the current status of BADGE X.

The BADGE system of the Air Self-Defense Force was adopted in 1963 as an essential item for the second defense build-up program (FY 62-66) and actually operated starting in 1968. The system automatically executes the following three-step operation and serves a key function of the Air Self-Defense Force: 1) discover flying objects by a radar network spread out over 24 locations throughout Japan, excluding Okinawa (4 locations); 2) discriminate immediately the identity of objects by computers and compute instantly the height, direction and speed of the object; and 3) transmit the data to counterattack fighters and "Nike" and "Hawk" air defense missiles, and handle guidance to the enemy crafts, destruction and return to base.

The BADGE system itself is composed of a large computer for computation of counterattack, a computer for tailing the planes, a data indicator and a high-speed radar-site data transmitter, and is posed in three--north, center and west--Air Self-Defense Force locations.

The Defense Agency proposed changing the BADGE system, which first started operating 10 years ago, to BADGE X, as proposed in the interim operations estimate (FY 80-84) for the following reasons: 1) relative reduction of capacity to cope with qualitative changes such as smaller and faster airplanes, and 2) anticipated limit to the processing of the volume of data increased by the introduction of the E-2C early warning plane.

In line with this policy, the Air Self-Defense Force has already sent an investigating party to the United States. Meanwhile, it has asked U.S. industries to investigate and examine the problems related to the current BADGE system, and is expecting to receive a report on the results of the investigation by the end of this fiscal year. The Air Self-Defense Force is thinking of first shaping a definite idea for modernization of the system, emphasizing the required performance in FY 81, and then proposing the idea to the makers in Japan.

That the Defense Agency consolidated the policy of developing BADGE X primarily by Japanese products is attributable to the remarkable technological progress of the Japanese information industry and to the judgment that, when considering potential future technological advancement, Japan has a capacity fully comparable to "advanced" America. Another factor that contributed to the selection of "development by domestic production" was the necessity, because the system is the key function of air defense preparation, for the agency always to be ready to plan a joint development with domestic makers so as to enhance the possibility of the technical reform.

Nonetheless, development of these air defense systems is more advanced in the United States. Japan's information and electronics industries in particular have no experience in dealing with the development of military systems. For this reason, it was decided to procure the computer proper from domestic products and to develop the data processing technology by seeking U.S. cooperation. The Defense Agency will present the military requirements to domestic makers as soon as they are completed by the Air Self-Defense Force, and will plan to decide on the contractors for the order on the basis of bidding.

It is estimated that renovation of the BADGE system will require a total of 200-300 billion yen for computer proper procurement expenses and for data processing technology development expenses. Although the procurement is 1 year behind the projection indicated in the interim operations estimate, selection of the procurement source will be completed by the end of FY 81, and it is hoped the appropriation for the procurement will be proposed in the FY 83 budget.

Computer companies and defense-related industries which have been zealously hoping for the BADGE X as the large project for the first half of the eighties, are very pleased once more to find that the Defense Agency has decided on a policy of developing the system primarily from domestic products. If the system design is to be completed within FY 81, the industries believe that the primary contractor for BADGE X will be substantially selected by this summer, and the competition in bidding for orders appears to be suddenly intensified as of now among computer companies such as Nippon Electric Company (NEC), Hitachi and Fujitsu.

The current BADGE system was delivered by the NEC group, which imported the technology from Hughes, and naturally NEC is getting ready to reclaim the victory.

On the other hand, Hitachi, which instituted a Defense Technology Promotion Headquarters last summer and has begun in earnest to deal with the defense industry, is also dead serious about gaining the edge at the finish line: "Computer technology of BADGE X can be converted to civilian applications in the future" (Susumu Isa, an executive director).

Meanwhile, the largest manufacturer in the computer industry, Fujitsu, is developing hypersonic planes for BADGE X use. Mitsubishi Electric and Toshiba, which have experience in receiving orders from the Defense Agency, have also started an early sales pitch aimed at becoming the primary contractor for BADGE X. It is certain that the primary contractor for BADGE X will be chosen from among these five companies. The consolidation of the policy of developing the system primarily from national products officially kicks off the real commercial competition surrounding BADGE X.

## JDA Director General's Interview

Tokyo NIHON KEIZAI SHIMBUN in Japanese 12 Jan 81 p 3

[Interview with Joji Omura, director general of Japan's Defense Agency, conducted by Makoto Fukagawa, director of the Political Section of NIHON KEIZAI SHIMBUN; date and place not given]

[Text] Foreign and domestic talk about "Japan's defense" is becoming livelier than ever, reflecting the changes in international currents. The regular sessions of the Diet, currently in recess, will be opened soon. Through deliberation over the FY 81 budget proposals, it is unmistakable that the basic attitude of the Suzuki administration toward security policy will once again be questioned. Focusing on "defense" which may affect Japan's course in the eighties, problematic points were discussed between Joji Omura, the director general of the Defense Agency, and Makoto Fukagawa, director of the political section of NIHON KEIZAI SHIMBUN.

### Increasing Threat of USSR

Fukagawa: Defense problems regarded as taboo for a long time are now being openly and loudly discussed. It is as though quite a number of fans came to fill the "defense" stadium which had previously been shunned by spectators. Diversified "views on ideal defense" are currently voiced from left and right. What is your basic thought about Japan's defense, including the existence of defense power in view of integral security?

Omura: Specifically, the invasion of Afghanistan by the USSR occurred at the end of 1979 and the Ohira-Carter conference were indeed the momentum that created the present atmosphere. With Japan's international position particularly uplifted by the economic aspect, the security issue is no longer negligible when talking with other nations about the roles to be played in international society. Yet, due to the constitutional restrictions ruling over Japan, "defense power" in the narrow sense must be integrated and coordinated with other areas as "diplomacy" and "economy." For instance, the aid to developing nations was started using the formula of doubling it in 3 years, but the next objective has not yet been set. Also, there is a delicate matter of uncertainty as to when we can finally achieve a defense power "to cope, as a rule, with limited small-scale aggressions" prescribed in the General Rules of defense programs formulated in 1976. I fear many things were left in a knotty mess.

At any rate, compared to the days when unavoidable political issues were only whispered backstage, we can now talk openly before the people. I think that is progress.

Fukagawa: It is an undeniable fact that the air, sea and land military power of the USSR has qualitatively improved, and it may even surpass the United States in some areas. On the other hand, the new Reagan administration in the United States intends to seek a "strong America." With this international background, how do you perceive the so-called "Soviet threat"?

Omura: We do not deny that the USSR strengthened its military power in the seventies, while the United States was at a standstill, and it is also true that one-third to one-fourth of the strengthened air, sea and land forces are stationed in East Asia. The intention of the USSR is not clear. It is building up "considerably" right in front of Japan, and it doesn't appear that all these efforts are made without thinking of the presence of Japan. That is why we state that the political threat is increasing.

Looking over the articles at the time the 1976 defense General Rules were formulated, it is not that the threat was totally ignored. Indeed, to cope with the threat simply as it occurred and as was thought best, was not what was contemplated at that time. The bottom line of the General Rules encourages us to do what we can do first. Now, then, doesn't it make sense to achieve promptly at least what is described in the General Rules, since the potential threat of the USSR is gaining in magnitude?

Fukagawa: The growth rate of the FY 81 defense budget is extremely high compared to other sectors. "Historical turning point" may be slightly overstated, though....

Omura: Well, we are not scheming at anything with such a magnitude, but we thought, under the circumstances, that it is necessary to facilitate voluntary defense efforts within the limit of national conditions while holding fast to the Japan-U.S. security treaty. The budget scale of approximately 2.4 trillion yen means an increase of 7.6 percent compared with the preceding year. Some complain that the budget allocated is 2 percent short of the target. However, speaking from the standpoint of the content, the General Rules of the defense plan will be realized as soon as possible. In sum, early realization of the interim operations estimate has become one step closer to reality.

Fukagawa: Don't you consider that to some extent the examination of the content was slighted by the numbers game that took off, leaving everything else behind?

Omura: As we were pressed to decide on the ceiling for the FY 81 budget by July, we asked what the Ministry of Finance had in mind. The reply was that the growth rate of 7 percent, 120-150 billion yen, would be appropriate considering that it was the second year since the financial reconstruction. However, that 7 percent will be eaten up by approximately 100 billion yen to be paid for fulfillment of the financial obligations incurred in the past and by increases in salaries and wages. That will not leave any room for the interim operations estimate regardless of the proposal. In order to implement the reform primarily for the front-line equipment, we thought that there is no use talking about it unless our budget is accepted at a slightly higher increase than the general administrative expenses. We finally came to the figure of a 9.7-percent increase, which was embodied as an approximate request of 2.4466 trillion yen submitted at the end of August. Truly, we came to this figure because we thought of the content.

Fukagawa: Do you think that one of the problems is that a "9.7-percent increase" was interpreted by the Americans not as the ceiling but as the bottom? In fact, I hear that the U.S. Congress is showing concern over Japan's lack of defense efforts. Do you anticipate that the defense issue will feed the friction between Japan and the United States?

Omura: Indeed, the U.S. Congress is critical of us. The U.S. military budget was initially 150 billion dollars, but 20 billion dollars was added (by the Congress) to expedite the production of missiles and other areas that are lagging behind the USSR. A commander of the U.S. 7th Fleet said: "It is embarrassing that we have not built a single new ship within the last 5 years. How can we be fit to protect the Strait of Hormuz in such a situation...? However, under the new administration we can hopefully put ourselves in some kind of shape and keep the commitment of the security treaty." In other words, in spite of the critical financial difficulty, the U.S. Government is trying to invest in security, and it is telling us to follow suit. I don't say I can't understand their feeling.

From the outside, it may appear that our defense expenses look very low compared with Japan's proven economic power. The defense budget is 5.1 percent of the budget for the general account. You haven't heard of a country like this. The defense budget in any other country is in double digits. It is only in Japan where the defense budget is less than 1 percent of the GNP. Yet, since Japan stated that it was going to endeavor for defense, something more notable was expected to happen. Unfortunately, the budget problem in the land of Japan cannot be solved 100 percent to (my) liking....

Fukagawa: Various items are to be procured by this defense budget, but 1.3 trillion yen will also be added to the liabilities of the later years. That really requires a double digit growth rate for the FY 82 budget for the purpose of balancing the budget.

Omura: That's characteristic of the defense budget. Procurement of weapons, naval vessels and aircraft usually extends over several years. Therefore, the initial year will cover 5-10 percent of the cost, a mere down payment, and the rest will be prorated over the span of several years. Now, let me give you some examples of programs that have been set forth by the FY 81 budget. New domestically produced type 74 tanks have been increased substantially, from 60 tanks last year to 72 tanks. Also, some 30 self-portable 155mm howitzers are to be procured. In the past, a towing vehicle was disengaged from a howitzer after arrival at the destination, and it took 20-30 minutes for the weapon to be ready for use. The new self-portable kind permits immediate action. Meanwhile, the Maritime Self-Defense Force is going to procure seven ships, including one 4,500-ton class escort ship which missiles (DDG), two medium-size escort ships and others, and to renovate one old escort ship completely under the FRAM (Fleet Renovation and Modernization Plan). The procurement of a total of eight ships amounts to 17,000 tons, which is almost double the 10,000 tons for FY 80. Procurement by the Air Self-Defense Force included two aircraft, an F-2C (early warning plane) and a C-130 suitable for mass human and material transportation. Six sets of domestically produced short-range SAM's (short-range surface-to-air missiles) are also promised, although this item is shared by Air and Land Self-Defense Forces. Expenses for these will be the financial liabilities of subsequent fiscal years. A cost of 1.3 trillion yen is an astronomical figure, but it will be prorated over a period of up to 10 years.

Defensive Defense Only

Fukagawa: What about the issue of priority in defense equipment?

Omura: General Rules has a separate table with definite "objectives." The interim operations estimate (IOE) tries to follow them. Fulfillment of the IOE, however, is still short of the line drawn in the General Rules. We have not, of course, given up, but we will do our best to reach the goal as soon as possible. The IOE prepared in 1978 is an estimate for the period FY 80-84, but the IOE is reviewed every 3 years. The IOE to be prepared next, in 1981, is the estimate of operations for after FY 83 (to 1987).

Therefore, the task of this year is first to get the FY 81 budget approved, subsequently to define the policy for the IOE, and also to effect joint research and to conduct joint training based upon the Japan-U.S. guidelines (guideline for cooperation in defense).

Fukagawa: I understand that limited small-scale aggressions are assumed in General Rules. Our countermeasures, naturally, change by actual cases, that is, by given conditions. However, in that context, we are put in a position to counter everything, and we lose our brake. Do you regard the General Rules as a sort of brake?

Omura: Yes, that was one interpretation that existed. At the time the General Rules were prescribed in 1976, U.S.-Soviet detente was still standing up. The threat of large-scale aggression involving nuclear power was not envisaged. Only small-scale aggression with conventional weapons was expected, if ever, to develop. We thought it best to prepare ourselves to deal with this with Japan's own power. However, now we hear some say that we must review the General Rules in the light of the very tense U.S.-Soviet relations that demolished such an assumption. It is true that the trust between the United States and the Soviet Union is diminishing, but it appears that for the time being we are not in the kind of situation such as to foresee the threat of a large-scale war in the vicinity of Japan. In this sense, we deem it necessary and practical to lose no time in perfecting our ability to counter the "limited small-scale aggression" described in the General Rules in view of the recent situation.

Fukagawa: One interpretation is that the budget was set tentatively in line with a 1-percent GNP guideline, since the extent of the necessary reinforcement was not determined.

Omura: Yes, that was expected from the beginning. Since the time the 1-percent figure was decided, it has been considered "tentative." However, I doubt that the budget will ever exceed the 1-percent level, although it may come closer to that level since the Japanese economy is still growing even if the present pace is maintained. After all, "defensive defense" is the only tool allowed for Japan, and by law we are bound not to possess weapons such as long-range missiles capable of attacking other countries and offensive aircraft carriers.

Fukagawa: How about the research and development field?

Omura: The research and development expenses of the Defense Agency were close to 30 billion yen for the fiscal budget this year, which is just a little over 1 percent of the defense budget. I believe, the procurement of weapons should be carried out case by case. Large equipment and equipment that Japan cannot produce must be imported, but the equipment which can be produced domestically under license should be produced here. Small equipment which can be produced at home should definitely be produced at home. Regulations for exporting weapons are very strict, and weapons makers may not be profitable for a while. With the steady increase in procurement, however, the business sector can, I think, promote development by relying on that factor. Taking this opportunity of being able to produce short-range SAM's at home, an unexpected space industry has made itself known by announcing its interest in a project. In particular, electronics companies have lot of potential, with the support of excellent technologies.

Fukagawa: Do you have any one point that you want everybody to think about in regard to Japan's defense?

Omura: We appreciate that your support for the Self-Defense Force has increased and the defense issues are openly and seriously discussed. But we need your definite cooperation as long as you discuss them. Now, we have a volunteer system for our recruits. With the decrease in the population growth rate, the number of young men available for work will drop and the families will get smaller and smaller. Lack of manpower will be felt in the future. With this in mind, we must also think of public relations to appeal to young people for participation. Of course, we welcome having all kinds of ideas suggested to the economic world, but we want preferential treatment for former Self-Defense servicemen who seek new employment. Also, if we can, we would like to extend the experience of military life for new corporate employees from the current 3-4 days to at least 30 months (he laughs).



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SCIENCE AND TECHNOLOGY

## QUESTION OF WEAPONS EXPORTS DEBATED BY DIET, INDUSTRY

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 23 Feb 81 p 4

[Article by editorial staff writer Akio Matsumoto]

[Text] Should restrictions on arms exports be relaxed, or should prohibitive measures be made stiffer? This political problem has been brought up again and again, and each time it has been the subject of fierce debate.

The present debate over weapons exports was touched off by the opposition parties questioning government responsibility in the case of Horita Hagane, a small company specializing in special steel exports which exported semifinished cannon barrels to the ROK. The matter was taken up in the House of Representatives Budget Committee and attacked as exemplifying the use of a loophole which actually violates the three principles of weapons-export prohibition.

Reacting to this, MITI recognized that "some semifinished products correspond to weapons parts regulated by the Export Trade Control Order" and notified the Public Prosecutor's Office via the Ministry of Justice.

Even after that, other problems were raised in the Diet as being violations of the three principles, such as cooperation by a construction company in building a military port in Malaysia (Saeki Construction, building Rumut port on the west coast of Malaysia) and Japanese-British collaboration in exporting barrels for the 105-millimeter guns to be mounted on the Model 74 tank (Japan Steel Works, Ltd., and the U.K. Defense Ministry).

As a result, opposition parties, such as the Socialist Party and the Komeito, claimed that loopholes in the present three principles of weapons-export prohibition have clearly been demonstrated, and they submitted a weapons-export prohibition bill to the government during the present session of the Diet. The proposal includes 1) prohibiting by law the export of weapons and the participation of Japanese companies in the construction of foreign military bases; and 2) an on-site inspection system for weapons manufacturers and suspension of exports when an exported product is used in a weapon by the country which purchased it or by a third country, even if the manufacturer was not consciously manufacturing it as a weapon. These strict legal measures were sought, and deliberations on the budget were brought to a halt.

International Trade and Industry Minister Rokusuke Tanaka raised strong doubts about putting this proposal into law. "If we regulate parts and semifinished products, it will create serious obstacles to our technological exports." "It is difficult to distinguish weapons parts in an export inspection. Such a detailed inspection would require a huge amount of time and trouble. There are limits to our present administrative capacity. If the staff is expanded, it will create something like a small government and will slow down exports."

Deliberations on next year's budget, which will have a great effect on the national life and economy, were stopped by this conflict between MITI and the opposition parties. Proceedings were reopened after the following three articles were agreed upon by the government and opposition parties on 14 February: 1) improvements in the system for regulating weapons exports, and the taking of effective measures; 2) continued discussion between the ruling and opposition parties on the issue of a weapons-export prohibition law; 3) a factual survey of the controversial weapons export situation. However, this problem is not likely to go away.

Aiming to Take Advantage of Special Demands in U.S. Military Expansion

Even prior to this, the financial community had repeatedly found occasion to advocate a softening of weapons export measures.

The financial community has been careful out of deference to public opinion, since "arms exports violate the spirit of the peace constitution and are criticized as the 'logic of the merchants of death'." However, it has started loudly advocating arms exports as a way of breaking out of the structural recession that followed the oil shock in the fall of 1973.

Recently, at the meeting of the Japan Chamber of Commerce and Industry in March 1978, President Shigeo Nagano stated in his opening remarks: "Japan has no resources, and in order to survive it is cultivating superior brainpower and developing advanced high technology. In this field, our country must actively develop and export products which meet international demand." He called for cultivation of the defense industry and for a flexible response to weapons exports.

The objective of the Nagano statement was 1) to develop and strengthen the defense industry, heretofore kept in the shadows, as a leading strategic industry in Japan, and to use military technology to trigger new technological development; 2) to promote the recovery of oil money from the oil-producing countries; and 3) to state that as long as it uses an "unarmed peaceful marketing strategy," Japan cannot compete in "butter" transactions, involving arms and long-term contracts for imported oil which bring in oil money, like French President Giscard d'Estaing's fighter exports to Iran and West German Chancellor Schmidt's tank exports to Saudi Arabia. He was presenting a multifaceted strategy for the 1980's.

As if in response to this, the leaders of the defense industry are also positive. "If arms exports increase and we are not limited to a small internal demand, costs will go down and the amount of the people's tax money used for defense expenditures will also decrease. The Middle Eastern countries are suspicious of the United

States, and in buying weapons from the Soviet Union they may fall under [Soviet] control. This could be prevented with Japanese weapons." (Keidanren Defense Production Committee Chairman Fumihiko Kawano; Mitsubishi Electric Chairman Tadakazu Shindo) "What the Third World countries want most is food and weapons. Japan should export weapons to be used only for self-defense and meet their demands." (Kawasaki Heavy Industries President Zenji Umeda)

Oil businessmen also advocate opening up exports from the standpoint of giving priority to oil security diplomacy. "In terms of overall security, arms exports and oil are inextricably linked. Oil is the greatest political and military product in the world. In order to secure a supply, we should export weapons applying electronics." (Arabian Oil Chairman Sohei Mizuno; Asian Oil Chairman Ryutaro Hasegawa)

Even without these expectant statements about arms exports from our top financial circles, the Middle East and other Third World countries already have their eye on Japanese weapons, with their excellent performance and quality control.

Inquiries are actively being made about the Model 74 tank with world-rank performance built by Mitsubishi Heavy Industries, Howa Industries' Model 64 rifle, Shinmeiwa Industries' US-1 large seaplane, Kawasaki Heavy Industries' CI large cargo plane, and the large "Battle" helicopter.

The arms export trade to the Third World amounted to a total of 60 billion yen between 1970 and 1979. The four largest exporters were the United States with 45 percent, the Soviet Union with 28 percent, France with 10 percent, and Great Britain with 5 percent. Some 48 percent of the import market is in the Middle East, 16 percent is in the Far East, and 11 percent is in North Africa. Japan is an outsider, but with its superior productivity, quality, and technological capacity, it has great potential as an exporting country.

Along with exports to the Third World, exports related to the United States' great military expansion are drawing attention.

The new Reagan administration has taken a strong stance against the Russian threat and has proposed the largest peacetime military budget ever--1.14 trillion dollars for the 5 years between 1981 and 1986.

This sudden increase in U.S. national defense demand is creating a gap between the obsolescence of military demand industries and productivity, as well as a shortage of experienced workers. There will be a shortage of such strategic materials as gold, silver, copper, lead, titanium, chrome, and cobalt and integrated circuits. Japan as a potential production capacity for military demand, subcontract orders to Japan are increasing, and requests to take over construction of aircraft carriers have sprung up.

Export negotiations related to military demand, variously referred to as the "special demand for Afghanistan" and the "special cold war demand," cover a wide variety of items, including machine tools, bearings, special steel, castings, forged steel products, and semiconductors.

Utilize Peaceful Business Transactions Centering on Private Demand

The financial community's desire to open up arms exports is based on resource diplomacy with the Middle East and the U.S.-Soviet competition in military expansion. However, a more careful outlook also has strong support.

Former Keidanren Chairman Toshio Tsushimitsu is critical. He says: 1) The level of technology will not necessarily be pulled upward by arms production. Sufficient technological progress can be made by product development and technological development centered on private demand in fields like electronics. 2) Japan is already being criticized by foreign countries for automobile and steel exports. If we were to export arms as well, trade frictions would only increase.

Keidanren Chairman Yoshihiro Inayama is against establishing a law prohibiting arms exports. "If export prohibitions become law, the distinction between arms and ordinary goods, parts and semifinished products will become difficult to make, and this will create obstacles for export business." It is notable, however, that his response is rational. "It would be wise not to get involved in a war; there is no need to pull chestnuts out of a fire. If we follow the three principles, we cannot make large-volume arms exports, and any economic significance will be very slight." Japan's armaments expenditures are 500 billion yen per year, about 1 percent of total industrial production. The arms market is very small compared to the peaceful private demand. Therefore, the real feeling of the financial community seems to be that it would be poor policy to get upset about this small market and restrict it even further.



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## NUCLEAR ENERGY DEVELOPMENT PROGRAMS DISCUSSED

### Nuclear Fusion Research

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 1 Jan 81 p 19

[Text] The sun continually directs light and heat to the earth. Research and development on nuclear fusion, which attempts to duplicate the sun's functions on earth, are now about to enter a new stage. Japan, along with the United States, European countries, and the Soviet Union, is constructing nuclear fusion experimental facilities and is waging a highly competitive race for "who will be first to achieve nuclear fusion." On the other hand, there is a move to avoid duplication of research and development and commitment of vast sums of capital by two or more countries joining together in cooperative efforts. On the technological front, emphasis is gradually shifting from basic research to engineering research focused on practical use. At the same time, activities of the industrial sector, which heretofore has not been much in evidence, have begun to surface. Nuclear fusion has sometimes been dubbed "the ultimate energy." The path to realization of this form of energy will be a long one, and it has been said that it will be well into the 21st century before we will begin to enjoy its benefits. The relentless efforts to attain this realization are expected to have profound effects on industrial society.

Once the narrow farm road is traversed, one comes to an open area. In the center of this cleared area, in which trees have been cut and a rough grading has been made, a square hole about 100 meters on each side and 15 meters deep has been excavated. At the bottom of the hole is a concrete caisson (box), 20 meters square and 15 meters high, which is being buried. The occasional operation of the crane and the biting cold wind which whips across the area are the only sounds. Only a handful of workers are in view.

"This caisson will rest 30 meters underground on solid rock. It will house the JT-60, which in itself weighs more than 4,000 tons," said our guide, Shinichi Fusai, representing the director of the construction department of the Japan Atomic Energy Research Institute (JAERI).

Aim of Attaining Critical Conditions

This is Naka-Machi in Ibaraki Prefecture. This is the construction site for the JAERI nuclear fusion facility located roughly 15 kilometers north of Mito. The Tokai laboratory of JAERI, where the first nuclear fire in Japan had been lit, lies some 6 kilometers to the east. The center of this approximately 1.5-million-square-meter area is where construction of this large nuclear fusion research facility "JT-60" is proceeding at a cost reputed to be 200 billion yen. The main body of the "JT-60" will be 15 meters in diameter and 13 meters high, and the experimental facility to house the main body will be 47 meters above ground when completed. This is a size comparable to the Todaiji at Nara in which the great Buddha is housed.

It is almost 25 years since nuclear fusion research was initiated in Japan. The "JT-60" is one of the breakthrough events in this research and development history. Plasma of 100 million degrees confined for the duration of one second--the so-called critical conditions--is the target of this facility. That is to say, the goal is to establish whether nuclear fusion can be achieved by human hands and to lay the groundwork for its practical use in the future.

It is now more than 2 years since construction was initiated. "Construction has progressed in a very orderly manner," according to Fusai. The greater part of this construction is expected to be completed during JFY 82. The installation of the "JT-60," which is now being fabricated by Hitachi Ltd as primary builder aided by Tokyo Shibaura Electric and Mitsubishi Electric, will start about that time. Then the experiments to attain critical conditions will finally begin in 1985.

Nuclear fusion reaction is the energy source by which the sun has been sending forth its light and heat from time immemorial. If we can reproduce this reaction, mankind will be able to assure himself of an inexhaustible ultimate energy source. At the same time, one gram of "fuel" consisting of deuterium from sea water and tritium, when used in a fusion reaction, will provide energy equivalent to that furnished by the oil in a single 80-ton tanker. A nuclear power plant burns one gram of uranium to generate energy equivalent to that present in 1.8 tons of oil, and nuclear fusion can produce far more energy per unit weight of fuel.

Nuclear fusion has already been demonstrated in practice through the hydrogen bomb. On the other hand, the reactor is not designed to discharge all its energy in a fraction of a second, but to release the energy more gradually to enable more effective utilization and set up a "sun on earth," according to the present aims of research and development. Now, there are a number of breakthroughs which are necessary before this goal can be attained. How shall we create the superhigh temperature and superhigh density conditions which are absolutely essential to attainment of a nuclear fusion reaction?

Intensifying Confrontation of Advance Guards of Various Countries

"To be honest, up to 5 years ago, I myself doubted that nuclear fusion could be achieved by human hands, but I am now convinced that we will definitely realize nuclear fusion power without fail," said Director Hidetake Kakihana of the Nagoya University Plasma Laboratory. As the result of a quarter century of research and development, we have used experimental facilities to come within a step of creating a nuclear reaction. It is only one more step until we attack the remaining barrier before practical attainment of a nuclear fusion reaction, and that will be the duplication of the critical conditions. JAERI's "JT-60" is planned to break this barrier.

At present a fierce vanguard competition is taking place worldwide between various countries intent on breaking this barrier. These include the American "TFTR," the European alliance "JET," and the Soviet "T-15." A number of these large facilities of a class comparable to the "JT-60" will be making their appearance in the next few years. Department head Yukuo Kobata of the MAERI Nuclear Fusion Research Department said: "We will be left far behind if we are too complacent. We cannot relax."

Nuclear fusion development has often been referred to as a "money-eating worm." The "JT-60," which will not produce any energy for consumption, alone will cost about 200 billion yen. The next step facility will cost several times that of the "JT-60." The Atomic Energy Commission revealed that the development funds necessary for the 10-year period from 1978 through 1987 will total roughly 670 billion yen. Since this total does not include university-related funds, the total funds required will amount to considerably more. Including university-related funds, nuclear fusion development funds, which totaled 900 million yen in 1973, increased to about 17.4 billion yen 5 years later, in 1978, and to 35.8 billion yen in JFY 80.

How do we come up with these funds, which keep on doubling? This is a common lament among the countries involved. In this situation, a movement has arisen proposing that the next step of the experimental nuclear fusion reactor development be attacked through international cooperative effort as exemplified by the IAEA (International Atomic Energy Authority) and its "INTOR" as well as two or more countries' cooperative efforts such as the Japan-U.S. nuclear fusion research cooperation and other multiple country cooperative efforts. "A country poor in resources such as Japan must not fall behind in nuclear fusion development. On the other hand, we must not only be competitive with the world but we must also have good cooperation with the rest of the world. It is important from here on that we adopt a mixed development strategy involving both competition and cooperation," said Director Kakihana.

Engineering Step Is Next

"The JT-60 will be a scientific demonstration of nuclear fusion. In other words, it will make a breakthrough in the scientific area. Next is the engineering demonstration, when we finally enter the technology stage," said permanent adviser Kenzo Yamamoto of the Japan Atomic Industrial Forum. Adviser Yamamoto was responsible for the formation of the "Nuclear Fusion Technology Roundtable" in February 1980 comprised of related industries from the forum.

After the critical conditions are attained, a second barrier lies in wait in the nature of maintenance and control of the "fire" of nuclear fusion. This barrier will involve the solution to such problems as the optimum shape of the facility, the materials suitable to withstand the harsh conditions involved, and the manner in which the energy is extracted. These are the engineering problems which need to be resolved. Technological developmental strength in the hands of the industrial sector is a must if this barrier is to be broken. "The breaking of this second barrier may well come near the end of the 20th century, but we must start making preparations for this breakthrough," said Mr Yamamoto. It appears that the time is approaching when the industrial world, which until now has been staying in the background, will begin to play an important role.



## Export of Nuclear Reactors

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 6 Jan 81 p 1

[Text] The Ministry of International Trade and Industry will promote the export of nuclear power plants as one phase of its promotion of the domestic nuclear power industry and information gathering related to export structures as goals for the first half of the 1980's. This situation came about because while the various domestic power companies were giving their attention to the location of power plants and the domestic nuclear reactor industry was developing to the stage that it even possessed export capability, as soon as the nuclear reactor industry saw the potential demand from the developing countries for nuclear power plants, it began to urge export to these "virgin soils." Any reactor for export at present will have to be a light water reactor, and all the nuclear reactor companies are polishing their light water reactor technology. At the same time, they have begun to seek revisions to the domestic and foreign "limiting conditions" as they relate to nuclear power and to various handling procedures, thereby removing the barriers to export.

Fierce competition is taking place in the international nuclear power plant market between Westinghouse (WH) and General Electric (GE) of the United States, West Germany's Kraut Werk Union (KWU), Sweden's Acea Atom, France's Framatom, and the Soviets. President Carter's nuclear nonproliferation policy and the U.S. Three-Mile Island incident were responsible for a number of order cancellations, and the international demand for nuclear power plants is stagnating at present. On the other hand, the sharply intensifying oil situation has made nuclear power plant revival necessary. The U.S. Government, which has great influence on the international nuclear power situation, has now come under the leadership of Reagan, who is a "nuclear power extremist," and this is interpreted to mean that the international nuclear power market will see some activity.

In Japan, the power companies introduced light water reactors manufactured by the American WH and GE companies to get their start in nuclear power generation, and the domestic nuclear reactor industry still remains under the influence of the WH and GE light water reactor technology. This industry has yet to export its first nuclear power plant.

Now, the light water reactor modification and standardization plan initiated by the Ministry of International Trade and Industry in 1980 is the wedge that has forced open the development of a Japanese type light water reactor distinct from the American technology, and it is expected that in a few years light water reactor technology of an even stronger domestic flavor will be established.

At the same time, there are movements toward utilizing the well-known light water reactor technology to develop an array of domestic light water reactors, including small and medium reactors. Even while the nuclear reactor industry was building up to this present capability, the Japanese nuclear reactor industry was pushing to export its first nuclear power plant as one phase of establishing the business foundation of each nuclear power reactor company.

The Ministry of International Trade and Industry is not only promoting nuclear reactor industry development through involvement in the new "export" concept but is also promoting removal of the various barriers which have stood in the way of export.

Japan is restricted by multiple country agreements such as the nuclear proliferation treaty (NPT) as well as bilateral agreements such as the Japan-U.S. nuclear power cooperation, and these agreements impose a number of barriers.

This situation is the result of the handicap this country received from being a defeated nation together with the fact that Japan is almost completely lacking in uranium resources to fuel its reactors, making it necessary to import the uranium needed from foreign sources, and this was accompanied by these international restrictions.

Despite these limitations, Japan has been able gradually to build up its independence and autonomy and has begun to establish its own independent fuel cycle. In the midst of these changes in the environment surrounding Japan's nuclear power situation, export of domestically produced nuclear power plants has become feasible, and the various preparations for this export are being promoted.

The ministry said: The statement that "Japan cannot export nuclear reactors" is not basically written into the various agreements and it will seek new interpretations while it aims for the mid-eighties to initiate export of domestically produced power plants.



## Types of Nuclear Reactors

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 6 Jan 81 p 6

[Text] Activity is intensifying in the nuclear power industry to enter into development of new-type power reactors. The fast breeder reactor (FBR) which is the odds-on favorite of the fission reactors, the new-type converter reactor which ties together the classic light water reactor and the FBR reactor, the multipurpose high-temperature gas reactor which not only will produce power but will be used in steelmaking and coal liquefaction and gasification, and the nuclear fusion reactor which is expected to be the energy source for the 21st century are the targets of national projects which the electric power industry and nuclear power equipment makers have been pointing toward through new promotional systems and active reinforcement of manpower training in an accelerated manner with the transition to the decade of the eighties. There is a particular desire to bring the FBR to the practical operating stage during the nineties, and in 1980 the electric power industry set up a "Fast Breeder Reactor Development Section" within the Japan Atomic Power Company along with a "Fast Breeder Reactor Promotion Council" and a "Fast Breeder Reactor Development Preparatory Section," while the electric power equipment industry established a "Fast Breeder Reactor Engineering" group. In the area of the nuclear fusion reactor, Hitachi Ltd has already set up its "JT-60" (critical plasma test facility) Promotion Headquarters, and Toshiba its "JT-60 Promotion Project Team," and the development systems are being steadily reinforced. Because of this situation, the trends in the nuclear power industry were investigated with regard to the long term development strategy of new-type power reactors.

Fast Breeder Reactor

Concerning the FBR, which has uranium utilization efficiency of 60-80 percent, far superior to the efficiencies of light water reactors, the Atomic Energy Commission in its JFY 80 Annual Report on Nuclear Power (white paper) indicated that this reactor will become practical in the decade beginning in 1995. The development promotion policy involves the experimental reactor "Joyo" (designed thermal output 100,000 kW, which went critical in April 1977), the prototype reactor "Monju" (electrical output 280,000 kW, expected to go critical in December 1987), and a 1-million-kW class demonstration reactor of the same type along about the start of the decade beginning in 1995, while the first practical reactor is targeted for criticality in the latter half of the decade beginning in 1995, according to the scenario that has been unfolded.

What has newly appeared on the scene as a problem is the line of development. The Atomic Energy Commission, the Science and Technology Agency, and the Power Reactor and Nuclear Fuel Development Corporation (DONEN) have adopted the strategy of pursuing independent technology development and have been pouring vast sums of money and huge manpower to this end, while the electric power industry, which is hoping to acquire operating experience as rapidly as possible and lay the cornerstone for a program of disengagement from light water reactor dependence, wants to look into the possible "introduction" of technology from other leading countries. In other words, the users as represented by the electric power companies are pointing toward the adoption of a two-pronged attack through independently developed technology and imported technology to hasten the day that the transition to the FBR fuel cycle can be made smoothly.

There is considerable room for study on this problem of introduction, for Japan is already 10 years or so behind the so-called leading countries such as France and the Soviet Union, and the fulcrum of the FBR fuel cycle, the spent fuel reprocessing plant, is only now at the stage where DONEN has initiated basic research.

The electric power industry is very concerned that such problems are causing delays in the development of the FBR, and the problem FBR introduction will probably undergo during the eighties will be one of the major nuclear power policy problems.

The prototype reactor "Monju" now under construction at Tsuruga city in Fukui Prefecture, on which construction is way behind schedule, received notification of having met its first safety inspection from Governnor Nakagawa of Fukui Prefecture in December 1980, and DONEN sent an application for siting approval to the governor, indicating new movement toward development.

The construction cost of "Monju" will be 322 billion yen, and this, together with the fuel and the costs of the comprehensive functional tests following completion, will bring the total cost close to 400 billion yen. The country will bear 80 percent of this and private interests the other 20 percent. Of the share of private interests, 60 billion yen will be borne by the nine power companies along with Japan Atomic Power Company and the Electric Power Development Company for a total of 11 companies, while another 20 billion yen will be accounted for by Hitachi Ltd, Toshiba, Mitsubishi Electric Industry, and Fuji Electric groups.

The electric power industry set up a "Fast Breeder Reactor Development Section" within the Atomic Power Industry on 16 February last year, and this section will become the window through which support and cooperation on the technology front will be issued. In addition, the four companies, Hitachi Ltd, Toshiba, Mitsubishi Heavy Industries, and Fuji Electric, on 1 April of the same year reorganized and expanded the FBR engineering office they had been maintaining and established the "Fast Breeder Reactor Engineering (FBEC)" with a capitalization of 300 million yen.

The electric power industry, on the other hand, plans to start construction on the next step to the prototype reactor, which is the 1-million-kW class demonstration reactor, during the first half of the decade beginning in 1985, to go critical at the start of the decade beginning in 1995. As one phase of this development, the DENJIREN (Electric Industry Alliance) established the "Fast Breeder Reactor Promotion Council" and "FBR Development Preparation Section" to study long term basic strategy for the development system of the FBR demonstration reactor. At the same time, promotion of the conceptual design for the demonstration reactor, survey research related to this design, and information exchange with both domestic and foreign organs are being promoted.

The makers are planning to have FBEC serve not only for development of "Monju" but for the development of the post-demonstration reactors as well, and the principal functions of this facility are to have control over FBR design and engineering and onsite construction projects.

Let us next look at the FBR development strategy on the part of the electric power equipment makers.

First of all, Toshiba has set up a plan which envisages 1993-1994 as the starting time for construction of the first practical FBR reactor, and it plans to establish itself as the main contractor by setting up the "FBR Engineering Center" within the next 10 years, for which it is making plans. This company served as manager of the software area during the experimental reactor stage and was in charge of core design so that its storehouse of technological information is extensive.

It is expected to handle core upper section construction, control systems, and rotary plugs.

At the same time, Hitachi Ltd is planning reinforcement of its manpower in the soft areas, including design and inspection, and it has been increasing its manpower at the rate of about 100 people a year since 1977 at its plants, which include Hitachi Engineering, Babcock-Hitachi, and other related industries. On the experimental reactor, this company is in charge of the primary coolant system and certain equipment (such as nuclear reactor container, safety container, intermediate heat exchanger, sodium pump, electromagnetic pump) design and production. It also will handle the primary cooling system and heater for the vaporizer to be used in the prototype reactor.

The Mitsubishi group--Mitsubishi Heavy Industries, Mitsubishi Electric, and Mitsubishi Nuclear Power Industry--also has some designs in FBR development. It has set up a 3-year program for the prototype reactor and a 5-year program for the demonstration reactor and is engaged in bolstering its manpower and improving its production technology. In the area of manpower, it has put together a force of 300 design and research people and is planning annual increases of 10 percent, by which means it hopes some day to equal the 1,100-manpower force for FBR work which the U.S. Westinghouse (WH) Company has put together. Up to now it has put out a total of 6-7 billion yen for facilities, including 600 million yen in 1980. It is planning to handle the nuclear reactor container, the structures within this container, and the containment vessel for the prototype reactor.

This company is planning an information exchange program including technology with the WH company.

Nuclear Fusion Reactor

The strategy on the reactor type for the nuclear fusion reactor, which is expected to become the energy source of the 21st century, is still uncertain. The inertial confinement method is represented by the laser and ion beam modes, while the magnetic confinement method is represented by tokamak, mirror, heliotron, stellarator, and bumpy torus modes.

Both the Science and Technology Agency and JAERI are now taking the tokamak path, and the Science Council in November 1980 decided on tokamak while also conducting parallel studies on the heliotron and laser modes but emphasizing the tokamak approach in its "long term policy on nuclear fusion research for universities and other organs." In this manner, Japan has taken the step to make the tokamak mode its mainstream of developmental efforts in fusion research just as the Western countries have done.

Japan has many research results along the lines of tokamak development, and JAERI has accumulated experience in plasma heating technology and technology to operate nuclear fusion reactors, which had been operated in a pulse mode in the past by continuous operation just as a fission reactor. In the development of the international cooperative power experimental, reactor INTOR, in which

Japan, the Soviet Union, and the EC participated, the Japanese played an important role in the design. At the same time, studies are under way to construct a Japanese type nuclear fusion reactor similar to the "Star Fire," which was designed at the Argonne National Laboratory in the United States.

Now, the nuclear fusion reactor is expected to follow the FBR and surface as a large energy source of commercial nature, and the five industrial groups--which are the group headed by Hitachi Ltd along with Tokyo Atomic Power Company, the group of which Toshiba is the main figure along with Japan Atomic Power Company, the Mitsubishi Atomic Power Group headed by Mitsubishi Electric and Mitsubishi Heavy Industries, the First Atomic Power Industry whose main companies are Fuji Electric and Kawasaki Heavy Industries, and the Sumitomo Atomic Power Group--are participating and conducting vigorous research and development.

Hitachi Ltd and Toshiba are planning to set up their intracompany structure as rapidly as possible, and in April 1978 Hitachi was successful in obtaining an order of 38.7 billion yen from JAERI for parts for the "JT-60" including the main body of the reactor, and this acquisition was the occasion for establishing its "JT-60 promotion headquarters" (present director, Takio Iwano) in August of the same year.

These two companies have already accumulated 20 years' experience in fusion development, and some of their orders include the Osaka University DCX; Hitachi-Central Research Laboratory's IBIC; Nagoya University Plasma Laboratory's TPD and BSG; Kyushu University Applied Dynamics Laboratory's sphenoid coil; Nagoya University Plasma Laboratory's TPD2; Kyoto University's solenoid coil; JAERI's JFT2 and improved JFT2a; Kyushu University's Applied Dynamics Laboratory's TRIAMI; Hitachi Energy Laboratory's noncircular plasma experimental facility; JAERI's JT-60; Nagoya University Plasma Laboratory's JIPP-I and JIPP-II; Kyoto University Heliotron Nuclear Research Center's Heliotron D, DM, and E; and Tohoku University's Aspirator NP, for a total of 20 or so projects.

In addition, participation in these big projects is being planned by a Hitachi group headed by Hitachi Ltd, including Hitachi Cables, Hitachi Kasei Kogyo, and Hitachi Plant Construction.

At the same time, Toshiba established its "JT-60 promotion projects" in May 1979 (present project manager, Junichi Nagamura) and has been sponsoring an annual nuclear fusion equipment exhibition since 1977; it is projecting its involvement in nuclear fusion. This company has a record of a large number of orders for nuclear fusion equipment and has supplied experimental equipment to the Doublet III power source under construction by GA Company of the United States, and the power supply to the poloidal magnetic field coils of the JT-60, which make up part of the 20 or so orders it has handled. It has produced heating equipment such as the neutral particles injection device for the JFT2 and the LCT superconducting coils for domestic research facilities as well as 20 other items. It has also participated in the INTOR conceptual design and blanket design methods.

In another direction, an innovational development to the tokamak concept was proposed by JAERI which envisages the placing of the reactor main body in a pool

pool of water, and Mitsubishi is engaged with JAERI in exploring the feasibility of this.

### Multipurpose High-Temperature Gas Reactor

The multipurpose high-temperature gas reactor has been tabbed as the ticket which will enable the shift from oil to nuclear heat to provide the nonelectrical energy which accounts for two-thirds of the total primary energy consumption. Research and development on this reactor is being conducted by JAERI, which contracted out the detailed design for a thermal output 50,000-kW experimental reactor in 1980 with the hope it will go critical in 1987, and this contract was issued to the four nuclear power groups, Fuji Electric, Hitachi Ltd, Mitsubishi Heavy Industries, and Japan Atomic Power Industry. In charge of this design will be Fuji Electric, which has ties with Kawasaki Heavy Industries, making it a very powerful force in the atomic energy field.

Since these two companies were somewhat behind other companies in the matter of light water reactor development, they put their main developmental efforts in the direction of new-type power reactors. One of their first moves was the establishment of a nuclear power promotion headquarters within the confines of Fuji Electric. The main function of this headquarters is to serve as a cooperative outlet with the national projects in which DONEN and JAERI are engaged. Ten years later, in April 1979, the name of this organ was changed ot "Fuji-Kawasaki Heavy Industries Nuclear Power Promotion Headquarters" to play up their joint participation, and President Fukushige Shishido was made headquarters director while President Zenshi Umeda of Kawasaki Heavy Industries was appointed assistant director, and the board of directors was set at 28 members, of which Kawasaki supplied 10.

In addition to its engagement in multipurpose high-temperature gas reactor development, Fuji Electric is also involved in fuel handling facilities for the FBR experimental reactor and the ATR prototype reactor "Fugen" along with radioactive waste treatment equipment and engineering safety protection equipment. It expects to handle the same line of equipment for the FBR prototype reactor. At the same time, Kawasaki Heavy Industries is conducting research and development on the soft and hard issues of the three main pillars of new-type nuclear reactors, which are the multipurpose high-temperature gas reactor, the FBR, and the nuclear fusion reactor. This company entered into a technology cooperation agreement with the U.S. General Atomics (GA) Company in September last year on matters pertaining to the multipurpose high-temperature gas reactor.

The top problem faced by this company is personnel. This company has available a total of close to 500 people in the software end, and it plans to increase this number by 10 percent a year. Fuji Electric has a 3-year program which it plans to initiate in 1981 which will be centered on the new energy area and electronics to develop new technology, and one phase of this new development has been the acquisition of 40 college graduate technologists who will be engaged in intermediate operations. This company hired 170 college and specialty school graduates for regular service last spring and plans to hire another 250 this spring.

At the same time, Mitsubishi Heavy Industries also has considerable experience in multipurpose high temperature gas reactors. It has a high-temperature helium loop installed at its Nagasaki Laboratory equipped with various test loops for high-temperature high-pressure, materials, and helium purification use. This setup is available because this company had once intended to become involved in the power gas reactor, as a result of which it has abundant test equipment and personnel, and the spinoff to the multipurpose high-temperature gas reactor development is large. In addition, Hitachi Ltd has been participating in development of the multipurpose high-temperature gas reactor since 1973, and it has been promoting mainly development of the nuclear reactor pressure vessel, intermediate heat exchanger, and high-temperature distribution line type primary cooling equipment.

Development of New-Type Power Reactors (1980)

21 Jan--Sixth Japan-United Kingdom FBR Conference convenes
14 " --Ion temperature of 6.4 million degrees (later 7 million degrees) attained by the turbulent flow type tokamak nuclear fusion facility of the Applied Dynamics Laboratory of Kyushu University
29 Jan--Atomic Energy Commission establishes the ATR Demonstration Reactor Evaluation Study Special Committee
1 Feb--First inspection of ATR prototype reactor
--FBR experimental reactor boosted from 50,000 kW thermal output to 70,000 kWt
16 Feb--Japan Atomic Power Development Company establishes its Fast Breeder Reactor Development Section
28 Feb--INFCE ends, utilization of plutonium as espoused by Japan and Europe opens up
1 Apr--Fast Breeder engineering (FBEC) organ established
11 " --4th IAEA Larbe Tokamak Facility Technology Committee convenes in Tokyo
18 " --Toshiba sponsors fourth Nuclear Fusion Equipment Exhibition
24 " --Federation of electric power companies presidents' meeting decides to host FBR promotion conference and FBR development preparatory section
4 Jun--JFT2 of JAERI attains plasma beta value of maximum 10 percent (later 11 percent), which is tops in the world
16 Jun--Toshiba receives order for 525,000-kBA vertical type pulse generator for the Doublet III nuclear fusion experimental facility from the American GA company
19 Jun--Osaka University Laser Nuclear Fusion Research Center completes Japan's largest glass laser generating facility Gekko XII module
--Electric Power Producers Association establishes 10-year plan for promoting technological development strategy concepts concerning FBR and related items.
8 Aug--DONEN starts plutonium mixture conversion plant
1 Sep--JAERI sends out orders for detailed design of multipurpose high temperature gas reactor to four atomic power groups such as Fuji Electric
8 Sep--Kawasaki Heavy Industries enters into technological cooperation with American GA company on high-temperature gas reactor
18 Jan--Institute of Physical and Chemical Research succeeds in separating tritium fuel for nuclear fusion reactors by infrared pulse laser method
9 Oct--JAERI attains magnetic field of 6 tesla with superconducting magnet

(niobium-titanium) for nuclear fusion use
30 Oct--DONEN purchases 2 tons of heavy water from China through commercial companies
10 Nov--Science Council proposes long term nuclear fusion research promotion plan for universities and similar organs
14 Nov--DONEN sends Japan's first plutonium fuel to ATR
14 " --JAERI operates electron cyclotron resonance heating experiment with JFT2 and succeeds in elevating plasma electron temperature to 12.8 million degrees
9 Dec--Minister of Education Tanaka is in agreement with promotion of nuclear fusion by industrial and academic worlds and industry-academia cooperative system
10 " --DONEN submits application for location of prototype reactor of FBR to Prime Minister Suzuki



## Nuclear Training Center

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 8 Jan 81 p 3

[Text] Kansai Electric Power has revealed its policy of engaging in earnest construction of a "Nuclear Power Repair Training Center" aimed at strengthening repair and control capabilities of nuclear power plants, setting a target date of 7 October 1983. This type of facility has already been established by American power companies and Tokyo Electric in Japan, but Kansai Electric plans to build on a much greater scale than the preceding facilities, with the thought that this will improve the repair and control system which is vital to nuclear power development.

The Kansai Electric concept envisions the use of the major equipment found at a nuclear power plant along with some simulated equipment and various instructional facilities at this training center. There will be a regular complement of 40 people, and training will be provided to bring a novice up to the level of an experienced operator. Some specific duties to be learned are the disassembly and assembly of the nuclear reactor container, spot inspection of the steam generator, and fuel rod installation, which are all necessary to periodic inspection and on which there will be drills to the point that actual onsite experience can be obtained.

This center will cover a ground area of 158,000 square meters, of which 5,000 square meters will be taken up by buildings, and the cost is expected to be 6 billion yen. Construction is expected to begin in the early part of 1982 and to be completed in October 1983. Kansai Electric says that the site is still undetermined, but since all of this company's seven reactors are in Fukui Prefecture, it is expected that this center will also be located in Fukui Prefecture.

Kansai Electric operates pressurized water reactors, and this center is designed to provide training in repair of this type reactor; however, it plans to make this facility available to other companies should they request its use.

Kansai Electric obtains 25 percent of its power from nuclear sources, and it is engaged in all-out efforts to acquire nuclear power as an oil substitute. It affirms that the construction of an actual training center will serve to guard beforehand against equipment trouble and improve the operating rate of nuclear power production.



## Cleaning Workers' Clothing

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 9 Jan 81 p 7

[Text] Hitachi Ltd has set up a policy of emphasizing dry cleaning of clothing and other articles workers wear close to their bodies as one means of lowering the release of radioactive materials from nuclear power plants. Tokyo Shibaura has established a system which concentrates and solidifies liquid wastes from the washing processes at nuclear power plants so that the radioactive material is not released outside the confines of the power plant, and this company has received orders for such a system from Tokyo Electric's Fukushima No 1 and No 2 nuclear power plants and Tohoku Electric's Onnagawa nuclear power plant (to go into operation 1982-1984). In contrast to this system, the Hitachi concept involves dry cleaning of the clothing so as to avoid the use of water and thereby eliminate this wash water problem, and there is a growing competition between these two companies in the area of "cleaning systems."

The Hitachi dry cleaning system is basically the same system as that used by a general dry cleaning establishment. The only difference is that if there should be some radioactive contaminant adhering to a worker's clothing, gloves or socks, a process is introduced which prevents the release of any of the radioactive material to outside the plant. This company says: "We are already at a stage at which we can develop an order receiving activity" (Yoshiro Tsutsui, head of Nuclear Power Industry Department), indicating the degree to which this system has been developed.

The problem with laundry effluent from nuclear power facilities is said to be the damage caused by the concentration of the radioactive products by the foam produced by the cleansing agent, and the system presently in use at the various power plants is to dilute this waste water with sea water before disposal into the sea. There is, however, the ALP (as low as practical) principle which proposes "every effort to minimize any release of radioactive materials from the confines of a nuclear power plant" which pervades the thinking of the concerned people in the nuclear power field so that there is consensus on the idea that "even wastes from laundry procedures will not leave a plant" which is expected to be put into effect in the next couple of years.

Toshiba developed a low foaming washing agent in establishing a cleaning method along the lines of the former water wash involving washing, waste liquid concentration, solidification, and storage, quite unlike the dry cleaning approach. This company pointed out that "dry cleaning is rather ineffective in removing perspiration residues from underwear, and this is a point of particular concern to Japanese workers' feelings, so that there is no choice but to go to a water wash."



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Toshiba admits dry cleaning may be possible for outer wear and has purchased dry cleaning equipment from the Allied Nuclear Company of the United States, which is a radioactive waste treatment service company. A hot test using clothing actually used in radioactive material handling is at present under way.



## Increased Plant Operating Time

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 10 Jan 81 p 3

[Text] Last year the facilities utilization rate (operating rate) of nuclear power plants (for the whole country) averaged above the 6-year plateau of 60 percent, and not only is the power industry happy at these results but the supervisory government organs such as the Ministry of International Trade and Industry and the Resources and Energy Agency are delighted. The facilities utilization rate, which barely broke the 50 percent mark in 1979 in line with the U.S. Three-Mile Island incident, was turned around in one swoop by an increase of more than 10 percent in the course of a year, and the concerned people cannot be faulted for their elation.

### Increased Performance of 11.9 Percent in One Step

What is giving the concerned people cause for this elation is the complete absence of any form of structural damage such as stress corrosion cracking or leaks in the small pipes of the steam generator during the entire last year's operation. This is why each power company has increased its watchfulness for the coming year, the the Ministry of International Trade and Industry said: "We hope to guide the industry to a better than 65 percent operating rate as an average for the whole country" (Shigeo Suehiro, head of Nuclear Power Operation Supervisory Department, Resources and Energy Agency), revealing its optimism.

The average for the year from January through December 1980 for all nuclear power plants in the country was 61.1 percent, which represented an improvement of 11.9 percent over the 49.3 percent for 1979.

When classified according to reactor type, Tokyo Electric Power, Chubu Electric Power, Chugoku Electric Power, and Japan Atomic Power Company which operate BWR (boiling water type light water reactor, total of 11 reactors) averaged 63.4 percent, which represented continuation of the better than 60 percent level from last year's 62.0 percent.

On the other hand, Kansai Electric Power, Shikoku Electric Power, and Kyushu Electric Power which use the PWR (pressurized light water reactor) experienced the very low operating rate of 32.1 percent in 1979 as a result of the Three-Mile Island incident, but rebounded in one year to the good level of 58.3 percent, and the difference in their operating rate compared to the BWR was cut down to 5.1 percent. The GCR (gas cooled reactor, 166,000 kW output) which Japan Atomic Power Company has been operating since 1966, displayed the very high operating rate of 69.7 percent, possibly a reflection of 15 years' operating experience.

Nuclear power plants are required by law to undergo periodic inspection once every 13 months. On the other hand, the actual situation is that "an overhaul after every 9 months of operation prevents trouble before it occurs" (section head Suehior), which represents the judgment of the Energy Agency, and the present practice is to operate for 9 months and undergo periodic inspection for 3 months during the course of a year.

The Upper Limit Is About 73 Percent

This is why the facility utilization rate of 75 percent represents full operation by desk-top calculation, but the actual situation is that a reactor requires considerable time to start and stop so that 73 percent represents the more realistic limit. Accepting this 73 percent as the upper limit value, the facilities' utilization rate for 1980 will be 83.8 percent, and this is called a "superior performance." When the different power companies and the Energy Agency hold their heads high, it is because they can take pride in this accomplishment in view of the somewhat miserable 40-percent level performances of the past.

The reason the concerned people were so elated at this utilization rate exceeding 61 percent is that there was virtually no incidence of new trouble. The BWR plants of JAERI's Tokai No 2; Tsuruga No 2; Tokyo Electric's Fukushima Nos 1, 3, 4, and 5; Chubu Electric's Hamaoka Nos 1 and 2; and Chugoku Electric's Shimane power plant were subjected to "periodic inspections every 3-4 months at the outset according to plan, and the results of these inspections revealed no new need for repair (Resources and Energy Agency), and this reflected the rather satisfactory state even when viewed by the supervisory organ.

There was, however, the incident of stress corrosion cracking at Tokyo Electric's Fukushima Nos 1, 2, and 3 in 1974, at which time it was decided to make the repairs during the periodic repair periods for the next few years, as a result of which the periodic inspection periods were extended to 7-8 months or roughly twice the regular periodic inspection period. The repair of this corrosion cracking will probably require until about 1983, but "the worst is over" (Nuclear Power Development Headquarters of Tokyo Electric) according to informed sources so that the periodic inspection periods hereafter will be reduced considerably, and the facility utilization rates are also expected to rise.

Excluding the small incident of the electrical system which required about 10 days to repair, the troubles which were of concern to the operators were all limited to those developed at the PWR of Kansai Electric. These were the Takahama No 1 (826,000 kW output, initiated operation in November 1974) and the Oii No 1 (1.175 million kW, started operation in March 1979).

During the periodic inspection of Takahama No 1 in May, cracks were discovered in the splitter attached to the distribution line at the inlet to the primary coolant inlet of the coolant pump, which was followed by the discovery of stress corrosion cracking in the small distribution pipes of the steam generator in July and primary coolant leak at the welded section of the air bleed to the pressure accumulation injection system in October. This extended the periodic inspection duration from 4 to 8 months.

Damage to the support pin of the control rod cluster guide tube was discovered during the periodic inspection of Osaka No 1, and the end result was that the inspection period was extended to 10 months. These two trouble incidents served to pull down the utilization rates of PWR greatly, but these troubles were repaired satisfactorily, and there seems little possibility of repeated troubles from these sources.

In this manner, the events of 1980 reversed the situation that resulted after the Three-Mile Island incident, but there is still another reason why the industry and the Energy Agency have high hopes for 1981 and that is that the many efforts which were put forth in the past are finally coming to fruition.

Prevent Troubles Before They Occur

With the aid and guidance of the Energy Agency, the power companies were able to expand the space within the nuclear reactor containment vessel and use robots (automated equipment) to automate inspections and thereby advance improvements and standardization to nuclear power plants. At the same time, the control rod pattern altering system was improved, and the fuel rod replacement ratio was increased. This has opened the way for a change from the 9-month periodic inspection to a 13-month periodic inspection as prescribed by law. It is thought that in 1981 these improvements and standardizations will "begin to pay off to a considerable extent" (Nuclear Power Operation Control Department).

The control system of the Ministry of International Trade and Industry has been undergoing reinforcement since April of last year, and this is also thought to aid the situation. Because of the reaction to the Three-Mile incident, the Ministry o International Trade and Industry installed local agencies at 15 sites nuclear power plants are located to serve as special offices to supervise operations. The officer at each of these offices was assigned to be in close touch with the operation and safety situation of the power plant, and it has been said that "this system should be very effective in preventing trouble before it starts" (section head Suehiro).

Improvement in the operating rate of a nuclear power plant, with its low power cost, will play a large role in keeping electric power costs low and in aiding the disengagement from oil. It would be great if it were possible in 1981 to top the highest operation rate achieved in the past, 64.8 percent (1971 by four plants), to, say, 65 percent.

Facility Utilization Rates of Nuclear Power Plants (%)

| 1 | 昭和44年 | 45年 | 46年 | 47年 | 48年 | 49年 | 50年 | 51年 | 52年 | 53年 | 54年 | 55年 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BWR | — | 76.2 | 63.5 | 67.7 | 66.1 | 65.0 | 26.6 | 64.0 | 26.3 | 53.7 | 62.0 | 63.4 |
| | | (1) | (2) | (2) | (2) | (4) | (4) | (6) | (6) | (10) | (11) | (11) |
| PWR | — | 91.1 | 65.6 | 50.8 | 50.1 | 56.5 | 45.9 | 53.6 | 48.8 | 55.2 | 32.1 | 58.3 |
| | | (1) | (1) | (2) | (2) | (3) | (5) | (6) | (7) | (7) | (9) | (9) |
| GCR | 62.0 | 59.3 | 68.5 | 67.2 | 70.3 | 67.2 | 69.0 | 69.8 | 67.6 | 69.9 | 70.6 | 69.7 |
| | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| 合 2 計 | 62.0 | 71.2 | 64.8 | 61.6 | 59.1 | 62.0 | 37.3 | 59.1 | 59.2 | 54.8 | 49.3 | 61.2 |
| | (1) | (3) | (4) | (5) | (5) | (8) | (10) | (13) | (14) | (18) | (21) | (21) |

(注)設備利用率＝発電電力量＋（認可出力×暦時間数）×100(%)、カッコ内は基数、B
3 WRは沸騰水型軽水炉、PWRは加圧水型軽水炉、GCRは日本原子力発電の東海ガス冷却炉

KEY: 1. 1969 [the next figures are years running consecutively from 1970 through 1980]
2. total
3. Note: Facility utilization rate = power produced ÷ (permissible output x time function x 100 (%). The number in parenthesis is the number of plants, BWR is boiling water type light water reactor, PWR is pressurized water type light water reactor and GCR is Japan Atomic Power Company's Tokai gas cooled reactor



Robots for Nuclear Plants

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 12 Jan 81 p 5

[Text] There has been a sudden rise in activity using the industrial robot, about which Japan can boast the world's top-level product for mastering the so-called three major problems in the nuclear power industry: assurance of safety, minimization of human exposure, and improvement of utilization rate of facility. In its studies related to the future vision of nuclear power generation technology (contracted to the Industrial Development Laboratory) the Ministry of International Trade and Industry is urging all-out promotion of robot utilization, and it proposed a "nuclear power generation supporting system" be developed over a 5-year period starting in JFY 80 to develop operational control systems and automated inspection systems for the containment vessel. On the receiving end of this proposal are the six companies--Hitachi Ltd, Toshiba, Mitsubishi Heavy Industries, Mitsubishi Atomic Power Industry, Mitsubishi Electric, and Japan Atomic Power Industry--which formed a system development group. At the same time, each maker is developing its independent robot technology, and Kawasaki already has at hand its in-service inspection robot (IS, inspection while in operation), Mitsubishi Heavy Industries has its eddy current detection robot for steam generator use, Toshiba has its automated fuel exchanger and remote-controlled control rod drive mechanism (CRD), and Hitachi Ltd has its automated robot for welding nuclear power distribution lines, which are all about to become practical. Furthermore, the use of these robots will not end at power generation, but they will be used in spent fuel reprocessing plants and high-level radioactive waste disposal operations and the decontamination of nuclear power plants which have come to the end of their days. The need for robots in the nuclear power field is increasing, and there is an increasing pattern of their use about the major equipment of nuclear power facilities.

The "robot for welding nuclear power distribution lines" developed by Hitachi Ltd and used at the No 4 reactor of Fukushima No 1 power plant is a robot which looks most like a robot. This robot has visual and feel capabilities and can detect from a considerable distance away any breaks in the weld or the condition of the weld, and if necessary it can correct the welding condition, thereby displaying its great flexibility in capabilities. Repair operations of distribution lines at atomic power plants are beset with the problem of lack of operating space as well as the presence of a radiation field. This radiation level becomes more intense the closer the site of operation is to the reactor core, and the time the welder is present has to be limited to a very short period in order to keep his exposure within permissible limits. This is why the practice in the past was to use a number of welders who successively spelled each other.

The welding robot for nuclear reactor distribution lines was developed to resolve this problem and to enable welding the distribution lines within the containment vessel by remote control from a safe site outside. First, a guide ring is attached to the distribution pipe, and the welding unit, sensory unit, and drive unit are placed on the three carriers on this ring. There is a visual device attached to this welding unit.

The carriers with these units are linked together and travel around the circumferential by action of the drive unit over the guide ring. It feels for the open break with the touch unit while a complete pass is made around the distribution line, and the point of the break is kept in memory. Next, all information about this site is progressively extracted, and the welding torch is positioned in line with the information, after which the weld is made automatically. During this time, the spread of the welding pool and the aim on the center line are monitored with the visual unit and displayed on a screen. The welder views this screen and manipulates knobs on the control panel whenever the welding conditions become inappropriate to correct the situation.

When the welding operation is completed, the welding unit is replaced by a grinding unit, and this unit together with the touch sensory unit are used to remove the unevenness on the bead by grinding. By replacing this grinding unit with an ultrasonic flaw detection unit, the weld can also be examined for defects.

Effective in Lowering Exposure to Radiation; Toshiba Develops Mechanism To Replace Fuel Rods

The occasions of periodic parts replacement and repair opertations at a power plant are numerous, and more often than not these operations are performed under condition of high radiation. This is why remote-controlled operations have long been the rule, but there has always been the hope of introducing robots to enable greater automation.

The "automated fuel exchanger" developed by Toshiba is a type of robot equipped with manipulators to remove and handle fuel rods, and it has already been put to practical use. The fuel exchange operation of a BWR is performed during the periodic inspection of a nuclear reactor which is made annually, and the spent fuel from the core is removed during this rest period of the reactor and new fuel rods are inserted or fuel rods are redistributed throughout the core. In these operations, performed in the past by a team of experienced workers and many assistants, the fuel rods in water were removed while sighting from above. This routine was conducted by teams of four men each in a three-shift rotation over a period of 15 days.

Because of the type of operation involved, the automated fuel exchanger was developed in order to reduce the radiation exposure, shorten the work duration, and improve reliability. This unit is comprised of an exchange unit main body, fuel handling tool, mast and control and drive equipment, and a computing system to serve as judgment device and issue commands to the control and drive equipment. With the development of this unit, the operating time for fuel replacement has been reduced 15 percent from what was required before, and one operator working by remote control can do the work formerly required by four workers, thereby effecting conservation of labor. At the same time, the exposure has been reduced to one-fifth, and this unit is already being used at the No 5 reactor of Tokyo Electric's Fukushima No 1 plant.

In addition, there is a "remote-control control-rod drive mechanism" (CDR), also developed by Toshiba, which is a maintenance robot. The exchange of control rods is also performed during the periodic inspection, and roughly 25 percent (35-50 rods) are removed from the lower reaches of the pressure vessel, inspected carefully, and reinserted once more into the reactor pressure container.

The CRD is long--4.7 meters long overall--so that its removal and reinsertion is a formidable task. At the same time, this work has to be performed in a high radiation field and in a very limited space, making this operation a classic example of worst possible working conditions. The actual operation involves the use of an electrically operated winch and a sliding mechanism. A team of five men stand on a platform to do the work (there are five shifts, for a total of 25 men), and they do most of the work manually. The performance of this routine by mechanized remote control is the work of the remote-control CRD unit. This mechanism has made it possible to replace the control rods from a control panel located in a safe environment.

Automated Inspection System Within the Containment Vessel

There have been intensified efforts during the past few years to introduce automation and remote control to handle routine operations in high radiation fields of nuclear power plants such as fuel exchange. On the other hand, the capabilities of these units are fairly limited, and the development of robots with much higher capabilities has become necessary in order to make safety at a nuclear power plant more reliable.

For example, located in the control room from which a nuclear power plant is operated is an operating crew of five or six people who look over a battery of 300-400 instruments and 1,000 or so alarm devices from which they receive information on the status of the reactor and select the necessary switches from the array of 500-600 switches to adjust the operation. In this manner, a tremendous burden is placed on these operating personnel. In addition, the containment vessel which houses a large number of the measuring devices is an area of very high radiation, making it impossible for a worker to enter the area when the reactor is in operation and some of the equipment is not functioning properly.

If a supporting system to lighten the burden on the operators or a robot which can be moved about the containment vessel while the reactor is in operation to check the situation within the vessel were introduced, the reliability of the reactor would be enhanced one step further, exposure in the event of trouble or accident could be minimized, and the worker's safety could be enhanced, which should contribute greatly to improved safety and increased utilization rate of nuclear power plants.

The "nuclear power generation support system," which is the target of a 5-year program initiated in 1980 by the Ministry of International Trade and Industry, is this ministry's answer to this need, and the development can be divided into the instruction system and the automated point inspection system for use within the containment vessel. The first mentioned member uses a computer to grasp the operating status of the power plant through the various pieces of equipment and summarize the information, transmit the status of the system to the appropriate terminals, and make the appropriate operational directions. The automated point inspection system for use within the containment vessel runs on a rail installed within the high radiation level interior of the containment vessel or on the floor of this vessel interior and examines the condition of the various pieces of equipment within.

The point inspection system as it operates within the containment vessel includes a point inspection dolley which runs on the floor, a space scanning type inspection vehicle, and a manipulator and detectors for this vehicle. The space scanning unit checks pumps and valves from above; the floor traversing dolley checks the various parts from below for air, water, and oil leaks; while the manipulator observes the equipment through a television camera and performs whatever operations can be performed by remote control.

The responsibilities have been divided up between the various companies so that Hitachi Ltd is in charge of the space scanning equipment, Toshiba the floor traversing dolley, and Mitsubishi Heavy Industries the manipulators. The private interests' nuclear power generation support system development group which was formed last summer by the six companies sent a survey group at the end of last year to the United States and Europe, where it minutely surveyed robot technology development and the status of its introduction. The results of this survey have not been compiled as yet, but it has been said that the situation with respect to robots for observing and operating within a containment vessel is virtually undeveloped. In light of this, the development and introduction of this type of robot in Japan should draw international attention, and the robot may become a future export item.

Robot for Spot Inspection

The point inspection robot is used mainly with ISI. ISI is the periodic inspection which is conducted once a year with the reactor shut down in order to check the safety aspects of the nuclear power plant. Fuel bodies are removed from the core, and the distribution lines inside and outside the core, valves, pumps, and their support members, are given a thorough examination. The inspection of the welds of and to the containment vessel and the weld sections of the distribution lines are the main focus of these examinations, and the inspection methods include ultrasonic testing and visual inspection.

Even when ultrasonic testing is used, the equipment has to be operated by human hands, and the time any worker can spend on the job is limited by the amount of radiation he receives, making for low efficiency. At the same time, the working quarters are so narrow that the worker often cannot come close to the working site.

The answer to this problem is the "ISI Robot System" developed by Ishikawajima-Harima Heavy Industries. This system was developed in a cooperative effort with the comprehensive research laboratory, Southwest Research Institute (SWRI) of the United States, and the system consists of an ultrasonic flaw detector, liquid damage seeking device, remote control and automated transport device to carry the above detection units, and automated recording and processing units for recording and processing the data accumulated.

Another point inspection robot is the "Steam Generator Eddy Current Detection Robot" developed by Mitsubishi Heavy Industries. The PWR steam generator consists of several thousand small heat transfer pipes where the heat from the primary coolant water is transferred to the secondary line, which is then used to generate steam to operate a turbine. When viewed from the standpoint of radiation control, this section serves as the "breastworks" which shields the radiation from the primary side. This is why these heat transfer tubes must always be in good shape, and the point inspection of these tubes is given particular attention during each periodic inspection. The robot developed by Mitsubishi Heavy Industries can cover these fine tubes completely for a given inspection and has the merit of lowering the worker's exposure to radiation and conserving labor.



## Inspection Systems

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 12 Jan 81 p 3

[Text] Japan's energy strategy, which is focused on promotion of nuclear energy as the main force to effect disengagement from oil, involves increasing the scale of power production from nuclear sources to 53 million kW by 1990, according to the cabinet decision adopted during the oil substitute energy deliberations of November last year. In other words, there must be local preparation and site selection for new plants to generate 23-25 million kW (23-25 reactors of the 1-million-kW class) over the next 10 years. This is why greater emphasis is being placed on assurance of nuclear safety and greater utilization rates of facilities, and improvement in observation systems which can spot an abnormal operation of a reactor at an early stage has become a pressing problem.

Nuclear power generating systems which are constantly increasing in size and capacity are designed from the outset with safety in mind, and great weight is placed on safety protection measures. This is why a pressurized light water reactor (PWR) operated by Kansai Electric at Takahama No 2 power plant (820,000 kW output) recorded 320 days continuous operation (from 21 November 1979 to 6 November 1980) and a boiling water type reactor (BWR) of Tokyo Electric, the No 4 reactor of its Fukushima No 1 plant, recorded 283 days continuous operation (from 22 November 1978 to 31 October 1979), thereby establishing new records.

On the other hand, Kansai Electric's Mihama No 1 (340,000 kW) suffered from an error in the selection of coolant, which resulted in corrosion of the fine tubes of the steam generator, as a result of which the reactor has not been operating for 6 years. It is an example of an extreme case in the other direction. Delay in detecting minor troubles and lack of proper treatment can effectively stop operation of a nuclear power generator plant, which is a product of massive science and technology efforts.

The reduction of radiation exposure to maintenance workers and repairmen during the periodic inspections is also considered an important objective in establishing industrial safety in nuclear power generation. One step in this direction is the recent activity in developing and introducing remotely operated observation equipment. This introduction is not complete, and the present situation is that the exposure suffered by the workers has emerged as a major social problem.

In another direction, the improvement in utilization rate of nuclear power generation facilities is considered very important from the standpoint of plant locations and stabilized supply of electric power. The utilization rate during the past few years has run the course of 41.8 percent in 1977, 56.7 percent in 1978, 54.6 percent in 1979, and 61.2 percent in 1980, showing an improving trend to a higher rate.

Facility utilization rate is directly tied in with power generation cost. If a 1-million-kW class reactor should suspend operation for a day, the loss would total 100 million yen, while a 10-percent reduction for the entire electric power industry would cost 30 billion yen. The high-performance fuel rods that can be used for high burnup and for long periods before replacement which the power industry is energetically promoting or the development of load pursuing type fuel rods are attempts by the power industry to increase the utilization efficiency.

The greatest factor responsible for lowering facility utilization rate is the so-called ISI or periodic inspection. This periodic inspection usually requires 90 days including the replacement of fuel rods. In other words, the reactor is idle at least one-fouth of the time even when it is trouble-free. Robot technology has recently has been coming to the fore as a possible solution to this situation.

Japan's robot technology has advanced to such a high level that robots presently are being exported to the United States in a situation just the reverse of what used to be. According to a survey by the Japanese industrial robot industry, production for 1980 totaled roughly 65 million yen, and this is expected to increase to 240 million yen in 5 years and to 450-600 million yen in 10 years.

The atomic power world plans to transfer the world's frontrunner robot technology to the subjugation of the so-called three primary problems in nuclear power generation: assurance of safety, reduction in radiation exposure, and increase in facility utilization rate. One of the reasons robot development is being emphasized so much is that during the U.S. Three-Mile Island incident a robot named "Berman" was used with great effect. This robot has a base which runs on caterpillar treads upon which are placed manipulators and television cameras which all are operated by remote control and are used to make radiation measurements within the nuclear reactor structure and operate valves and perform similar manipulations.

The inroads of robot technology into the atomic energy industry are fairly small compared to the automobile industry, the electrical industry, and the general machine industry. On the other hand, remote-control units with handling capability or visual capability have made their appearance, and it is thought that this will be the opening by which the use of robots for atomic power requirements will henceforth see great expansion in line with increasing needs for safety and other related items.

Robots for nuclear power use can be classified under the three large categories of operational, maintenance, and spot-inspection use depending on the application at hand, and products which fulfill these ends are now making their appearance.



## Instrument Calibration Center

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 12 Jan 81 p 14

[Text] The Radiation Measurement Association Inc (director, Masahiko Murakami) will conduct calibrations of radiation measuring instruments over the entire country starting this month. The accurate measurement of radiation is a most basic and important subject from the standpoint of exposure control and nuclear power development. The practice heretofore has depended on the instrument makers to make their own uncontrolled calibrations, but the Radiation Measurement Association, making use of the standard radiation facilities of the Japan Atomic Energy Research Institute in Ibaraki Prefecture, has developed a highly reliable calibration capability and plans to serve as Japan's calibration center.

### Standard Facilities at Tokai Laboratory

When an instrument for measuring radiation is used over a long period, the measurement begins to drift as the result of radiation wihin the instrument itself and other causes. The function of calibration is to bring these errant values to their proper place. Radiation measuring instruments are used in a wide area of application, including nuclear power plants, laboratories, hospitals, and radioisotope (RI) handling establishments, and these instruments need to be calibrated on the average of once a year.

In the past, when an institution purchased radiation measurement equipment it drew up an agreement with the vendor, and a trusted worker took the instrument to a maker or at times to the Agency for Industrial Science and Technology or JAERI which has capability for the calibration. This practice resulted in considerable variation in the reliability of the calibration, while imported products were associated with the problem of a large number of handling steps, In order to resolve these problems, the Radiation Measurement Association was established in October last year. Since all the equipment which was ordered has been accumulated, it is about to take up its appointed duties.

The calibrations will be made relying on the "Radiation Standard Facility" located within the Tokai laboratory of JAERI. Although this facility is not 100 percent complete, it is provided with a number of standard radiation "yardsticks," which can be used as standardizing equipment for the calibration and maintenance control of survey meters, environmental monitors, and neutron rem counters.

The building is a two-story structure with one underground floor, a floor area of 1,900 square meters, and it houses irradiation rooms, laboratories, and spot inspection and repair rooms. There is a very low-level radiation room for measuring x-rays and gamma rays at very low levels, rooms where low, medium, and high rates of irradiation can be performed and a neutron irradiation facility.

At present the national standards for dosimeters and sources are kept in custody at the Electrotechnical Laboratory, and this facility has standard measurement equipment and standard sources which are compared and calibrated with the national standards on hand, which can then be compared with the measurement equipment in question for the calibration.

The cost of this calibration is about 22,000 yen for a GM survey meter for gamma use (not including shipping and repair costs) which is said to be somewhat less costly than the other routes.



## Research Cooperation

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 12 Jan 81 p 14

[Text] The Central Research Institute of the Electric Power Industry and JAERI have decided to enter into intimate interchanges on nuclear fusion development, including technological information exchange. The ground-breaking event for this liaison was the first "roundtable on nuclear fusion" which was cosponsored by these two organs and held in December of last year. It is planned to hold these seminars periodically to enhance this exchange.

Nuclear fusion is considered to be a very powerful energy source for the future where the electric power industry is concerned. It is said that it will be at least 2020-2030 before this type of reactor will operate on a commercial scale, and preparations for a practical reactor must be accelerated if this timetable is to be met.

Research and development on nuclear fusion is now in the stage of shifting from research centered on plasma physics to engineering research with practical adoption in mind. That is to say, research is now at a crossroads, and it is the belief of the Central Research Institute that now is the time to initiate studies on the practical reactor so that the electric power industry can make a smooth introduction of fusion power in the future. It is said that these studies will be viewed particularly from the user's standpoint, taking into account reactor economics, reliability, operation, maintenance, and environmental problems.

The Central Research Institute set up a research group on nuclear fusion within its Energy Technology Development Headquarters as one example of the manner in which studies related to the nuclear fusion reactor are being promoted, and the tieup with JAERI is planned to push this development even further.



## PWR Automatic Control System

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 13 Jan 81 p 6

[Text] Mitsubishi Electric has embarked on the development of nuclear reactor instrumentation and operation control systems to enhance safety and enable complete automation of the pressurized light water reactors (PWR). A demonstration system will be built within its Kobe plant which will serve both as an experimental facility and a demonstration facility to the consumer. It is said that the danger of radiation exposure to operators and maintenance personnel is less than that experienced with the boiling water type reactor (BWR). Demand for PWR instrumentation and control type automated systems has been weak in the past, but the trend toward increasing the size of nuclear reactors has led to increased demand so as to lower the burden on operators and increase the facility operating rate through automation, and Mitsubishi Electric is demonstrating sensitivity to these requests.

### Construction of Demonstration Facility

Control is exercised over a large number of control systems such as the reactor pressure cooling system, the output control system or water circulation system, and the control of turbine and generator systems in the operation and control room of a nuclear power generating plant. A large number of gages, meters, and operational equipment are assembled here, and there is a good possibility that a slight error might end up as a major accident. This places tremendous responsibility on the operational control personnel. In the particular case of the BWR, coolant water which passes through the core also circulates through the turbine section in the construction that has been adopted, and direct entry into the plant equipment to make inspection and measurement is very difficult because of the radiation exposure involved. This is one impetus for the installation of a central observational capability. The computerization of the operation and control systems along with the introduction of robots are being urged to attain this end, and BWR makers such as Toshiba and Hitachi have introduced systems names "Podea" and "New Cam 80" which they developed.

In contrast to the BWR, the PWR has a cooling system divided into the primary water system which circulates through the core and the secondary water system which circulates through the turbine section, and the net result is that there is less exposure of workers, making unnecessary the development of a concentrated central observation and control system such as that required by the BWR. This is the present view. On the other hand, if the premise of increased plant safety for the future location of even larger nuclear power plants is to be implemented, the PWR will undoubtedly also be made difficult to operate in an error-free manner, and demands for a reduced burden on workers are increasing. This is why the Ministry of International Trade and Industry is providing subsidies to aid the development of such systems.

Mitsubishi Electric is a member of a PWR makers group which has handled instrumentation and control systems and has compiled an impressive record, and it has decided to engage in development of systems of greater capability and conservation of power compared to previous systems, including capabilities such as color display devices and voice input-output. One phase of this development will be the establishment of a demonstration system which is a compilation of the technology to date, at a cost of several hundred million yen, which is expected to aid research and development as well as to be useful for explanations to users and actual training of technologists.



MITI's Subsidy to ABWR

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 14 Jan 81 p 1

[Text] The Ministry of International Trade and Industry has decided to aid development of the "Improved Boiling Water Type Light Water Reactor" (ABWR), which is intended to be the standard Japanese type reactor on which five companies both domestic and foreign from four nations have started work, including Toshiba, Hitachi Ltd and General Electric (GE) of the United States, as one phase of the third improvement standardization (nationalization of light water reactor) technological development which is part of a 5-year program initiated in 1981. The ABWR is an international development on a private base which was started due to demand for development of an even better BWR. Meanwhile, the Ministry of International Trade and Industry was looking at the ABWR as the next generation BWR, and it has incorporated this concept into the nucleus of the third improvement and standardization program, thereby entering into its development. The ministry informally explained its policy to GE, Toshiba, and Hitachi Ltd among others, as well as to Tokyo Electric Power as representative of influential BWR users, and the net result is that technological demonstration tests on the nuclear reactor internal circulating pump (internal pump) will begin in 1981 as the start of a "Made in Japan" ABWR.

First Internal Pump Technology

ABWR development was instigated under the leadership of GE, which solicited Toshiba, Hitachi, Sweden's Acea Atom and Italy's Ansuld Mechanico Nuclear to form a five-company, four-nation group of BWR makers, and this development was started about 2 years ago. The technological sector of each company formed teams which incorporated basic BWR concepts of the past into the conceptual design which they then subjected to new stages of development.

Tokyo Electric has maintained a forward looking attitude toward the developments being made by these five companies, but recently other companies which have introduced BWR are also displaying forward looking attitudes toward the day when the ABWR becomes practical.

In another direction, since 1975 the Ministry of International Trade and Industry has been engaged in improvement and standardization of second-generation light water reactors and has looked toward independent Japanese technology in this area, which heretofore depended on technology introduced from the United States. With the energetic cooperation of the electric power industry, the light water reactor makers such as Toshiba, Hitachi, and Mitsubishi Heavy Industries saw their technologies make great advances.

With this background, the Ministry of International Trade and Industry, in its efforts to come forward with a more nationalized light water reactor technology, emerged with a policy of improving and standardizing the third-generation reactors starting in 1981 and put forth a call for domestic technology to tackle the nuclear reactor interior, which up to now has been the most difficult to nationalize, and truly aim for a Japanese type light water reactor.

The ABWR concept fell right in line with this line of thinking, and it was decided to finalize the third-generation improvement and standardization plan in the form of ABWR development.

The idea is for the two powerful companies which are influential in ABWR development, Toshiba and Hitachi Ltd, to be the member makers for the improvement and standardization of this third-generation model to support this activity.

In the specific matter of the technological test demonstration of the internal pump which is one of the prime items in this third-generation standardization, a budget of about 480 million yen has been allocated for 1981 with a funding of 8 billion yen projected for the next 5 years for pump-related costs. The overall cost is expected to be about 20 billion yen.

It is said that the power companies are expecting 1990 to be the approximate date of ABWR introduction, and development of the Japanese label ABWR is aimed at the start of the decade beginning in 1985, with all the power companies taking forward looking attitudes toward this standardization plan.

The Ministry of International Trade and Industry further believes that once the ABWR becomes practical somewhere in the post-1990 period, that important data related to approval will turn out to be "nationalizable" from within the standardization operations, and this may prove to be another major plus.

GE believes that the advancement of research and development funds by the Japanese Government will benefit future sales, and this unusual international joint development seems to be starting off with various expectations.







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## Nagoya University Fusion Research

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 14 Jan 81 p 4

[Text] The Nagoya University Plasma Laboratory (director, Hidetake Kakihana) will embark on a third 10-year plan on plasma research in which deuterium (D) and tritium will actually be burned in a DT nuclear reaction (R plan). The experimental facility in which this reaction will be conducted is a medium-class tokamak of about 15 cubic meters volume. Because this facility was trimmed to the minimum size which would still allow experiment, some of the benefits which will be realized are: 1) the experiments will be easy to conduct, 2) many experiments can be run, and 3) a small amount of tritium will suffice. The plans involve preparational research and design and fabrication of the facility up through the first period to about 1887, after which the actual facility will be set up in 1988 at Doki City in Gifu Prefecture, where actual burning experiments with the injection of DT are expected to be initiated in 1989. Nuclear fusion research to date has been involved in experiments with light hydrogen nuclear reactions, and these nuclear fusion core plasma experiments are expected to be the first in the world.

Many nations are putting forth great effort on the theory and experimentation of nuclear fusion, which is expected to become the new energy source for the 21st century. The tokamak-type plasma experimental facility, which is the mainstream of this development, is now undergoing construction as very large facilities such as the JAERI "JT-60," the American TFTR, and the European alliance JET, with the hope of attaining critical conditions in 3-5 years. These facilities will represent major advances in plasma confinement and heating, but none of them will get to the stage that an actual DT combusion will be involved, although some altogether different reactions will be achieved, so that any analysis of the actual fusion reaction will have to await later experiment.

Representative nuclear reactions include DT and DD reactions; the DT reaction has a very high reaction rate, and nuclear fusion research utilizing this reaction makes up the bulk of this type of research today. On the other hand, tritium, which is one of the reactants, does not exist in nature as a natural form, making it necessary to produce it from lithium, which has to be reacted with neutrons produced by a nuclear reaction. This is the shortcoming of this fuel.

On the other hand, deuterium, which is present in abundant quantity in the natural world, enters into a DD reaction of a low reaction rate, and a DD nuclear fusion reactor may become an eventuality because it does not require the breeding of tritium.

The plasma at the core of a fusion reactor contains an abundance of charged particles from DT and DD reactions, and their free energies are of the same level or higher than the thermal energy of fuel plasma. It is said that this free energy is responsible for various instabilities such as thermal instability of the core plasma, thermonuclear instability, or diffusion through the radially directed electric field.

In light of this situation, the Nagoya University Plasma Laboratory is proposing its R plan, which is not limited to the DT reaction but also includes the study of nuclear reaction plasma research necessary to the DD reaction using a compact version of the DT tokamak and following the various phenomena induced into the core plasma as the result of nuclear reactions.

The experimental facility for this purpose has a 15-cubic-meter volume, a 0.6-meter minor radius and a 2.1-meter major radius, which is roughly one-fourth the size of the JT-60 which JAERI is constructing. Included in the design is a plasma current of 1.8 mega-amps, a toroidal magnetic field of 50 kilogauss, a discharge time of 1.5 seconds, a neutron particle injection heat input of 15 megawatts, and a high frequency heating of 5 megawatts or more.

Consideration has also been directed to safety measures regarding radiation, and shielding will be provided by the walls of a spherical concrete structure 15 meters in internal diameter which is to be constructed. The first wall (0.5 meters thick) will be of boron containing heavy concrete, and the second wall (1.5-meter-thick concrete) will shield the injection device and its surroundings. The ceiling of this structure will be 0.5 meters thick, and it will be located 500 meters away from the nearest building. These measures are planned to produce weekly exposures of the order of 0.1 millirem per week, which is less than one-tenth the amount occurring in nature.

The plasma which is the objective of this research wil have a temperature of more than 120 million degrees at its center, a density of $10^{14}$ per cubic centimeter, and a confinement time of 0.1 second according to the target figures.

The plans involve a new construction on a 76,000-square-meter plot in Doki city, Gifu Prefecture. The first 3 years, up to 1983, will involve control of impurities (such as oxygen, carbon), nuclear reaction plasma measurements, and safe handling of tritium and radiation-type preparatory research, after which the 4-year period starting in 1984 will be taken up by design, construction and equipping the experimental facility. The facility is expected to be completed in 1988, at which time a year and a half will be allotted to tests with injections of ordinary hydrogen, and then experiments with DT nuclear reaction plasma are expected to begin in earnest in the fall of 1989.

The construction costs include 40 billion yen for the tokamak test facility main body, and more than 50 billion for the related facility costs. There will be a complement of 60 research personnel and 90 assisting personnel, for a manpower total of 150, indicating the magnitude of this project.

At present, the American TFTR and the European alliance FET are also aimed at conducting experiments on the DT nuclear reaction plasma, but these are large-scale projects which incorporate many problems so that the plans are reportedly encountering one delay after another. This is why there are great expectations that the world's first combusion tests will be conducted at this compact facility which is part of th e R plan of Nagoya University.

The promotion of the R plan is tied in with various plasma technology developments accompanying long term operation of the JT-60 which will be mutually supplemented by fuel mode front information to contribute to Japan's future reactor technology test facilities. These will also be useful in the development of the plasma technology necessary for future DD nuclear fusion. Joint research on the part of all the universities in the country is necessary if this program is to be promoted in the universities. At the same time, the training of young researchers is considered vital to long term nuclear fusion research and development.

Director Hidetake Kakihana of the Nagoya University Plasma Laboratory made the following statement: The combustion of real fuel is important to nuclear fusion development. I hope this will be done as quickly as possible. JAERI's JT-60 is a very large affair, while the R plan is only the size of an eyeball. If we succeed in tying together the results of these two projects, Japan will become a leader in the field of the practical implementation of nuclear fusion.



## Reactor Material

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 15 Jan 81 p 4

[Text] The two countries which are intensifying their unity with regard to nuclear fusion development, Japan and the United States, have decided to enter into a joint study, the "RTSN Plan," on reactor materials development using a large accelerator in the United States. According to releases from the Ministry of Education, this accelerator is the high dose damage use accelerator (RTNS) located at the Lawrence Livermore Laboratory (LLL), where irradiation experiments on reactor materials will be conducted over a 5-year period starting in 1981 by Japanese-American joint effort, and this program is expected to be continued with the next stage accelerator, RTSN2, now under construction. The Japan-U.S. nuclear fusion research cooperation agreement ratified in May 1979 was started off in the form of the Doublet III plan, from which considerable information such as that relating to plasma characteristics is being derived. This reactor materials joint development plan is the next large project involving use of experimental facilities which follows the Doublet III, and the results are being awaited with great interest.

Reactor materials is a key technology to the practical use of nuclear fusion reactors. This is why the Ministry of Education built the "Octavian" for generating 14 mega eV at Osaka University starting in 1978. At the same time, the Research Institute for Metals at Tohoku University started on the development of superconducting magnet materials in a project budgeted for about 3 billion yen (for a 3-year period starting in 1980). In addition, the University of Tokyo will work on a high irradiation research facility with 4-5 MeV capability (3-year project starting in 1981) on funding of 750 million yen.

The development of wall materials for reactors is the most important element in reactor materials, because these materials are subject to 14 MeV high energy irradiation, which is one order of magnitude highter than that received by the cladding tubes of fission reactors, and materials which can withstand such high irradiation and still not suffer volume expansion (avoid swelling) for at least 10 years are needed.

Other means to be utilized in these material developments being considered are 1) the super high voltage electron microscope (the 1 MeV electron beam which operates this electron microscope can be used as damage causing irradiation, and swelling experiments using electron microscopes is a popular subject), 2) nuclear reactors, and 3) accelerators. Japan is limited to the 1 MeV neutron facility, which is the materials testing reactor (JMTR) at JAERI, and there is no facility which can deliver heavy irradiations on the order of 14 MeV such as will be generated in a fusion reactor.

In contrast, the nuclear fusion reactor use material research in the United States is considerably advanced, with the availability of the RTSN at LLL and the large irradiation use accelerator "FMIT," construction of which at the Hanford National Laboratory is being promoted. The U.S. Department of Energy (DOE) has asked for Japanese participation in these two projects based on the Japan-U.S. nuclear fusion research cooperation agreement, as a result of which the Ministry of Education hammered out its policy for cooperation in the RTSN plan starting in JFY 81 and allctted an initial year's outlay of 350 million yen. If possible, researchers will be dispatched as early as June to start Japan-U.S. joint experiments.

If an RTNS scale accelerator facility should be constructed in Japan, the cost will be at least 4 billion yen and will require 5 years to complete, and developing nuclear materials based solely on the use of our own capabilities will greatly delay nuclear fusion reactor development. In this respect, the present Japan-U.S. agreement is thought to play the role of a primer in the advancement of nuclear fusion development.



## Plutonium Reprocessing

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 16 Jan 81 p 5

[Text] The Tokai reprocessing plant of the Power Reactor and Nuclear Fuel Development Corporation (DONEN), which is targeting a goal of reprocessing 80-120 tons (uranium conversion) this year, is gradually establishing itself as a leading plant on a worldwide basis. This is because the degree of cleanliness of its external environment and its working environment greatly surpasses that of other leading reprocessing countries. On the operating end, this plant topped the previous record of the French of 16 tons continuous operation, which had been considered almost unbeatable, by a performance of 28.5 tons continuous processing. If the goal targeted for this year should be attained, Japan will surpass the United Kingdom and West Germany and close in on France. This operating record is attracting attention both at home and in foreign circles, and there is no doubt that its success is contributing greatly to the construction of a second reprocessing plant by private effort. We asked the director of the Tokai plant, Hideo Yasukutsu, to discuss the status and prospects of reprocessing technology, including the operational plan of the Tokai plant, and he said: "The Tokai plant is just about ready to enter the stage of competing with France for top position, and the reprocessing-related technology which was nurtured as a national project should serve as the base for the immediate construction of a second reprocessing plant by domestic technology. We will certainly cooperate in such a venture," he emphasized.

The Tokai plant was constructed by technology imported from the SGN Company of France, but what made this plant a truly independent Japanese plant was the acid recovery vaporization can, which was considered to be the most formidable problem in this processing (holes had formed at weld sections in March 1978, and operation was suspended for 1 year and 3 months). This was the opportunity which enabled the Tokai plant to become autonomous, as a result of which the denitirification facility which had been treated as an inferior process and in which France had no real experience registered the amazing record of 206 hours continuous operation.

The quantity of fuel processed between July 1977 and November last year totaled 79.2 tons, but the production was 60 tons for the year starting in November 1979 after the repair to the acid recovery volatilization can had been made. We were able to process 28.5 tons for the C1 campaign and 20 tons for the C2 campaign.

It is said that these operating records of the Tokai plant are even surprising the French. The track record of the French, which to date has been the leading reprocessing country in the world, has not been the best where operating efficiency is concerned. The Karlsruhe Plant in West Germany called WAK (35 ton/year reprocessing capacity, initiated operation in 1971) has only reprocessed 114 tons over the past 10 years, and it is not operating at present because of a leak in the dissolution tank. At the same time, the Windscale Plant in the United Kingdom (400 tons, started operation in 1969) has developed trouble and is not operating at the present time, and the plant has yet to hit the 100-ton mark in fuel reprocessed.

The La Arg reprocessing plant in France (400 tons, started in 1976) reprocessed a total of 250 tons for the 5-year period up to June last year. When we consider the low operating rates of these foreign reprocessing plants, it appears that problems with the shearing mechanism and the filter equipment used to filter the dissolution liquid from the dissolution of spent fuel elements in nitric acid are the major obstacles.

When plant directors of the foreign reprocessing plants including the French visited Japan, what interested them most was the blade of the shearing machine, and there was the inevitable question: "How often do you change the blade?" This is because the French use a mode in which the fuel assembly is held vertical for the shearing, whereas the Germans leave the fuel rods in scattered array while the knife suspended like a pin descends on these rods. This practice is hard on the knife blade, necessitating frequent changes.

In addition, we put great effort into minimizing radioactive discharges to the environment, and we registered the value of 26 curies discharge for the year, which is close to the limiting value in the inspectional operations preceding actual operations up to the end of last year. This is several thousandths of the 45,000 curies of the French and the 80,000 curies of the British. In this manner, despite a late start Japan's reprocessing development is compiling good results, and this is having a sharp effect on the operations of the other leading countries.

Up to 27 December last year, the Tokai plant received a total of 615 fuel rod assemblies which converts to 132 tons of uranium, of which 79.2 tons were reprocessed. From this process, 450 kg of plutonium was recovered and 74.5 kg of uranium.

Full scale production will be initiated on 17 January, and the total to be processed within a year will be a maximum of 140 tons, based on 200 days operation for the year. Since a 1-million-kW-class light water reactor will produce 30 tons of spent fuel per year, this plant will be able to handle only 4.5 million kW reactors per year. This year's operational plan calls for a division into two periods in which 50-70 tons BWR fuel will be reprocessed, while the latter period will be devoted to reprocessing PWR fuel, and a total reprocessing capability of 80-120 tons is targeted. If this goal should be realized, the total processed thus far will be more than 160 tons, including what has been reprocessed in the past, which will put us ahead of the British and West Germans and close to the French.

Now, when we come to the second reprocessing plant era, although some actual experience may be necessary, it will be necessary to reprocess fuels of high burnup of as much as 40,000-50,000 megawatt days/ton. This high burnup fuel will not dissolve completely in nitric acid, resulting in the formation of insoluble residue (dregs), thereby creating uncertainty regarding the solvent extractions which follow.

The Tokai plant has reprocessed 28,000 megawatt-day/ton fuel from the Genkai power plant of Kyushu Electric and we had considerable anxiety over this insoluble residue although there were no serious consequences. We are preparing for the coming days when we will be involved in the reprocessing of these high burnup fuels through the solution of these problems.



## MITI's Budget for FBR

Tokyo NIKKAN KOGYO SHIMBUN, in Japanese 19 Jan 81 p 1

[Text] Taking aim at the period from the latter half of the decade beginning in 1986 to the 21st century as the period for the practical implementation of the fast breeded reactor (FBR), the Ministry of International Trade and Industry (MITI) will engage in development surveys of both the technology front and the economic front starting in 1981. The FBR is being promoted by various countries throughout the world as a "miracle nuclear reactor," but MITI is preparing itself for the day when the FBR will actually become practical by setting up the necessary preparations such as siting systems, power transport systems, establishment of nuclear fuel cycle, and setting up nuclear nonproliferation safeguards and is making all possible preparations in order to create a vision of a practical FBR. Research and development on the FBR is now taking place centered on the Science and Technology Agency and DONEN, but it will come under the administrative umbrella of MITI once it becomes practical, as a result of which MITI will be handling a new area. This is the first case in which MITI has considered FBR-related items in the budget.

Focus on Location and Nuclear Fuel Cycle

The FBR is a reactor which can utilize uranium extremely efficiently, and its appearance is awaited with great expectations by the various countries of the world as the powerful successor to the light water reactor.

France has been the most active in promoting development of the FBR, and developmental efforts in Japan have been spearheaded by the Science and Technology Agency and DONEN, which have centered their efforts on self-developed technology. Regarding actual construction, the experimental reactor "Joyo" (thermal design output 280,000 kW, went critical in April 1977) is being followed by the prototype reactor "Monju" (280,000 kW electrical output) which is targeted to go critical in December 1987, and research and development is gradually being advanced.

The plans for demonstration reactors of the 1-million-kW class to follow "Monju" are gradually assuming concrete form, and MITI believes that the FBR will make the transition from the research and development stage to the practical stage sometime in the latter half of the decade beginning in 1985.

MITI initially placed a 20-million-yen item for FBR development in the budget for 1981, and it may be said that behind the vision created from the technological and economic fronts, including practical implementation of the FBR, is the situation that the initial schedule has been followed by and large, and the self-developed FBR development is gradually taking shape.

The envisaged creation of the FBR in which MITI plans to engage in this new fiscal year will be entirely directed at the practical development of the FBR, and MITI plans to take up as quickly as possible the necessary technological and economic problems which Japan will face with the practical implementation of the FBR.

It is anticipated that the problem of the location of the practical FBR will be considerably greater than what was experienced with the light water reactor. This is because there is not only the question of power output end but also the need to locate the nuclear fuel facility at the same site.

The problem of just where in Japan to locate these large energy bases will become a major economic problem of the people, and it is necessary to establish a location image and an FBR base image.

At the same time, it is expected that a network of power distribution lines throughout the nation to deliver power from the FBR bases to the power demand areas will change greatly with the advent of FBR, and early attention must be given to the technology and economics to bring this about.

In addition, we must establish technological evaluation of the practical FBR. At the same time, the positioning of the practical FBR in Japan's overall nuclear fuel cycle must take place as rapidly as possible in order to effect nonproliferation of plutonium and its regulation.

In this manner, MITI hopes to engage in development of utilization systems for the FBR from this new fiscal year. Recently, the electric power industry also appears to be moving vigorously toward a practical FBR, and it may be that the placement of FBR development on the budget by MITI will accelerate Japan's practical development of the FBR.



## Commercial Nuclear Ships

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 19 Jan 81 p 9

[Text] The research and development plan for a reactor plant for an improved ship, which is the practical goal of the nuclear powered ship for the 21st century, is undergoing renewed activity this year through a government-private industry joint effort centered on the Japan Nuclear Ship Development Agency (director, Kazuhiko Nomura). Plans call for development of a 100-150 megawatt output pressurized water reactor equivalent to 30,000-50,000 hp shaft output, to be placed aboard high-speed container ships which will be mass produced, and for establishment of technology for safe shipping. The first step will be a 5-year program starting in 1981 during which time the selection of the reactor along with conceptual and test design drafting and design evaluations will be conducted. This agency is to set up the developmental office under its technological department and to involve academic and industrial sources in coming up with preparations and procedures by March.

### Agency To Come Up with Conceptual Design in 5 Years

A nuclear powered ship has such a high output that there is no comparison with a diesel powered ship, and it is ideally suited to serve as high-speed container vessel or superlarge tanker or even an icebreaker. When viewed from the standpoint of the limits of oil energy, its development is a must where Japan is concerned. The development of nuclear powered ships in Japan has been delayed because of the radiation leak incident on the nuclear powered ship "Mutsu," but the Western countries have not neglected long-term development. The U.S. plans were delayed from the original timetable, and studies are underway to come up with a large number of nuclear powered commercial ships in the latter half of the eighties. West Germany is conducting transport tests on a completed ship and reportedly is now developing a superlarge container vessel of 240,000 hp.

It is only natural that the greatest attention be directed to safety in the development of nuclear powered commercial ships, but the economics is also important. In the case of power generation on land a higher output will provide the "scale of profit," but this is not directly applicable in the case of a ship, so that the development of small and low cost reactors or the problem of fuel must be resolved before practical realization is attained.

Research and development on nuclear powered ships was conducted centered on the "Mutsu," but the emergency parliament of last year amended a section of the law pertaining to this nuclear powered ship working group, and the way was paved for emphasis to be placed on the establishment of manpower and technology for the day when the nuclear powered ship will surely make its appearance. At the same time, the time limit for this law was extended in the past, but the limits to this working group have been abolished, and administration will be simplified by merging this group with JAERI or DONEN by the end of 1984.

In the light of this, this working group has decided to point toward research and development on reactor plants for ship use parallel with improvements to the nuclear powered ship "Mutsu" and experimental voyages. The budget in 1980 for reactors for ship use was about 20 million yen, to which will be added the 1981 research and development funds of 190 million yen, indicating the government's view of this project.

In the matter of the direction in which this project should be promoted, "the theme" for JFY 81 will be: "What kind of reactor shall attention be directed toward?" (senior managing director Masaaki Kuramoto of the working group). Preparations for making a major start will be under way for the rest of this fiscal year, and it is thought that not only will this working group be involved but a committee will be formed, including representatives from the academic world and industry, along with the establishment of working sections to work in this direction.

In the first stage starting in 1981, the core of a pressurized water type light water reactor plant, which is thought to have the potential to become the power plant for nuclear powered ships in the near future, the primary system equipment, and a number of types of the shielding structure will be test designed along with the ship body and land support facilities. These will be evaluated, and the concept will be established. Some specific research subjects are: 1) comparison and evaluation of unitized reactor and divided reactor to aid in selection of reactor type, 2) program development and analytical research that will enable evaluation of the reactor itself with respect to fuel behavior and heat transfer flow, 3) actual irradiation tests in case the fuel becomes critical using an experimental reactor, and 4) information gathering. Except for the experimental research, there will be a shift to execution starting in JFY 81.

The program after this second stage will involve checking the established concept from all angles, after which the basic design and test fabrication and testing of various items of equipment will begin. At this time, particular attention will be directed at improving the economics. There will be another check and review before the third stage is entered, after which the construction and operational tests on the improved prototupe reactor for ship use will be finally started, according to this plan.

## Import of CANDU Reactor

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 20 Jan 81 p 3

[Text] The cries for the introduction of the Canadian type heavy water reactor (CANDU reactor), which were concealed for a while, have arisen again recently. When Minister Tanaka of MITI visited Canada a while back, he told the Canadian prime minister: "Please exert all possible effort (for the introduction of this reactor to Japan)," indicating an all-out attitude for the introduction of the CANDU reactor. During the summer 2 years ago, the CANDU reactor was hit by the conclusion of the "goodby to introduction" issued by the Atomic Energy Commission, but MITI and the Electric Power Development Company still burned with the desire to acquire this reactor, and they used this recent expression on the part of Minister Tanaka to intensify their efforts.

Let us look at the past history of this so-called CANDU problem. In 1976, the Electric Power Development Company, just as former undersecretary of MITI Yoshihiko Ryosumi became president of the company, initiated a plan to introduce the CANDU reactor. The CANDU is a heavy water reactor developed by the Atomic Energy Public Corporation of Canada (AECL), and it is a self-developed Canadian reactor which burns natural uranium with good efficiency. It has one of the best operating records in the world, and for the six reactors exported to five developing countries, this reactor has had a good record. It is a strategic export item of Canada.

The question of the introduction of this reactor was initiated at the new-type power reactor development discussion sponsored by the Atomic Energy Commission in 1978. In the meeting of presidents of the electric power industry in November of the same year, the conclusion was to approve the introduction of this reactor as a "test demonstration reactor." At this time, the new power reactor introduction roundtable appeared to have a forward looking attitude. Now, along about the end of March 1979, the Three-Mile Island incident occurred, as a rsult of which the self-development principal overtook the Japanese nuclear power industry, and the Atomic Energy Commission drew the conclusion of "goodby to introduction" in August of that year.

MITI and the Electric Power Development Company reacted strongly to this situation and announced their policy of "continuing technological studies aimed at introduction," and the Electric Power Development Company even budgeted 700 million yen for developmental preparations for testing this reactor in 1981 and has decided to continue its studies along the technological front.

One reason MITI and the Electric Power Development Company are so earnestly promoting introduction of the CANDU reactor is that this reactor will complement the light water reactor as far as reactor types go. The other reason is that this introduction may serve long term stable assurance of access to the oil, natural gas, uranium, and coal of Canada. In other words, by introducing the strategic Canadian export item, the CANDU reactor, stable supply of resources will be assured. In this matter, MITI and the Electric Power Development Company claim that the Atomic Energy Commission is completely off base as far as stable energy supply is concerned.

At the same time, however, the safety of the CANDU has been suspect, as Under-Secretary Ob of MITI said: "The CANDU reactor is operating smoothly in developing countries. Is Japan a backward nation where nuclear power is concerned?", indicating that there is a conflict in technological viewpoints.

It was with such a background that Minister Tanaka of MITI made his forward looking statement with regard to the CANDU introduction. There will be a meeting of Japanese and Canadian economists in May, followed by a (summit) meeting of leaders of the leading countries in July, both in Ottawa, and the possibility that the CANDU problem will develop anew cannot be denied.



## Radiation Clean-up Technology

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 20 Jan 81 p 9

[Text] Kurita Kogyo plans to put its strength into development of radiation decontamination technology. The electric power companies have come to put efforts into safety management of workers in nuclear power plants and their decontamination, while the increasing number of years of operation of nuclear power plants will necessarily entail system decontamination and disassembly of shutdown reactors, and this company hopes to be ready for these situations. In this respect, this company is developing remote control and automation technology as well as research on volume reduction and solidification of decontamination solutions in its policy.

An installation such as a nuclear power plant undergoes periodic inspection once a year, at which time the necessary equipment is decontaminated of its radioactivity before it is used again. If this decontamination treatment should be insufficient, workers may be exposed to increased radiation, and this will mean the use of more workers and more time. In this manner, efficient and safe decontamination becomes an important problem in the operation of nuclear power plants from the standpoint of worker safety, cost, and time economy.

Kurita Kogyo has a record of having decontaminated a large number of items such as recirculating pumps, spent nuclear fuel racks (storage shelves), and waste gas treatment devices. These decontamination procedures involve both mechanical and chemical procedures, and this company has top records in both classes.

It is expected that the decontamination problems to be faced in the future will be even more formidable. When the decontamination of an entire system becomes the problem, there may be situations in which existing technology may not be able to cope with the situation, and there will be even greater developmental efforts. This company received orders to clean the nuclear power plant equipment and systems of the Japan Atomic Power Company's Tsuruga atomic power plant No 1 and the Kansai Power's Mihama atomic power plant No 1 before they went into operation and has accumulated information and experience on nuclear power plant equipment and systems which will provide it with powerful weapons for its future development. The Dow Chemical Company of the United States went through several years of preparation to decontaminate an entire nuclear power plant system in the form of the Dresden nuclear power plant No 1, but it still has not been able to complete the project. This is a technology in which there is no example anywhere else in the world, and Kurita Kogyo appears to realize it is necessary to accumulate considerably more technology in the future.

In another direction, the decontamination solutions produced by past decontamination were contracted to and processed by various power companies, and this company is studying means by which it can concentrate and solidify such wastes. This company has embarked on waste water treatment for removal of heavy metals and other contamination, and this technology will be applied together with the development of solidification in asphalt.



## Reprocessing Negotiations With U.S.

Tokyo NIHON KEIZAI SHIMBUNSHA in Japanese 21 Jan 81 p 1

[Text] With the inauguration of the new president of the United States, Reagan, the Japanese Government has decided to strongly urge a review of the September 1977 agreement between Japan and the United States which has proved to be a crippling influence on the promotion of Japanese nuclear power policy. A government negotiating team will visit the United States in March to initiate negotiations. The joint agreement drawn up during President Carter's administration imposed limitations on the reprocessing of spent fuels, which is the key point in the establishment of an independent fuel cycle. The government claims this agreement is a major impediment to the operation of the reprocessing plant now in use at Tokaimura in Ibaraki Prefecture and the construction of the second reprocessing plant now being planned, and is asking for 1) an extension of the operating period of the reprocessing plant and 2) a large expansion of capacity of the reprocessing plant.

### Take a Second Look at the 1977 Agreement

The September 1977 agreement between Japan and the United States, which has proved to be a ball and chain to Japan, includes a basic policy of "reprocessing all spent fuel." It states "the total amount of spent fuel which can be reprocessed in Japan hereafter during a 2-year period will be 99 tons or less." Agreement was reached on this issue because Japan responded to President Carter's fierce efforts to limit nuclear proliferation.

After this joint agreement was drawn up, the operating period of 2 years for the reprocessing plant was gradually extended, and the present situation is that it can operate up to the end of May this year. In addition, the quantity handled is expected to be increased 50 tons as an emergency measure accompanying the initiation of operations of the reprocessing plant at Tokaimura, but it will still be under 149 tons.

Up to now the government has been able to cope with the provisional extension (2-year period) and expansion with respect to extension of the period of operation and expansion of the quantity reprocessed but: 1) the Tokai reprocessing started operations in January, and the limiting quantity bolstered by an increase of 50 tons (for a total of 149 tons) will be surpassed sometime this summer, and 2) a second reprocessing plant under private capital has already been initiated (Japan Nuclear Fuel Service) with the target date of 1990 to initiate operations. Thus, the need to review the joint agreement has become more pressing.

The government is of the opinion that President Reagan will be much more flexible regarding Japan's requests for the operation and construction of reprocessing plants than President Carter.

It is thought that President Reagan's nuclear power policy will be enunciated near the end of February, when he decides on the staff for nuclear power-related positions, and Japanese Government circles say: "During the presidential race Reagan's speeches and the dialog between Reagan's staff and Japan's nuclear nonproliferation principle. On the other hand, he will probably push for fast breeder reactor development and will in all likelihood push the nuclear nonproliferation demands on Japan just as President Carted did."

Because of this situation, the government views the Reagan inauguration as "a chance to eradicate the joint agreement. "A government negotiating team will be dispatched in March to renegotiate this agreement. Even before this government group makes its visit, a good will group mainly of power company people will visit the United States to discuss the expectations of the industrial world to engage in nuclear power development in a plan now under consideration.

The specific contents of this renegotiation will be discussed between MITI, the Foreign Office, and the Science and Technology Agency, but a great extension in operating period and large increase in reprocessing volume are sure to be requested.



### Australian Talks on Reprocessing

Tokyo MAINICHI SHIMBUN in Japanese 21 Jan 81 p 9

[Text] According to a disclosure by government circles on 20 January, the Japanese and Austrialian Governments will meet in Tokyo on 21 and 22 January for the sixth Japan-Australia leaders' meeting, at which time the revision by this fall of the Japanese-Australian nuclear energy cooperation agreement will be discussed. The spent fuel reprocessing system will be handled in the rather mild form of "consensus beforehand on the contents," and this is where the modifications are to be made in which the Australian wishes for strict nonproliferation measures will be combined with Japan's desire for a stable supply of uranium. The government hopes that this new agreement will become a model of two-country agreements and is striving to draw up similar agreements with the United States and Canada.

The revision subjects in the Japanese-Australian agreement include the long-standing problem which involves the Australian proposition made in 1977 that "each time there is a reprocessing, both parties come to an agreement beforehand." This proposal is in line with U.S. President Carter's stand that reprocessing essentially will be prohibited, and the Australian Government has maintained that "as long as the agreement is not revised, there will be no new contracts for uranium export," presenting its very stern viewpoint. In answer to this stand, the Japanese Government said: "To have to come to agreement each time reprocessing is performed at any point will make the red tape unbearable."

At the preliminary negotiations last December the Australians proposed "consensus beforehand on the contents." This proposal makes it incumbent on the uranium-consuming nation to summarize its nuclear power utilization plan and submit it to the uranium-producing nation, which then determines the extent of reprocessing that should take place within such a framework.

This revisional negotiation will be pursued vigorously during the meeting of leaders of the two countries. In addition, there will be a business meeting in March with the hopes that final signing will take place in June.

The government hopes that this new agreement can, if at all possible, be presented to the emergency meeting of parliament this fall. If not, it hopes that it will be ready by the regular session of parliament which will be convened near the end of the year, after which it hopes to enter into negotiations with the United States and Canada.



## Nuclear Powered Steel Mill

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 21 Jan 81 p 4

[Text] The Nuclear Power Steelmaking Technology Research Group (director, Ichiro Fujimoto, president of Kawasaki Steel), which faces an uncertain future because of the failure of the nuclear powered steelmaking research and development project utilizing a high-temperature gas reactor sponsored by the MITI Agency for Industrial Science and Technology, will hold a meeting on 23 January to determine future operating policy. At present, the view is to somehow avoid the worst possible case--that is, dissolution--and possibly participate in the soft area of projects such as coal gasification in a sort of moonlighting effort until the promotional plan is reactivated. On the other hand, this group was subjected to a major shock when the 1.5-megawatt heat exchange capacity high-temperature helium test loop, which is indispensable to safety research on nuclear powered steelmaking and which had been requested in the 1981 promotional funds, was jeopardized by the withdrawal of some 200 million yen from the budget, and the country's nuclear policy from here on may cause withdrawals and even dissolution of the group. In any event, the multipurpose high-temperature gas reactor development, which during the past couple of years had been considered the ticket to disengagement from oil and was given increasing budgets each succeeding year, saw the principal member of its utilization system, nuclear powered steelmaking, collapse. This has rocked the long term multipurpose high-temperature gas reactor utilization plan for the use of nuclear heat to the very foundations, and a new look by the government is in order.

The Nuclear Power Steelmaking Technology Group, which was established in May 1973 on the basis of the Metal Industry Technology Research Group Law, is comprised of 15 companies, including Kawasaki Steel, Shin Nittetsu, Ishikawajima-Harima, Toshiba Ceramics and the Japan Steel Association. That year the first-stage plan was initiated, including development of constitutive element technology for high-temperature heat exchangers and reducing gas production facility for a nuclear powered steelmaking plant, and during the 8 years since then it has received about 12.35 billion yen from the Agency for Industrial Science and Technology. This sum was augmented by self-produced funds totaling 330 million yen up to the end of October last year.

Then the second stage (up to 1994) was to be entered in 1981, at which time the utilization system was to be docked to the JAERI high-temperature gas experimental reactor (50,000 kW thermal output, expected to go critical in 1988). In the previous stage (up through 1980), Ishikawajima-Harima was to install the steam reformer at the high-temperature helium test loop with inlet temperature of 1000 degrees Celsius of the primary system helium loop, which had been completed in 1978, and to check the properties of new thermal insulating materials at the helium bypass which uses two types of new alloys developed for heat exchanger use, and these efforts were to be funded by a grant of about 13 billion yen which also included improvements and safety demonstration tests of the utilization system.

The group had requested 2.2 billion yen for this project, but the Agency for Industrial Science and Technology gave the following reasons to effectively "freeze" the project by cutting its budget to zero: 1) there is excessive steel-producing capacity, 2) development of the experimental reactor at JAERI has been delayed, 3) there has been no request from the Nuclear Safety Bureau of the Science and Technology Agency for a safety demonstration test, and the Agency for Industrial Science and Technology cannot run ahead on its own, and 4) even when the safety test is not performed, the results obtained in the first-stage studies can be directly applied to the experimental plant.

As a result, the group tried to pass on these results to JAERI and requested the Science and Technology Agency and JAERI for this transfer of technology, but this effort also failed, and the requested maintenance and management funds for the high-temperature helium test loop (for one year's government agency inspection as required by the High Temperature Gas Handling Law) of 120 million yen also was slashed to zero. Conversely, the extraordinary situation resulted in that 200 million yen was allocated for the removal of this loop. In response to these actions on the part of the government, some members of the group claim that these actions do not constitute freezing of funds but a cancellation of the project, and any chance of restoration is very slim. In this manner, the future operational policy of this group is in a turbulent stage.

The group seems to be planning to participate in the coal gasification project after the end of 1981 and to participate in the survey on nuclear heat utilization by JAERI. On the other hand, the removal of the high-temperature helium test loop has severed the pathway to a safety demonstration test plan, and increasing weight is being given to the thought that the nuclear powered steelmaking project has failed.



## Nuclear Waste Disposal

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 21 Jan 81 p 1

[Text] MITI will embark on development of a "system to receive solidified material reprocessed and returned from foreign countries" with an outlay of several billion yen, according to a 3-year program starting in 1981. This system will be comprised of hard and soft technology centered on the remote-control operating technology necessary to handle safely high-level radioactive waste from reprocessing plants for spent fuels which are solidified in glass. The nine electric power companies, including Tokyo Electric and the Electric Power Development Company for a total of 10 companies, contracted back in 1977 and 1978 to have their spent fuels reprocessed in the United Kingdom and France, as a result of which high-level radioactive waste solidified in glass will be shipped back to this country starting in 1990, and there will be a need to develop domestic technology to safely receive this waste product.

### Return From France To Start in 1990

The spent fuel which the 10 power companies contracted to the British BNFL and the French COGEMA public corporations for reprocessing in 1977 and 1978 totaled 1,600 tons per year. The 1,500 tons of uranium which had been contracted to the same two companies before these 2 years was reprocessed with the agreement that the high-level radioactive wastes produced by the reprocessing would be disposed of by the respective reprocessing countries. On the other hand, the wastes from the fuel covered by the 1977 and 1978 contracts are to be solidified and sent back to Japan starting in 1990.

These solidified high-level radioactive wastes will be shipped back from these two countries, and experience in receiving such material is a first for Japan. In order to be able to receive this material safely, development of a domestic technology for the safe receipt will be needed.

The technologies for solidification of high-level radioactive wastes and their storage are being gradually developed by DONEN, which is operating Japan's first reprocessing plant for spent fuel, but the technology to safely handle radioactive waste in solidified form after its shipment from abroad is something completely missing in this country.

This ministry plans to start development on this technology over a 3-year period starting in the new year for the safety of the people of the nations, and the main attention will be directed toward remote-handling technology.

High-level radioactive wastes are products of nuclear fission and emit both heat and radiation, making their handling very important. The most common international practice is to solidify the wastes in glass, store the glass for a long period to extract most of the heat, and then subject the glass to ultimate disposal.

It is not clear in just what form the two foreign companies will ship back the wastes to Japan, but these companies are required by contract to notify Japan of the specifications as to size, form, concentration, and shape of enclosing container by 1 January 1982. Japan has up to 1 January 1984 to respond to this specifications proposal, and the system to be developed by MITI will take these specifications into account.

The ministry has budgeted about 400 million yen in JFY 81 for development of this system and is studying a contract to the Nuclear Power Environmental Control Center.



Revision of Nuclear Programs

Tokyo NIHON KEIZAI SHIMBUN in Japanese 21 Jan 81 p 4

[Text] The Atomic Energy Commission (chairman, Ichiro Nakagawa, director of the Science and Technology Agency) announced on 20 January its policy of making an overall reassessment of the "long term plan for nuclear power research and development" which was set up in 1978, in view of the changes in the nuclear power environment during the past few years. This situation is the result of the considerable advances made over the past 3 years in the area of light water reactors, new converter reactors, the fast breeder reactor, and even the fusion reactor, as well as adverse effects brought about by the Three-Mile Island nuclear power reactor incident, which complicated nuclear reactor location problems, and the emergence of the treatment and disposal of radioactive wastes as a social problem. Thus, some major changes are taking place in the nuclear power situation, and the long term plan should be revised accordingly. The Atomic Energy Commission has plans to involve all its subsidiary organs in initiating these changes as quickly as possible and in coming up with a new long-range plan by this August.

This long-range plan will encompass the entire field of research and development over the next 10 years. It was first drawn up in September 1978 and was to be revised every 5 years. Since it is the opinion of the Atomic Energy Commission that the worldwide situation in nuclear power has changes so much over the past 3 years, a reassessment of the plan is in order. This is why the commission pushed ahead the date of review by 2 years and has listed this revision as one of the most important items for 1981.

It is expected that those areas in which changes have been most significant over the past 3 years, such as nuclear fusion, fast breeder reactor and treatment and disposal of radioactive wastes, will be given the greatest attention in this reassessment. Nuclear fusion is undergoing development through a national project involving a tokamak-type facility, but research on modes other than tokamak are taking place at Kyoto University, Osaka University, and Nagoya University, among others, with considerable success. Now, the plan of 3 years ago mentioned only the tokamak, and research at universities was considered simply for reference purposes. The Atomic Energy Commission said: "It will be too much for the budget to continue developing the modes being pursued at all the universities. The results must be reviewed and condensed quite a bit before further nuclear fusion reactor research is continued in our long term plan" (Koyonari substituting for the commission chairman). In addition, rather specific plans are in the offing for the future of the demonstration reactor, which will be the next step following the prototype reactor "Fugen" in the area of new-type converter reactor and the centrifugal separation method, the operation of which was initiated at Ningyo Toge in Okayama Prefecture.



## Uranium Enrichment Model Plant

Tokyo NIHON KEIZAI SHIMBUN in Japanese 22 Jan 81 p 7

[Text] The Science and Technology Agency on 21 January issued a permit for nuclear fuel use to the Asahi Chemical Industry Company for the chemical exchange uranium enrichment model plant facility which this company is planning to construct at Himukai city in Miyazaki Prefecture. With this receipt, the company will apply for a construction permit from Miyazaki Prefecture and start construction during JFY 80 if possible. If this company should succeed with this model plant, it is believed the way will be open to the construction of a 1,000-ton year uranium enrichment plant, and Japan's domestic enrichment of uranium plan, which is based on the national project of the centrifugal separation method now being developed by DONEN, will be backed by another member.

The chemical exchange method is an epoch-making uranium enrichment method which this company has developed and is the first of its kind in the world. Wher tetravalent uranium and hexavalent uranium of differing chemical properties exist together, use is made of the property that the uranium-235 which is used in nuclear fission concentrates to the hexavalent side to bring about enrichment. The principle of this separation was thought of some 30 years ago, but Asahi Chemicals was able to develop high-performance ion exchange resins and developing solvents suitable for this enrichment and come up with the basic technology.

The model plant which is to be constructed to establish the technology and develop the economics to enable the next step to commercial application. Four chemical exchange towers of one-twentyfifth the practical scale of 1-meter-diameter and 1.5 meter-high will be set up to produce 3 percent enriched uranium for use as fuel in light water type reactors. When this plant goes into full operation, it will be able to produce 500 kg/year of 3 percent enriched uranium, but this product will be mixed with depleted uranium (material whose uranium-235 content is less than the natural abundance ratio) for reuse so there will be no accumulation of enriched uranium at this plant.

Ashi Chemical expects to complete this plant by the spring of 1983 and to complete operational experiments and economic evaluations by 1985. The development and research costs are expected to total 12 billion yen, but since this is an important technolgoy which is tied into Japan's energy assurance and the nuclear diffusion problem, two-thirds of the total cost will be supplied by MITI and the Science and Technology Agency as a subsidy, and development will proceed under government direction.

Plans involve the processing of 5 tons of natural uranium per year in this facility, but the Science and Technology Agency deemed that there will be no problem of waste materials countermeasures or discharge of radioactive agents to the environment so that it issued what amounts to a building permit but is actually a permit to handle nuclear materials (permit prescribed by the Nuclear Reactor Law).

There is a belief that it may require some time to receive a building permit from Himukai city where the plant is to be located.



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SCIENCE AND TECHNOLOGY

## NUCLEAR ENERGY EXPLOITATION IN INDUSTRY OUTLINED

Tokoyo GENSHIRYOKU KOGYO in Japanese Dec 80 pp 47-56

[Article by Toshikazu Hayashi, investigation officer, Planning Office, Japan Atomic Energy Research Institute]

[Text] 1. Curtain Raising to Development of Alternate Energy for Oil

It can be thought that the energy situation in the leading industrial countries for the 1980 decade will be greatly controlled by the manner in which the countries develop their development strategy on oil substitutes to counter the long term strategy on the part of OPEC to raise the price and lower production of crude oil.

The long term strategic plan of OPEC was studied and drafted about 2 years ago under the leadership of Oil Minister Yamani of Saudi Arabia, which country accounts for roughly 40 percent of OPEC's total exports, and a consensus is being aimed at with regard to this long term strategy at the 20th anniversary of the founding of OPEC which will be observed on 4 November of this year in Baghdad, Iraq, at which time the crude oil pricing policy is expected to become the principal subject. At the general meeting held in Algiers in June, there already was effected an increase in the per barrel price of oil, which had been left untended for awhile, from 32 to 37 dollars (Saudi produced oil to 28 dollars, Iranian oil to 35 dollars, North African oil to 37 dollars) from which there was to be a systematic price adjustment at the 30 dollar level. OPEC itself was to maintain a strong price cartel, and thereby plan long term stability of OPEC to counter the developments in oil substitute energy expected on the part of the leading industrial companies.

On the other hand, the seven leading industrial countries met at the so-called Venetian Summit on 22-23 June of this year, at which time discussions were held to counter the series of adverse environments associated with increase in oil comsumption - rise in cost of oil - inhibition of economic growth. Agreement was reached on long term policies, and this event has been published as the Venetian declaration.

The items in this declaration related to the energy problem can be summarized in the following manner. 1) There is need to effect conservation of oil and high level production and utilization of substitute energy sources. 2) Invite oil ceilings and oil stockpiling policies studied and proposed by EC, IEA, and OECD.

3) No new oil fired thermal power plants for base road use should be constructed, and conversion from oil to other thermal fuels should be accelerated. 4) Plan to increase energy sources other than oil by 15-20 million barrels/day oil equivalent during the next 10 years through a great increase in use of coal and expanded use of nuclear energy, while striving for a long term increase in production of synthetic fuels, solar energy, and other reusable energy. 5) Improve the infrastructure of each country to enable doubled production of coal by 1990 while putting forth all effort to prevent adverse environmental effects as the result of increased production and combustion of coal. 6) Assure public health and safety while increasing the power generation capacities of nuclear power plants, perfect methods for handling spent fuel and radioactive wastes, assign maximum priority order, assure stabilized supply of nuclear fuel, and minimize the danger of nuclear proliferation. 7) Strongly urge taking into consideration the aforementioned INFCE operational results when each country draws up its policies and plans for peaceful use of nuclear energy. 8) Adopt a comprehensive energy policy for the 1980's which will reduce oil demand such that the ratio between the rate of increase in energy consumption and the rate of economic growth (energy elasticity value) for the summit countries will decrease to about 0.6 in 10 years while the fraction taken up by oil in the total energy demand will decrease from the present 53 percent to about 40 percent in 1990 so that a balance can be struck between demand and a permissible price. These were the items on which consensus was reached.

As is evident from the above discussion, the important item here is that oil substitute energy will be increased over the next 10 years by the combined efforts of seven participating countries to provide 15-20 million barrels/day (oil equivalent) which is equivalent to a billion t/year production after 10 years. To be sure, the list of substitute energy includes nuclear power, coal, tar sand, oil shale, and biomass, and the figures presented above are the target values which the seven participating countries come to agreement on.

In another direction, the development targets on substitute energy for the participating countries which were reported in IEA were on a daily basis 9.5 million barrels for the United States, 1.3 million barrels for West Germany, 1 million barrels for Canada, 0.7 million barrels for Italy, 0.3 million barrels for the United Kingdom, and 3.2 million barrels for Japan. France does not participate in IEA, but has announced a goal of 1.5 million barrels, and the total of 17.5 million barrels/day is the present target.

Where Japan is concerned, the "Long Term Provisional Energy Demand and Supply Estimates" compiled by the Advisory Committee for Energy in August of last year set development targets of 1.2 million barrels/day through coal, 1.1 million barrels/day through nuclear energy, and 0.9 million barrels/day from other sources, and this is an example in which the summit declaration and a nation's plan are in agreement on an international level.

In this manner, Japan is planning to lower its dependency on oil in keeping with the common goal of the seven leading industrial countries, and a policy of active promotion development and introduction of oil substitute energy and assurance of this country's long term energy security was initiated this fiscal year. The budget details and other policy details have appeared in a number of other publications [1], and the following are the four major items.

1) The rate of the electric power development promotion tax was increased in order to assure the necessary funds for the long term, the disbursement area was expanded, and the disbursement area of the oil tax was expanded (see Table 1).

2) A power development diversification account will be newly established within the power development promotion specail countermeasures account as a stabilizing and planned budget management while the coal and oil countermeasures special account will be renamed "Special Countermeasures Account for Coal, Oil, and Oil Substitute Energy," and the oil account will be altered to "Oil and Oil Substitute Energy Countermeasures Special Account."

3) The "Law Related to Promotion of Development and Introduction of Oil Substitute Energy" will be enacted to promote development and introduction of oil substitute energy.

4) A "New Energy Comprehensive Development Organ" (special corporation) will be established as the central promoting organ for executing policies.

The related legal items necessary to the above program have already been set up at the 91st ordinary session of parliament.

The "New Energy Comprehensive Development Organ" is expected to initiate activity on 1 October of this year, and it will be funded by a 4.7 billion outlay from the government along with funds left over from the Coal Industry Rationalization Work Group (absorbed and incorporated) as well as some funds from private sources. It will be comprised of a total of 337 people (of which 250 will be transferred from the coal work group), and the scale of its activities involves a budget of 36.5 billion yen including related accounts (see Table 1). What is of note here is that where nuclear power development is concerned, it is assumed that a develo - ment system has already been established centered on the Power Reactor and Nuclear Fuel Development Corporation and the Japan Atomic Energy Research Institute, and nuclear power is not included in the objectives to be handled by this new organ (established in Article 39). Board Chairman Watamori of this new organ, while assuming his new position, said, "I cannot understand why nuclear power, which should be the backbone of substitute energy, is not included," and there remains the question on the scope of this new organ's activities of just how to go about substitute energy development which requires the utilization of nuclear heat, a subject to be amplified later.

In another direction, the industrial world established the "New Energy Foundation" on 12 September in order to put together all of its forces and engage in all out participation in the development of oil substitute energy. This foundation has 49 participating companies, and will be initially capitalized at 1 billion yen while its scale of activities entails an expected outlay of 8.6 billion yen in JFY 1980-1981. It is expected to promote substitute energy along with local energy, small scale hydropower, and geothermal power utilization and development.

2. Status of Conversion to Alternate Energy

According to the most recent long term electric power plan, it is planned to convert 9.5 million kW power production originally intended to be fueled by oil to some other fuel during the 11 year period between 1980 and 1990, and coal is expected to fuel 600,000 kW, LNG to fuel 7.65 million kW, and LPG to fuel 1.25 kW, according to this plan.

To this end, the Tokyo Electric Power Company, in a joint effort with the Electric Power Development Company, is planning to construct a COM (coal and fuel oil mixed fuel) production plant (most recnet scale: 5 million t/year) at Komeihama in Iwaki City of Fukushima Prefecture to respond to this expansion in coal utilization. This plant is expected to take up ground area of 350,000 $m^2$, total construction costs of 70 billion yen (excluding grounds cost), and go into operation in 1984. Coal will be handled through the No 7 pier of Komeihama port, while the facility for handling COM shipments will be newly constructed at the Fuji Kyosan site.

In another effort, Tokyo Gas and Showa Denko have set up a joint plan for the effective utilization of coal gas in which the Rsurumi Plant of Tokyo Gas and the Kawasaki Plant of Showa Denko will be connected by pipeline whereby the coal gas produced for city gas use at the Tsurumi Plant will be separated into high calorie methane gas and hydrogen (raw material for the manufacture of ammonia) at the Kawasaki Plant of Showa Denko, and the methane gas will be used by Tokyo Gas while Showa Denko will handle the hydrogen. In this manner, Tokyo Gas hopes to obtain high calorie gas (5,000 $cal/m^3 \rightarrow 11,000\ cal/m^3$) to keep up with the rapidly increasing demand, while Showa Denko, which is producgin ammonia from the relatively high priced raw material naphtha, hopes to switch away from dependence on oil products. Construction on this pipeline is expected to start within the year.

On an international scale, the 11 countries comprising IEA (Japan, the United States, Canada, Australia, Denmark, Spain, Ireland, Norway, Holland, the United Kingdom, Sweden) and EC held a special COM conference on 8-9 October of this year at Paris; a formal signing of an international joint program on COM technology development was observed, and it is expected that joint research will be initiated. This project is expected to focus on (1) large scale continuous production technology, 2) shipping transport technology, 3) long-term stable storage technology, and 4) development of large capacity COM pumps capable of operating with high viscosity fluids and with high wear resistance.

In addition, IEA, in November 1975, set up the joint program "Economic Evaluation of Coal" as a research and development effort on the part of eight countries, including the United States, Canada, Holland, and West Germany. This program will look into 1) cost of conversion technology for gasification, liquefaction, and power generation involving coal; 2) evaluation of treatment technology for ash, dust, $SO_x$, and $NO_x$ and the effects on the environment; 3) transport cost of coal; and 4) cost somparisons with other forms of energy. Joint research on these four subjects is being promoted. The Energy Development Committee (CRD), which is a suborgan of IEA, held a meeting at Tokyo on 24-25 September of this year, and Japan made use of this occasion to be formally made party to this international agreement.

In this manner, it may be said that the various industries within a given country and the various countries on the international scene have initiated development in rapid tempo of evaluating the economics of developing and intorducing alternate energy at an early stage, as well as evaluating the effects on the environment.

3. Development of Utilization Technology of Alternate Energy

Natural gas and coal are resources which can be readily utilized as laternate energy for oil.

Coal is a natural resource with abundant reserves, and it is not polarized with respect to source distribution as are oil and natural gas, making it very advantageous from the standpoint of assurance in energy security. As a result, it has suddenly come into the limelight as a substitute energy resource.

Now, it is well known that when coal is burned directly, it produces sulfur components, nitrogen components, and ash in quantities which when compared on a heat output basis with oil, are several ten times as large, and the ash output is several hundred times as large, and it becomes necessary to install smoke desulfurization facilities, smoke denitrification facilities, and dust collectors to prevent environmental pollution. At the same time, nonpolluting countermeasures need to be adopted for the ash which is discarded. In the practical technological developments along this line, such as that taken by a coal fired power plant, there is the 4,000 $Nm^3/h$ pilot plant which was started in line with the Mochirai [transliteration] No 7 power plant (250,000 kW), which is a thermal power plants operated by the three companies of Tokyo Electric, Tohoku Electric, and Tokiwa Kyodo, in which a comprehensive smoke removal and treatment system is undergoing demonstration tests, and the dust removal rate of greater than 99 percent and desulfurization rate of greater than 90 percent have been achieved with an electrical dust collector and a wet desulfurization scrubber. In addition, denitrification rates of more than 80 percent have been attained by the high dust denitrification method (case I) and the low dust denitrification method (case II).

On the other hand, these facilities are several times larger than comparable facilities for oil fired thermal power plants, and the cost and ground space required are major problems. While the ash treatment countermeasures vary with the type of ash, the burning of coal produces 15-25 percent ash, and developments are being promoted to enable use of this ash as fill for marshy land, mix material for construction work or with cement, or as potassium silicophosphate, which is a major component of a new fertilizer. In order to promote development of utilization technology of coal ash, the industrial world formed the "Coal Ash Utilization Council" on 11 September which is expected to look into directions of utilizion development.

In this manner, utilization of coal makes necessary new coal storage sites, ash treatment facilities, harbor facilites, transport equipment, and storage facilities, and coal centers which have restacking capability, ash storage and accumulation capacity, ash mixing capability, organized custom clearance capability, and supply capability for spot demands are envisioned. There are already candidates for 10 million ton scale facilities such as Tomakomaki Higashi in Hokkaido, Sakido in Nagasaki, and Kyonan.

In addition, it is known that coal can contain a number of radioactive components, depending on the source, and calculations of the exposures to be expected from a 1,000 MWe scale power plants have been reported [2].

On the particular subject of environmental problems of substitute energy, the "Environmental Safety Items" which were not in the original proposal of the Ministry of International Trade and Industry were added with the comment of "being cognizant of environmental safety" in Article 3, Item 2 through the strong insistence of the Environmental Agency circumventing the aforementioned "law concerning development and introduction of oil substitute energy." In addition, the Environmental Agency set out on 13 August of this year to conduct surveys relative to the effects on environmental pollution accompanying the combustion of substitute fuels, and will set up a study group during the course of this year. In a separate action, a new national level discussion is expected to be proposed in the form of the Ministry of International Trade and Industry's "reassessment of environmental standards" (easing of standards).

As discussed above, the direct utilization of coal involves environmental, siting, and cost problems, and this is why one naturally must look at the utilization of processed coal as classified in Table 2, or look to conversion utilization.

The development of coal conversion utilization technology has been promoted since JFY 1974 in the form of the "Sunshine Plan" under the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry. The solvolysis method for coal liquefaction is under joint development by the Electric Power Development Company, Mitsubishi Heavy Industries, and Mitsubishi Chemical Industry, and a 1 ton/day pilot plant is already in continuous operation. At the same time, the solvent treatment method was jointly developed by the Electric Power Development Company, Sumitomo Coal, and Sumitomo Metals, and a 1 ton/day coal processing pilot plant is under construction. It is also expected that construction will soon be initiated on a 2.4 ton/day pilot plant for the direct water addition method.

In the area of coal gasification studies which are being conducted in parallel manner with the liquefaction efforts is the low calorie gasification test plant (5 ton/day coal capacity)which was developed by the Coal Technology Laboratory, and this is being scaled up to a 40 ton/day pilot plant which is presently under construction and is expected to enter into operation this year. A high calorie gasification method is being jointly developed by the Electric Power Development Company, Hitachi Limited, and Babcock-Hitachi, and a 7,000 $m^3$/day pilot plant is being constructed at the old Tokiwa Coal grounds. This plant will be used to test the hybrid gasification technology in which COM is pressurized and gasified by a fluid bed method and pressurized water addition gasification technology in which hydrogen is introduced under pressure. It is expected that these technologies will be developed into practical form within 10 years and become commercialized.

Apart from the Sunshine Plan projects mentioned above, there is another solvent treatment liquefaction method which is under study based on the Japan-United States Science and Technology Agreement by which an international effort on the part of

Japan, the United States, and West Germany on the SRC II project of the Gulf Corporation of the United States is under way (6,000 ton/day: under construction). There are also the joint enterprise of Kobe Steel, Mitsubishi Chemical Industries, and Nissho Iwai on the"KOMINIC method" which is intended to liquefy Australian peat under a Japan-Australia agreement, for which a plant in Australia (50 ton/day) has been constructed, and the EDS project (250 ton/day: under construction) being promoted by the Exxon Company of the United States, in which a Japan Liquefaction Technology Development Company consisting of 12 Japanese companies headed by Idemitsu Kyosan is participating.

On the other hand, the energy required for the production of one of the oil substitute energies described above has to be provided by fossil fuels, and this will involve "mutual eating into each other behavior" of fossil fuels in the future as the production scale is expanded. In order to prevent such an occurrence, the utilization of nuclear energy which can deliver a large quantity of energy from a small quantity of resources using a compact source and causing little environmental pollution seems to be the most effective approach [3].

4. Production of Substitute Energy by Utilization of Nuclear Power

The production of secondary energy from nuclear power has up to the present time, been through the medium of nuclear power plants such as the light water reactor, gas cooled reactor, and the heavy water reactor. Now, as shown in Fig 2, the "Long Term Provisional Energy Demand and Supply Estimates" proposed by the Advisory Committee for Energy projects that of the total energy supply of 807 million kl (oil equivalent), 35.7 percent will be supplied by electric power and 64.3 percent by nonelectric power, and the nonelectric power forms are expected to supply more than 60 percent of the overall energy supply.

Assuming that a multiple purpose high temperature gas cooled reactor with the specifications given in Table 3 will become practical sometime during the decade including 1995, calculations were performed for combinations of various practical scale production plants by the Japan Atomic Energy Research Institute, with the cooperation of various makers [4]. Examples of cost calculations for different plants are shown in Table 4. The price of crude oil at the time these calculations were made was 13.6 dollars/barrel, which later rose to 30 dollars, and is expected to go up to 60 dollars, as a result of which the comparison of production costs cannot be made very readily, but there are prospects that superior economics can be realized over methods of the past.

The operating rate is generally an important problem in a nuclear power utilization production plant. There is a legal obligation to suspend nuclear reactors once a year (for roughly 2 months to conduct periodic inspection), but suspending the utilization system during this period has some adverse economic effects, and the use of a combination of several reactors is being considered to shore up the utilization rate of the utilization system. According to studies conducted by the Energy Comprehensive Engineering Laboratory, under contract to the Minister of International Trade and Industry, a secondary energy center is envisioned in which four multiple purpose high temperature gas cooled reactors (of which three are operating and one undergoing periodic inspection), each of 1,000 MWt output, are teamed with three units of coal processing plants [5]. There are five types of unit models being considered; the gases under consideration are the three different types of SNG, LNG, and CL (liquefied coal oil). The principal specifications of the multiple purpose high temperature gas cooled reactor are given in Table 5, while the general items of the coal processing unit model are given in Table 6.

As shown in Table 7, examples of calculations related to each unit model show the cost values of the major products to range between 57-160 yen/$10^4$ cal, and these are thought to come to the same level as costs in the past.

5. Development of Multiple Purpose Gas Cooled Reactor

Attempts to utilize the heat from nuclear reactors for local heating and steam supply for factory use were in vogue during the first half of the 1960 decade in Sweden and the United Kingdom. Development of a high temperature gas cooled reactor to supply process heat for coal gasification or liquefaction found sharp rise in activity as the 1970 decade began in West Germany and the United States [6].

Development of the multiple purpose high temperature gas cooled reactor has been promoted in Japan since JFY 1969, and it is recognized that the technological foundation has been established [7]. The results of this development have been reported at nine research report seminars (once a year; this year's seminar will be on 25 September), and many reports covering results in various areas such as design, fuel and materials, reactor engineering, high temperature equipment, and high temperature irradiation technology are offered [8].

The Japan Atomic Energy Research Institute has begun detailed design of an experimental reactor from this Japanese fiscal year following the development schedule shown in Table 8 to operate an experimental reactor during the first half of the decade including 1985 in which a "temperature of 1000°C" will be targeted for the high temperature gas to be generated as part of the "Long Term Plan for Nuclear Power Research and Development Utilization" which was proposed by the Atomic Energy Commission.

Needless to say, the construction and operation of the experimental reactor is an indispensable precursor to the demonstration of technological feasibility of the practical reactor slated for the decade including 1995, and this will provide a minimum level of bargaining power necessary for Japan in order that it maintain its position in its international cooperative developments with the United States and West Germany.

The Japan Atomic Industrial Forum reorganized the "Multiple Purpose Utilization of Nuclear Reactors Roundtable" which had continued activities since 1969 to "Nuclear Reactor Heat Utilization Roundtable" which will collect information from the private sector to promote development on the utilization of nuclear heat, and it may be said that the development of nuclear reactors and their utilization systems has now entered the stage of a national project in which the cooperation of the private sector is the foundation of this promotion.

(20 September 1980)

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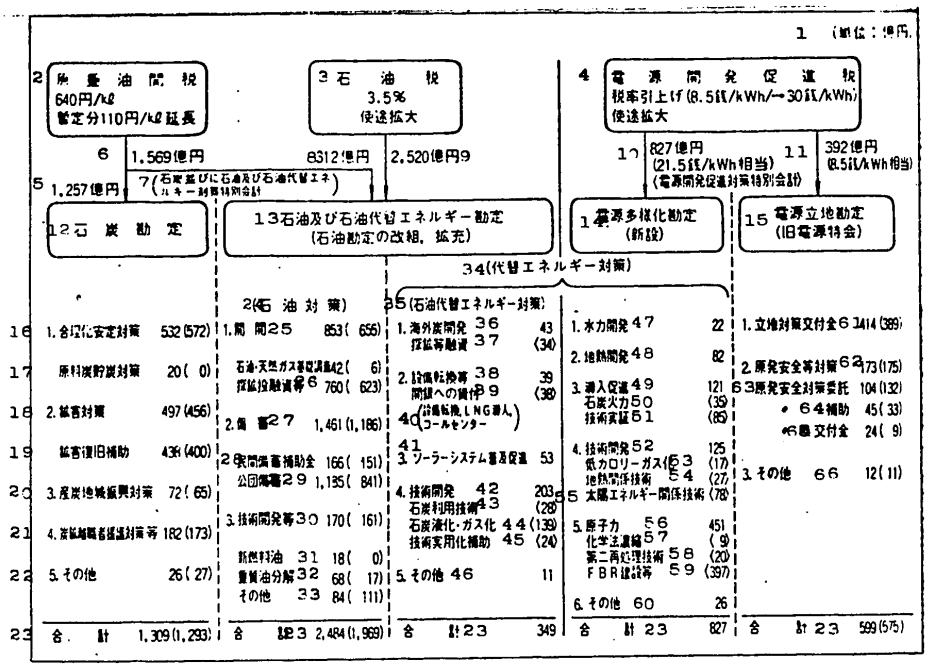


Figure 1. Special Energy Related Accounts and Budgets

Key:
1. unit: 100 million yen
2. crude oil customs 640 yen/kl, provisional increase of 110 yen/kl
3. oil tax 3.5 percent, expanded disbursements
4. Electric Power Development promotion tax, tax rate raised (8.5 cents/kWh → 30 cents/kWh) expanded disbursements
5. 125.7 million yen
6. 156.9 million yen
7. special account for coal, oil and oil substitute energy
8. 31.2 billion yen
9. 252.0 billion yen
10. 82.7 billion yen (equivalent to 21.5 cents/kWh) (Special Electric Power Development Account)
11. 39.2 billion yen (equivalent to 8.5 cents/kWh)
12. coal account
13. oil and oil substitute energy account (revision and expansion of oil a-count)
14. diversification of electrical sources account (newly established)
15. power sources siting account (formerly power sources special group)

Key to Figure 1 (continued):

16. rationalization and stabilization measures
17. raw material coal storage measures
18. mineral damage countermeasures
19. mineral damage restoration subsidy
20. coal producing district promotion measures
21. aid to unemployed miners, etc.
22. others
23. total
24. oil countermeasures
25. exploration
26. basic survey on oil and natural gas, prospecting funds, etc.
27. stockpiling
28. subsidy for private stockpiling
29. public stockpiling
30. technological development, etc.
31. new fuel oil
32. heavy oil cracking
33. others
34. substitute energy countermeasures
35. oil substitute energy countermeasures
36. overseas coal development
37. prospecting, financing, etc.
38. conversion of facilities
39. loans from Development Bank
40. conversion of facilities, LNG import, coal center
41. promoting popular use of solar energy
42. technological development
43. coal utilization technology
44. coal liquefaction, gasification
45. subsidy for practicalization of technology
46. others
47. hydropower development
48. geothermal development
49. promoting introduction
50. coal fired thermal power
51. demonstration of technology
52. technological development
53. low calorie gasification
54. geothermal related technology
55. solar energy related technology
56. nuclear power
57. chemical enrichment method
58. second reprocessing technology
59. RBR construction
60. others
61. funds for siting countermeasures
62. safety measures against nuclear explosions, etc.
63. contracted safety measures against nuclear explosions
64. subsidies
65. grants
66. others

Table 1. New Energy Comprehensive Development Structure Budget (New Energy Related Fraction) (Unit: 100 Million Yen)

| | | |
|---|---|---|
| 1 | 1. 海外炭開発の促進 | 43 |
| 2 | (1) 海外炭探鉱融資（対象拡大，融資比率70%，金利6.5%） | (34) |
| 3 | (2) 海外炭開発債務保証（市中分および輸銀分の1/2計70%対象 倍率15倍） | ( 5) |
| 4 | (3) その他（開発可能性調査，地質構造調査） | ( 4) |
| 5 | 2. 石炭エネルギー技術開発 | 15 |
| 6 | サンシャイン石炭液化 | (15) |
| 7 | 3. 地熱エネルギー技術開発等 | 86 |
| 8 | (1) 技術開発（熱水利用発電，地熱探査技術，深層熱水供給システム） | (10) |
| 9 | (2) 調査（地熱開発促進調査，全国地熱資源総合調査） | (45) |
| 10 | (3) 地熱開発債務保証 | ( 2) |
| 11 | (4) 大規模深部地熱調査 | (29) |
| 12 | 4. 太陽エネルギー等技術開発 | 16 |
| 13 | (1) 太陽光発電 | (12) |
| 14 | (2) その他（産業用ソーラーシステム，電力貯蔵システム） | ( 4) |
| 15 | 5. その他（設立出資金，事務費等交付金） | 16 |
| 16 | 6. 関連予算 | 176 |
| 17 | (1) 太陽熱発電，高カロリーガス化 | 94 |
| 18 | (2) SRC-II 分担金 | 75 |
| 19 | (3) その他（継続事業のうち，新機構設立まで他機関が行なう分） | 20 |
| 20 | 計 | 365 |

21 (注) 端数四捨五入

Key:
1. promotion of overseas coal development
2. overseas coal prospecting fund (expanded objectives, loan ratio 70 percent, interest 6.5 percent)
3. assurance of loans for overseas coal development (to account for 70 percent of one-half total of cities fraction and Export Bank fraction, 15 times multiplication rate)
4. others (survey of potential development sites, geologic structure survey)
5. development of coal energy technology
6. Sunshine coal liquefaction
7. development of geothermal energy technology
8. technological development (hot water utilization power generation, geothermal prospecting technology, deep layer hot water supply system)
9. survey (geothermal development promotion survey, comprehensive all country geothermal survey)
10. assurance of geothermal development funds
11. large scale deep geothermal survey
12. development of solar energy technology
13. solar photoelectric power generation
14. others (industrial use solar systems, electric power storage systems)
15. others (siting funds, business operational cost funds)
16. related budgets
17. solar power generation, high calorie gasification

Key to Table 1. (continued):

18. SRC-II support fund
19. others (among the continuing activities, those which are conducted at other facilities until new facilities are constructed)
20. total
21. (Note) final manpower 45 people

Table 2. Classification of Coal Utilization Technology

| 1 利用区分 | | | (1) 2 輸送形態 | 3 発電所での利用技術(2) 4 従来形ボイラ 5 ガスだき | 6 油だき | 7 微粉炭 | 8 流動床ボイラ | 9 ガスタービン利用複合発電 |
|---|---|---|---|---|---|---|---|---|
| 10 石炭 | 11 直接利用 | — | 12 塊 | | | ○ | ○ | |
| | 11a 加工利用 | 13 水スラリ | 14 塊/液 | | | ○ | ○ | |
| | | COM | 15 液 | | △ | ○ | △ | |
| | | 16 改質 | 15 液 | | ○ | △ | △ | |
| | 17 転換利用 | 18 ガス化 19 低カロリーガス化 | 12 塊 | ○ | | | | ○ |
| | | 20 高カロリーガス化 | 12 塊 | ○ | | | | ○ |
| | | 21 液化 | 15 液 | | ○ | | | ○ |
| | | 22 メタノール化 | 15 液 | | ○ | | | ○ |

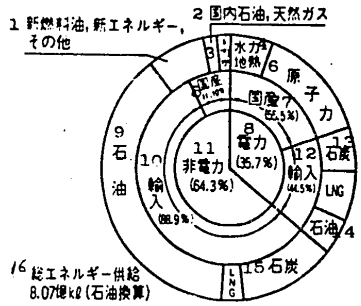
23 備考：太わくで囲んだ部分が新技術としての対象技術

24 注(1) 塊は塊炭，液は液状輸送の意，したがって輸送船ではそれぞれバルクキャリヤ，タンカーに対応する.

25 (2) ○：適，△：要検討

Key:

1. utilization classification
2. transport mode
3. utilization technology at power plant
4. boiler of the past
5. gas burning
6. oil burning
7. fine coal powder burning
8. fluidized bed boiler
9. compound power generation utilizing gas turbine
10. coal
11. direct utilization
11a. utilization for working use
12. mass
13. water slurry
14. mass/liquid
15. liquid
16. modification
17. utilization for conversion
18. gasification
19. low calorie gasification
20. high calorie gasification
21. liquefaction
22. production of methanol
23. remark: the section bounded by the large enclosure is the objectives of the new technology
24. Note (1) mass refers to lump coal and liquid to liquid transport material. Consequently, the transport ships can be classified into bulk carriers and tankers
25. (2) O: suitable,
    △: study needed




第2図 わが国の1次エネルギー供給量 (昭和70年度)

Figure 2. Primary Energy Supply for Japan (JFY 1995)

Key:

1. new fuel oils, new energy, others
2. domestically produced oil, natural gas
3. domestically produced coal
4. water power, geothermal
5. domestic production 11.10 percent
6. nuclear power
7. domestic production 55.5 percent
8. electric power 35.7 percent
9. oil
10. import 88.9 percent
11. nonelectric power 64.3 percent
12. import 44.5 percent
13. coal
14. oil
15. coal
16. total energy supply 807 million kl (oil equivalent)

Table 3. Principal Specifications for Practical Multiple Purpose High Temperature Gas Cooled Reactor for Multiple Applications

| 1 番号 | 2 項目 | 3 諸元 |
|---|---|---|
| 4 I | プラント形態 | |
| 5 1 | 利用系形態 | 原子力製鉄, 石炭液化, 水素製造等, 19 各種熱利用用 20 |
| 6 2 | 原子炉基数 | 1基 21 |
| 7 3 | 原子炉熱出力 | 3,000 MW |
| 8 4 | 最終冷却方式 | 海水冷却 22 |
| 9 II | 原子炉基本仕様 | |
| 10 1 | 燃料 | ブロック型被覆粒子燃料（低濃縮ウラン使用） 23 |
| 11 2 | 冷却材 | ヘリウム 24 |
| 12 3 | 冷却系統 | 中間熱交換器および2次冷却系付き 25 |
| 13 4 | 冷却ループ数 | 8ループ 26 |
| 14 5 | 原子炉冷却材出口ガス温度 | 1,000℃ |
| 15 6 | 原子炉冷却材圧力（入口） | 40kg/cm²G |
| 16 7 | 原子炉容器 | PCRV |
| 17 8 | 原子炉格納容器 | 完全二重格納方式 27 |
| 18 9 | 耐用年数 | 30年 28 |

Key to Table 3.

1. number
2. item
3. specification
4. plant type
5. utilization system type
6. nuclear power steelmaking, coal liquefaction, hydrogen production, various thermal utilization applications
7. thermal output of nuclear reactor
8. final cooling mode
9. specifications for basic reactor unit
10. fuel
11. coolant
12. coolant system
13. number of coolant loops
14. coolant gas outlet temperature of nuclear reactor
15. nuclear reactor coolant pressure (inlet)
16. nuclear reactor container
17. nuclear reactor containment vessel
18. projected years of use
19. nuclear power steelmaking, coal liquefaction, hydrogen production, etc.
20. various thermal applications
21. one unit
22. sea water coolant
23. block type coated particle fuel (using low enrichment uranium)
24. helium
25. with intermediate heat exchanger and secondary coolant system
26. 8 loops
27. completely doubly contained type
28. 30 years

Table 4. Outline of Practical Scale Plant for Nuclear Heat Utilization

| 1 プラント名 | 2 建設費1) | 3 敷地面積2) | 4 所要人員 | 5 原料3) | 6 製品年間生産量4) | 7 製品コスト | 8 石油換算量 |
|---|---|---|---|---|---|---|---|
| 9 多目的高温ガス炉 (3,000MWt) | 10 2,800億円 | 11 4.0ha | 12 120人 | 核燃料 13 6.9TU/年 | 1.86×10^11 kcal 14 | 15 2.71円/kcal | |
| 16 石炭液化プラント | 17 1兆,362億円 | 625ha | 18 1,184人 | 19 石炭, 9.31×10^6T/年 21 (米国東部炭)<br>25 水, 4.34×10^7T/年 | 20 (主) 精製ナフサ, 1.04×10^6T<br>23 (主) 灯油ベース油, 1.82×10^6T<br>26 (主) 軽油ベース油, 1.11×10^6T<br>27 (副) 電気, 1.86×10^9kWh<br>29 (副) SNG, 1.38×10^9Nm³<br>31 (副) LPG, 2.29×10^5T<br>33 (副) 液体アンモニア 1.15×10^5T<br>35 (副) イオウ 2.93×10^5T | 21 31,000円/kl<br>24 37,000円/kl<br>24 37,000円/kl<br>28 9円/kWh<br>29 22円/Nm³(LNG)<br>32 31,300円/T<br>34 60,000円/T<br>36 7,000円/T | 37 300万 kl/年 |
| 38 石炭ガス化プラント | 7,133億円 39 | 280ha | 1,225人 40 | 41 石炭, 15.1×10^6T/年 (太平洋炭)<br>水, 12.8×10^6T/年 42 | (主) SNG 7.2×10^9Nm³ 43<br>(副) 電気 10.7×10^9kWh 44 | 45 22円/Nm³(LNG)<br>46 9円/kWh | 500万 kl/年 47 |
| 48 原子力製鉄プラント (還元ガスによる直接製鉄法) | 5,340億円 49 | 195ha | 1,680人 50 | 石炭(褐炭) 51 1.75×10^6T/年<br>鉄鉱石(67.5%Fe) 52 7.6×10^6T/年<br>水 1.8×10^6T/年 53<br>54 酸素 4.0×10^7Nm³/年<br>55 電極 2.7×10^4T/年 | (主) 粗鋼 5.0×10^6T 56<br>(副) 電気 11.4×10^9kWh 57<br>(副) チャー 8.4×10^5T 58 | 59 4,500円/T<br>60 9円/kWh<br>— | 530万 kl/年 61 |

62 (注) 1) 建設費は 1979 年価格で土地代金, 建設期間中金利, 創業費を含む.

63 2) 敷地面積は原子炉の敷地面積を含む.

64 3) Tはメートル・トンを示す.

65 4) (主)は主製品, (副)は副産物を示す.

Key to Table 4.

1. name of plant
2. construction cost
3. site area
4. manpower required
5. raw materials
6. annual product production
7. product cost
8. oil saving converted value
9. multiple purpose high temperature gas cooled reactor (3,000 MWt)
10. 280.0 billion yen
11. 4.0 ha
12. 120 people
13. nuclear fuel 16.9 TU/yr
14. $1.86 \times 10^{13}$ kcal
15. 2.71 yen/kcal
16. coal liquefaction plant
17. 636.2 billion yen
18. 1,184 people
19. coal, $9.31 \times 10^6$ T/yr
20. (main) purified naphtha $1.04 \times 10^6$ T
21. 31,000 yen/kl
22. American northeast coal
23. (main) lamp oil base oil, $1.82 \times 10^6$ T
24. 37,000 yen/kl
25. water, $4.34 \times 10^7$ T/yr
26. (main) light oil base oil, $1.11 \times 10^6$ T
27. (byproduct) electricity, $1.86 \times 10^9$ kWh
28. 9 yen/kWh
29. (byproduct) SNG, $1,38 \times 10^9$ $Nm^3$
30. 22 yen/$Nm^3$ (LNG)
31. (byproduct) LPG, $2.29 \times 10^5$ T
32. 31,300 yen/T
33. (byproduct) liquid ammonia, $1,15 \times 10^5$ T
34. 60,000 yen/T
35. (byproduct) sulfur $2.93 \times 10^5$ T
36. 7,000 yen/T
37. 3 million kl/yr
38. coal gasification plant
39. 713.3 billion yen
40. 1,225 people
41. coal $15.1 \times 10^6$ T/yr (Pacific coal)
42. water $12.8 \times 10^6$ T/yr
43. (Main) SNG $7.2 \times 10^9$ $Nm^3$
44. (byproduct) electricity $10.7 \times 10^9$ kWh
45. 22 yen/$Nm^3$ (LNG)
46. 9 yen/kWh
47. 5 million kl/yr
48. nuclear power steelmaking plant (direct steelmaking method using reducing gas)

Key to Table 4. (continued):

49. 534.0 billion yen
50. 1,680 people
51. water 1.8 x $10^6$ T/yr
52. iron ore (67.5 percent Fe) 7.6 x $10^6$ T/yr
53. water 1.8 x $10^6$ T/yr
54. oxygen 4.0 x $10^7$ $Nm^3$/yr
55. electrodes 2.7 x $10^4$ T/yr
56. (main) crude steel 5.0 x $10^6$ T
57. (byproduct) electricity 11.4 x $10^8$ kWh
58. (byproduct) char 8.4 x $10^5$ T
59. 4,500 yen/T
60. 9 yen/kWh
61. 5.3 million kl/yr
62. (note) 1) the construction costs include land cost, interest during construction period, and initial costs at 1979 prices
63. 2) the ground area includes the area taken up by the nuclear reactor
64. 3) T is metric ton
65. 4) (main) indicates main product, (byproduct) is side product

Table 5. Major Specifications of 1,000 MWt Class Multiple Purpose High Temperature Gas Cooled Reactor Concept for Nuclear Heat Utilization

| | | |
|---|---|---|
| 1 一般諸元 | | |
| 2 原子炉形式 | | 21 黒鉛減速・ヘリウム冷却型 |
| 3 原子炉熱出力 | MWt | 1,000 |
| 4 冷却材温度　原子炉入口 5 | ℃ | 400 |
| 原子炉出口 6 | ℃ | 1,000 |
| 7 冷却材圧力 | kg/cm²g | 50 |
| 8 冷却材流量 | t/h | 1,156 |
| 9 熱交換方式 | | 22 中間熱交換方式 |
| 10 冷却ループ数 | | 4 |
| 11 炉心諸元 | | |
| 12 炉心等価直径 | m | 5.9 |
| 13 炉心有効高さ | m | 4.7 |
| 14 反射体厚さ | m | 23 上下部 1.2, 径方向 1.2 |
| 15 炉心平均出力密度 | W/cm³ | 7.8 |
| 16 燃料体形式 | | 24 六角柱黒鉛ブロック マルチホール型 |
| 17 原子炉容器 | | |
| 18 型　式 | | 25 プレストレストコンクリート製 (PCRV) |
| 19 主要寸法　高さ | m | 40 |
| 20 径 | m | 32 |

Key:

1. general specifications
2. nuclear reactor type
3. nuclear reactor thermal output
4. coolant temperature
5. nuclear reactor inlet

Key to Table 5. (continued):

6. nuclear reactor outlet
7. coolant pressure
8. coolant flow rate
9. type of heat exchanger
10. number of coolant loops
11. core specifications
12. equivalent core diameter
13. effective core height
14. thickness of reflector
15. average core output density
16. shape of fuel body
17. nuclear reactor container
18. type
19. principal dimensions, height
20. diameter
21. graphite moderated, helium cooled
22. intermediate heat exchanger type
23. vertical section 1.2 m, radial direction 1.2 m
24. hexagonal graphite block multihole type
25. prestressed concrete type (PCRV)

Table 6. Outline of Coal Processing Unit Model Utilizing Nuclear Heat

| | 1 タイプ1 | 2 タイプ2 | 3 タイプ3 | 4 タイプ4 | 5 タイプ5 |
|---|---|---|---|---|---|
| 6 原子炉熱出力 (MWt) | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| 7 石炭処理量 (t/d) | 12,572 | 9,136 | 3,109 | 2,676 | 12,458 |
| 8 主製品 ($Nm^3/d$) | SNG<br>$8,597 \times 10^3$ | LNG<br>$6,245 \times 10^3$ | 9 合成ガス<br>$7,896 \times 10^3$ | LCF<br>3,479(t/d) | OIL<br>6,447(t/d)<br>GAS<br>1,664(t/d) |
| 10 発生電力 (MWe) | 100 | 145 | 168 | 225 | 345 |
| 11 外部供給電力 (MWe) | 0 | 41 | 80 | 144 | 242 |
| 12 副製品硫黄 (t/d) | 476 | 346 | 122 | 104 | 436 |
| 13 副製品液体アンモニア (t/d) | 253 | 183 | 70 | 60 | 170 |
| 14 プラント効率 (%) | 76.8 | 72.6 | 64.6 | 56.5 | 74.8 |

Key:

1. type 1
2. type 2
3. type 3
4. type 4
5. type 5
6. reactor heat output (MWt)
7. volume of coal processed
8. main products
9. synthetic gas
10. power generated
11. power supplied from outside
12. byproduct sulfur
13. byproduct liquid ammonia
14. plant efficiency

Table 7. Economics of Unit Model
(Test Calculation)

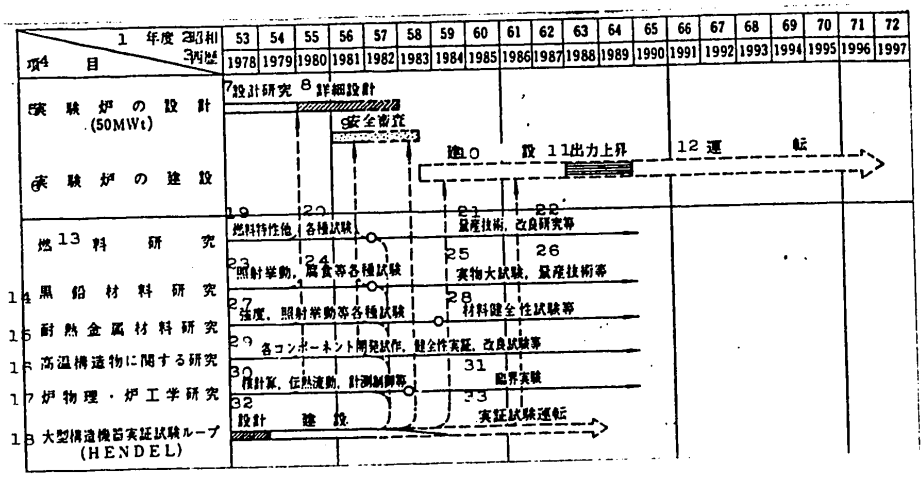
| 1 項目 ＼ 2 製品タイプ | SNG | LNG | 3 合成ガス | LCF | C.L |
|---|---|---|---|---|---|
| 4 建設費 (億円) | 6,199 | 5,790 | 4,795 | 4,820 | 5,972 |
| 5 原子炉系 | 880 | 880 | 880 | 880 | 880 |
| 6 熱交換系 | 940 | 865 | 1,315 | 1,315 | 1,240 |
| 7 発電系 | 150 | 150 | 150 | 150 | 150 |
| 8 石炭処理系 | 2,530 | 2,320 | 1,110 | 1,130 | 2,050 |
| 9 インフラ | 420 | 380 | 350 | 350 | 420 |
| 10 建中・利子総経費 | 1,279 | 1,195 | 990 | 995 | 1,232 |
| 11 年間経費 (億円) | 1.550 | 1,386 | 1,030 | 986 | 1,443 |
| 12 金利・償却 | 779 | 738 | 614 | 617 | 755 |
| 13 人件費・修繕費 | 384 | 359 | 300 | 301 | 370 |
| 14 燃料費 | 387 | 289 | 116 | 68 | 318 |
| 15 製品コスト | | | | | |
| 16 副生品収入 (億円) | 70 | 82 | 86 | 125 | 367 |
| 17 主製品コスト (億円) | 19 1,480 | 20 1,294 | 21 944 | 22 895 | 23 1,052 |
| 18 主製品生産量 (年間) | 21.9億$Nm^3$ | 114万トン | 20億$Nm^3$ | 89万トン | 164万トン |
| 24 主製品単価 (円/$10^4$kcal) | 64 | 76 | 128 | 160 | 57 |
| 25 同上 (利子率4%の場合) | 52 | 61 | 100 | 123 | 43 |

26 (注) 1. 建設費に土地代を含まず，また単位は1,000MWt当り億円
27 2. 主製品コストは利子率均等化のケース

Key:

1. item
2. type of product
3. synthetic gas
4. construction cost (100 million yen)
5. reactor system
6. heat exchanger system
7. power generation system
8. coal processing system
9. infrastructure
10. total interest during construction
11. yearly cost (100 million yen)
12. interest, amortization
13. manpower cost, repair cost
14. fuel cost
15. product cost
16. income from byproducts (100 million yen)
17. cost of main product (100 million yen)
18. quantity of main product (per year)
19. 2.19 billion $Nm^3$
20. 1.14 million tons
21. 2 billion $Nm^3$
22. 890,000 tons
23. 1.64 million tons
24. cost of main product (yen/$10^4$ kcal)
25. same as above (with interest rate of 4 percent)
26. (Note) 1. land cost not included in construction costs, and unit is 100 million yen per 1,000 MWt
27. 2. main product cost is based on averaged interest case

Table 8. Development Schedule for
Multiple Purpose High Temperature Gas Cooled Reactor




Key:

1. JFY
2. Showa year
3. Western Calendar year
4. item
5. design of experimental reactor
6. construction of experimental reactor
7. design research
8. detailed design
9. safety survey
10. construction
11. rise in output
12. operation
13. fuel research
14. graphitic material research
15. heat resistant metals research
16. research related to high temperature structural materials
17. research on reactor physics, reactor engineering
18. experimental loop for demonstration test of large structural equipment
19. fuel properties, etc.
20. various tests
21. mass production technology
22. modification research, etc.
23. irradiation behavior
24. various tests such as corrosion
25. major test with actual material
26. mass production technology, etc.
27. various tests such as strength, irradiation behavior
28. material soundness test, etc.
29. development and test fabrication, demonstration of soundness, and improvement tests on various components
30. nuclear calculation, heat transfer flow, measurement control, etc.
31. critical experiment
32. design, construction
33. demonstration test, operation



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SCIENCE AND TECHNOLOGY

## ALTERNATIVE ENERGY SOURCE STRATEGIES, POLICIES OUTLINED

### Wind Power Utilization Projects

Tokyo NIHON KOGYO SHIMBUN in Japanese 20 Dec 80 p 4

[Text] The report "Wind Topia Project" of the Science and Technology Agency, a result of 2 years of research conducted by the agency with the participation of five small wind generator makers, has been released recently. However, the "feasibility" evaluation of wind power generation has turned out as a considerable blow to the related enterprises.

Reflecting this result, in conjunction with the sluggish sales of generators, each enterprise is attempting to shift from a policy exclusively for power generation to a policy for technology and development of diversified wind energy utilization.

In concurrence with this movement, power generation itself is about to enter into an era for large units, and the talk of incorporating into national Sunshine Programs the 100 KW class large generator project which was once planned for construction by Tokyo Electric Power Company on Miyake Island, one of the seven islands of the Izu Island Group was substantially concluded. All these indicate the coming of a great turning point in wind energy utilization.

"The Wind Topia Project" (formally termed Investigation of Technology for Effective Utilization of Wind Energy), which has been implemented by the Science and Technology Agency as a 2 year project starting from fiscal 1978, was then considered a promising springboard for the propagation of wind power generators, one of the "future technologies."

For this project, eight 1-2 KW class small wind power generators (among which one generator did not produce electricity but directly used the turning effort for pumping up water) were presented by five companies--Matsushita Seiko, Fuji Electric, Yuasa Battery, Bosei Kigyo, and Hinomaru Puro--and tested for use in cooling and heating of greenhouses, charging golf carts and electric vehicles, warming piscicultural water tanks and lighting insect luring lamps.

However, according to the released investigation results, "the average generation efficiency of the seven windmills, an indicator of the extent to which the wind energy can be converted to electric energy, was only 10.5 percent. Generally speaking, it is considered that this wind power generation efficiency can be



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raised to the 35 percent level, which means there is a possibility for further improvement. It is desirable to upgrade the efficiency by converting the wind energy directly into heat and so forth in the future."

To be more exact, it may be concluded: "Wind power generators tested at this time for the Wind Topia Project were useless," and the announcement sent devastating shock waves not only through the participating companies, but also through the related industries.

This caused the utterance of complaints: "The report on Wind Topia is too cruel. How dare they condemn wind power generation when they installed the generators without thoroughly investigating wind conditions. Makers who presented generators for the test at below-cost are enraged. If they knew how to use the generator properly, the efficiency would have been better." However, it is a fact that the report made at this time worsened the sales slump.

Other existing projects comparable to Wind Topia are "Windmill Utilization System for Communication Power Sources" of Nippon Telegraph and Telephone Public Corporation, and "Wind Power Utilization Related to Green Energy Project" of the Ministry of Agriculture, Forestry and Fisheries. Interim reports of these projects were also presented at the "Wind Energy Utilization Symposium" (principal sponsors: Japan Wind Power Energy Association and Japan Foundation for Promotion of Science and Technology) held in Tokyo in the middle of November.

Among these, the project of NTT started from fiscal 1977, to test operate propeller type (made by Matsushita Seiko, output: 2 KW) and Darius type (made by Nippon Electric Industry, output: 3 KW) generators. Incidentally, states NTT: "Extremely high reliability is required for communication power sources, and we are hoping to work for an early establishment of an appropriate technology for communication power supply system."

Another current topic is the news that the Japan Housing Corporation has consolidated its policy to practicalize wind power generation as an army of energy conservation measures. This project aims to provide power for street lights and the like by installing small windmills on the top of medium and high rise buildings for public housing.

According to the General Experiment Station of NHC, they say, "Presently, we are in the stage of investigating the basic performance of a windmill. However, this type of windmill is useful even for relieving wind damages associated with building of higher and taller windmills. Eventually, numerous small wind power generators will be arrayed for supplying power. The depreciation period is also the problem."

Related to the field of large size generators, the Sunshine Project of the Agency of Industrial Science and Technology also commenced feasibility investigation starting from fiscal 1976 and reported the following wind condition investigation results: "Preconditioning a yearly average of over 4m (per second) wind velocity, the estimated number of installable 1,000 KW class windmills will be about 5,000 units."

Based upon this conclusion, the agency aims to manufacture and construct a 100 KW class semipilot plant in fiscal 1981 and 1982, and subsequently to construct a 1,000 KW class pilot plant through fiscal 1984-85, and a 10,000 KW class demonstration plant through fiscal 1987-89.

In comparison, in the private sector, Tokyo Electric Power Company, with the cooperation of Ishikawajima-Harima Heavy Industries, has pressed forward a plan to construct 100 KW wind power generators for 2 years. Though TEPC has its mind set on starting the operation on Miyake Island from the autumn of 1981, the company reached a basic agreement recently with the Sunshine Project Promotion Center, which requested, "Why don't you place your project with the Sunshine Project, and let us work together for development under the leadership of the government."

If a formal contract is drawn, a 100 KW class generator will be operated about half a year later than the original TEPC project, based upon the "Large Size Wind Power Generation System Development Expense Aid" (approximately 500 million yen requested from both fiscal 1981 and 1982) of the New Energy Development Organization.

In the field of diversified utilization of wind energy, "Specified Combined Research for Wind Power-Thermal Energy Utilization Technology" is set up by Special Research Facilitation Expenses of the Science and Technology Agency.

This program started from fiscal 1980, and will be carried out with a budget of approximately 800 million yen for 5 years; it aims to develop a new technology which converts mechanical energy derived from windmills directly into thermal energy, subsequently to store this energy in the form of hydrogen by using the characteristics of metals that store hydrogen. The system concept is as shown in the chart, and is comprised of the following primary contents: (1) Development of durable and efficient 20 KW class windmills, (2) Development of exothermic devices for converting wind energy to thermal energy, (3) Development of inexpensive efficient hydrogen storage metal materials for storing thermal energy safely, and (4) Development of an integrated system. Currently, the following groups participate in the research effort: National Aeronautical Laboratory of STA, National Research Institute for Metals, Yokohama National University, Tokai University and Kawasaki Heavy Industries.

Meanwhile, the indisputable champions of the private sector are Japan Wind Power Generator and Hinomaru Puro, which, although operated on a smaller business scale, have sold original generators. First of all, the JWPG has sold 20 50 watt to 6 KW generators effective even under mild wind since the company started in May 1979 to present, and now JWPG has just developed a system to light neon tubes by inventing a method for generating high voltage when the turning effort of a windmill applies pressure on piezoelectric elements by means of the principle of an electronic lighter. Says President Osamu Tate, "We have succeeded in an experiment to light a 100 meter neon tube by using 100 piezoelectric elements under a wind velocity of 4 meters. This is good enough to be fully competitive against commercial power sources. We intend to start selling it before the end of January."

Also, Hinomaru Puro, the company which has sold close to 10,000 small generators named "Yamada Windmills," has developed a new field of products, "Wind Power Heat Generators," and plans to start selling them from around next summer. This device warms water by agitating it with the turning effort of the windmill. The company has already successfully made a test model which obtains 200 kc using a 2 hp windmill. "In case of a set with one 15 meter roter, it is possible to obtain a 20,000 kc/h heat generation. The conversion efficiency to heat of this device amounts to 95 percent. In the first marketing year, we expect to receive orders for 100 units to be used for vinyl greenhouse cultivation," said President Motohiro Yamada.

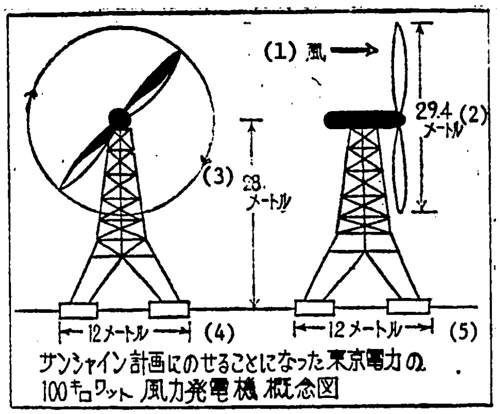


Chart 1. Concept of 100 KW Wind Power Generator Incorporated in Sunshine Project

Key:

1. Wind
2. 29.4 meter
3. 28 meter
4. 12 meter
5. 12 meter

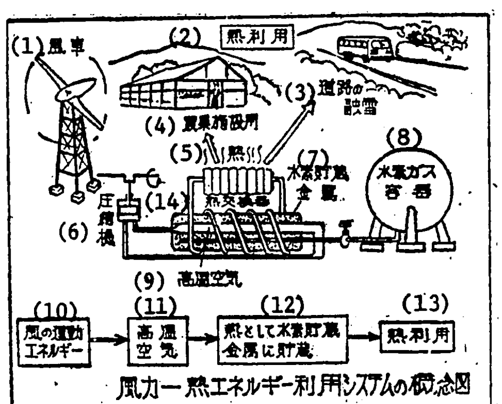


Chart 2. Concept of Wind Power-Thermal Energy Utilization System

[Key on following page]

Key:

1. Windmill
2. Using of heat
3. Melting of snow on streets
4. Use for agricultural facilities
5. Heat
6. Compressor
7. Hydrogen storage metals
8. Hydrogen gas container
9. Hot air
10. Wind kinetic energy
11. Hot air
12. Storing of wind energy in hydrogen storage metals as heat
13. Using of heat
14. Heat exchanger



## Practical Applications of Battery

Tokyo NIHON KOGYO SHIMBUN in Japanese 13 Dec 80 p 2

[Text] According to "targets for supplying oil substitution energy" concluded earlier by the government, the natural gas supply, which claims currently only 4.7 percent (19.4 million kl in terms of oil) of the total, is projected to be increased to 10.2 percent (71.1 million kl) 10 years later, in 1990. The natural gas supply is expected to expand markedly with coal and atomic power. In this case, naturally, requests for development of technology for effective utilization of natural gas are expected to become louder, and the fuel battery is envisioned to be the one which seems to serve as a dominant system in demand. Although new thermal power plants have reached a 40 percent power generation efficiency, the first generation fuel batteries boast an efficiency of 45 percent, and the power generation efficiency will jump to the percent level of the 70's if the heat by-product yielded during operation is also put into use.

Some say that we will see in the future the coming of factory compounds and leisure lands powered by fuels of natural gas supplied by gas companies. This vision is very likely to be substantiated when the characteristics of fuel batteries are considered. Forecasting the arrival of such an era, Tokyo Gas and Osaka Gas Companies keep on field testing American made batteries which are the only manufactured products available. The companies plan to research "methods for utilization" of fuel batteries even after the completion of the PC-18 field test, and it may be highly likely for them to switch over to homemade batteries in the future.

On the other hand, American technology is also encompassed in the fuel battery power plant on the grounds of the Goi Thermal Power Station which has been under construction (approximately 5 billion yen invested) since August by Tokyo Electric Power Company. This is a GRI model, a product developed jointly with UTC, the primary developer of PC-18.

The PC-18 test model was developed 5 years ago by UTC, and the batteries in the Goi plant are remodeled PC-18 test models. Taking the form of cooperating with the UTC, Tokyo Electric Power Company raised the power generation efficiency up to 37 percent by remodeling the original from the aspects of producing a highly efficient electrode structure, simplifying the structure and mass-production. This unit may be called an original model of the PC-18 which is scheduled for field tests 2 years later by Tokyo Gas Company. A rated output of 4,800 KW will be produced by using 20 batteries, which generate 250 KW each. The purpose of TEPC is slightly different from that of the gas companies, and long term research will be conducted to find out the rate of operation, reliability (including durability) and economical efficiency of the fuel batteries as a device for producing electricity. The research is projected to be completed in January 1982, and the demonstration test will be continued until the end of fiscal 1983. However, with the performance check of the battery proper being the primary apparent purpose of the research, utilization of waste heat that is exhausted at 140-150°C is not the concern of the study in the present stage.

Incidentally, GRI's target price for development is 500 dollars per kilowatt (approximately 120,000 yen), whereas the same figure of TEPC's system amounts to approximately 1 million yen.

What about the movement of the national technology in comparison to the movement of fuel batteries associated with GRI as revealed above?

Fuji Electric Company is currently conducting joint research with Kansai Electric Power Company to develop a medium scale (30-40 KW) model, and Hitachi, Ltd has also joined hands with the Chubu Electric Power Company to develop a 500 watt system.

Additionally, Toshiba Corporation and Mitsui Toatsu Chemical are participating in work for developing a plant with a rated output of 4,800 KW now under construction at Goi Station by TEPC. All other three companies but Mitsubishi Electric Company have successfully sought a closer relationship with electric companies. Furthermore, disregarding the unique case of Toshiba, all other companies seem to proceed with their original technology and development in line with their independent development policy.

Moreover, it is the moonlight project (currently asking for an appropriation) to be started from fiscal 1981 that aims to combine these independent policies and to outsail the United States.

This project puts up as targets the development and practicalization of a first generation phosphoric acid model, a second generation molten carbonate model, and a third generation solid electrolyte model all together. Looking at the first generation model which is expected to be practicalized as of now, the completion is projected to be fiscal 1985, and the demonstration test is scheduled for 1986.

The target scale is the same as the American pilot plant, which means that a 1,000 KW model will be built from the beginning without bothering with smaller ones. STA plans to reach the American level by 1985. It is interesting to watch whether or not the project will progress as envisioned.

According to the plan, this battery generates electricity using partially hydrocarbonaceous hydrogen fuels derived from purifying coal gas fuels and LNG in a reformer.

Specifically, LNG and others are hydrogenated in a reformer to produce a fuel with a large hydrogen content, and this fuel is subsequently supplied to hydrogen electrodes to remove electrons. Hydrogen ions are then transferred into a phosphoric acid solution (electrolyte) and allowed to react with oxygen at approximately 150°C to produce water. This water changes to steam, recirculates into the reformer and serves as steam for the hydrogenation reaction. The system also retrieves and utilizes waste heat. It is estimated that the power generation efficiency of the battery will be 40-45 percent, and possibly little less than 70 percent if waste heat utilization is accounted for. Once this project sets forth, two companies, Hitachi, Limited and Fuji Electric Company, are likely to join the band as battery makers.

To sum up, domestic technology is on the brink of originally starting to make some positive moves on a full scale. In the case of the fuel batteries, large scales as seen in general power plants are not conceivable, and the practical scale is said to be about 30,000 KW at largest. Adding very encouraging merits such as high efficiency, free of pollution and saving of space to the above factor, it is hoped that we can make use of them by installing them in nearby collective houses and factory compounds unlike general power plants built in distant mountains and dependent on long distance power transmission.

In other words, in the future energy shortage, collective apartment houses equipped with a power generation plant are likely to make their appearance, and this technology is expected to accommodate such a need even in quantity.



## Ligneous Biomass Conversion Project

Tokyo NIHON KOGYO SHIMBUN in Japanese 15 Dec 80 p 15

[Text] The Science and Technology Agency will commence a 6-year plan starting from fiscal 1981 for research and development of a ligneous biomass conversion process. This program will be implemented as a part of "Specified Combined Research for Biomass (various organic resources) Energy Utilization" to be initiated in the next fiscal year by the agency as one of the themes for Specified Combined Research, and its objective is the establishment of a process for alcoholization of ligneous resources.

Ligneous resources such as wood materials and residual waste woods were used in the past as firewood and charcoal which composed a major part of fuels in Japan. However, today the percentage of firewood and charcoal in the total fuel energy is reduced to a meager 0.1 percent (1977).

According to the Forestry Agency's data, the potential energy of annual net production (gross growth) of Japan's forests is the largest source of the biomass resource, reaching 140 million kl in terms of oil, but a considerable part of it is being wasted and thrown away. With this in mind, a movement has emerged recently advocating utilization of ligneous resources as fuels by converting them to ethanol, in short, by a process in which cellulose content is saccharified with enzymes and fermented to obtain ethanol.

However, the first step, the saccharification technology, has not yet been established due to the extremely hard to decompose lignin which has a three dimensional diversified mesh structure, composes about 25 percent of wood materials and indicates an adhesive property. The research to be commenced starting from next fiscal year by the Science and Technology Agency was motivated by the recent discovery by the Institute of Physical and Chemical Research of high alkaline bacteria which produced methane gas, ethane gas and various organic acids when the lignin content was decomposed. The agency intends to expand the IPCR's achievement and to make the saccharification technology complete by developing a technology for the simultaneous evolution of cellulose saccharification and lignin decomposition.

The IPCR's research is still in the elementary stage, but it is feasible to perform cellulose saccharification and lignin decomposition in the same reaction tank. The STA is planning to develop a new semi-continuous saccharification process.

Generally, a continuous type is considered advantageous for a cellulose saccharification and fermentation process. The STA, however, thinks a semi-continuous type, the process wherein chips of raw wood material are continuously fed into the reaction tank and the reaction products are intermittently taken out, more meritorious from various aspects.

According to the plan, the reaction process will be completed within 3 years to fiscal 1983, a pilot plant will be manufactured, operated and analyzed over the 3 years starting from fiscal 1984, and a utility model will be ready, hopefully, for fiscal 1986 and after.



## Coal Liquefaction Technology Race

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 15 Dec 80 p 1

[Text] While oil consumption reduction has become an international mandate, the hope for liquefaction of coal is soaring. The two current major alternatives for transition from oil are burning of raw coal and nuclear power. However, by the 1990's, coal liquefaction is likely, under the circumstances, to be called on to serve as one of the alternative energy supplies. IEA (International Energy Agency) place coal liquefaction in the top of the priority order for new energy technology and development. Meanwhile, the U.S. formulated a plan to produce large amounts of synfuels, 2 million barrels a day, by 1992, concentrating on liquefaction. Also in Japan, acceleration of the Sunshine Project is determined, and an ambitious goal to produce 22.6 million kl (slightly above 3 percent of the primary energy supply in Japan) of liquefied oil in fiscal 1990 was set up. Japanese business groups concerned with coal liquefaction technology and development also have graduated from being conventional research groups serving as subcontractors for the government, and have emerged as business groups aiming at the future, commercialization in mind. The coal liquefaction race among business groups is getting intensively heated.

Although the general meeting of OPEC to be held from the 5th on Bali is expected to be controversial due to the effect of the Iran-Iraq War, that does not alter the fact that OPEC's final goal for raising the price of crude oil will settle as the price standard of the alternative energy. Furthermore, they will adjust the level at the price of synfuels such as coal-liquefied oil which can directly substitute for crude oil instead of coal and nuclear power. Petroleum consuming nations are pressed for practicalization of coal liquefaction even for the purpose of applying a brake on the escalating crude oil price.

Synfuels can also be manufactured from tar sands, but coal liquefaction particularly draws interest because of the enormous coal reserves. At the present time, the economically extractable coal reserve alone is estimated to be 660 billion tons, approximately 5 times more than the crude oil reserves.

However, mere burning of raw coal has a limit as a fuel that substitutes for oil, because "the energy supply system is fluidized. Taking the example of railroads, we cannot now revive the ancient steam engines" (technology examiner Masami Yamanaka of the Agency of Industrial Science and Technology). If we are to bring about a full-scale restoration of coal, we have no choice but to direct our effort towards raw coal burning ⟶ COM (coal oil mixture) ⟶ coal liquefaction.

Coal resources in Japan are scarce. Successful coal liquefaction, if achieved, will not be directly useful for improving the energy self-supply ratio as in the U.S. and West Germany. Without contributing to technology, however, it is difficult to secure energy resources from abroad. This sense of crisis is spurring the coal liquefaction efforts.

Around the time when the Sunshine Project just started in 1974, the government itself held an obscure vision of coal liquefaction as "one of the 21st century's clean energy sources." Now that the transition from oil is an urgent issue, there is no other way but to incorporate it in the energy strategy. The "Alternative Energy Supply Target" embodied by government in November of the current year sets the amount of coal liquefaction in fiscal 1990 to be 22.6 million kl, which corrects upward the 15 million kl projection agreed upon 1 year ago by the "Strategy for Acceleration and Promotion of the Sunshine Project" of the Council for Industry and Technology. This volume is comparable to the current imports of crude oil voluntarily developed by Japan. The New Energy Development Organization has also been instituted as an agency to whip up technological development by the private sector.

Business groups which have managed to keep coal liquefaction research going under meager funding are starting to incorporate coal liquefaction, formerly branded as "hobby," in a branch of operational strategy.

In January, the Mitsui group founded Mitsui Coal Liquefaction (main office: Tokyo, president: Shingo Ariyoshi, capital: 500 million yen), and made the first move in organizing a structure for commercialization. Then, the KOMINIC group which is represented by Kobe Steel, Ltd and others followed suit and established Japan Brown Coal Liquefaction (main office: Tokyo, president: Kokichi Takahashi, capital: 500 million yen).

Japan Brown Liquefaction, dubbed "Japan-Australia joint national project" by the government, will begin to prepare for the construction of a pilot plant with a coal treating capacity of 50 t/day in early next spring, to experiment with brown coal from Victoria, Australia. Mitsui Coal Liquefaction, meanwhile, developed the Mitsui SRC (solvent-refined coal) method which obtains refined coal and oil fractions practically half and half, and is independently investigating the construction of a 6,000 t/day Victoria brown coal liquefaction plant.

The three Sunshine Program Projects--solvolysis method (Mitsui group), solvent extraction method (Sumitomo group) and direct hydrogenation method (Mitsui Shipbuilding and Engineering Co, etc)--are also in the process of strengthening their structures. The Mitsubishi group instituted an operation committee composed of executive director class members on the motion by the four related companies lead by Mitsubishi Heavy Industries, and brought the organization ready for the construction of a 40 t/day plant to be built next. The Sumitomo group, which is currently constructing a 1 ton plant, is still cautious about commercialization, but says, "In the future, we may incorporate Sumitomo Coal Liquefaction" (Toshio Ikejima, vice president of Sumitomo Metal Industries). The direct hydrogenation method has been researched by Mitsui Shipbuilding and Engineering Co and the Hokkaido Government Industrial Development Institute, but now the workable line-up for facilitation of commercialization is completed after three new companies, Nippon Kokan Kabushiki Kaisha, Hitachi, Ltd and Asahi Chemical Industry, joined the research.

Parallel to domestic technology and development, international joint technological developments are also in progress. Japan Coal Liquefaction Technology and Development (main office: Tokyo, president: Shosuke Idemitsu, capital: 27.3 million yen), established by 12 companies headed by Idemitsu Kokan, has participated in the EDS project led by Exxon since 1978. The SRC II project led by Gulf has a budget of over 1.4 billion dollars, and will be promoted by the cooperation of three nations--the United States, Japan and West Germany. In Japan, a new company which concentrates on Mitsui Coal Liquefaction will be set up at the earliest convenience in the next year.

The United States, the first challenger to produce a large size plant, successfully diversified risk-bearing by solicitating Japan and West Germany for participation. On the other side of the coin, Japan, where the largest plant currently existing is only a 5 t/day scale plant of Mitsui Coal Liquefaction, is anxious to learn the techniques for upgrading the scale from the two large advanced American projects.

As discussed above, coal liquefaction is internationally flourishing, but not yet feasible for practicalization. Economical efficiency is vulnerable more than anything else. The basic principle of coal liquefaction, that the molecular weight is reduced in conjunction with the addition of hydrogen, has not changed for the last 50 years. Already, during World War II, Germany liquefied sizable amounts of coal, and Japan also practiced it in Haohgi, Korea and Manchuria (northeast region of present People's Republic of China). However, those operations were carried out during the war, giving no head to cost accounting. It is not so easy for an artificial oil processed through many extra steps to compete with crude oil.

With last year's soaring crude oil prices, coal at one time became very inexpensive compared to oil. However, this phenomenon was adversely affected by the popular fuel switch over from oil to coal. Now, the price of general coal is sky high,

JAPAN'S OIL LIQUEFACTION PROJECTS

| Liquefaction Group | Liquefaction Method and Characteristics | Participating Corporation and Institution | Past and Present | Future |
|---|---|---|---|---|
| Mitsui Coal Liquefaction (Mitsui Group) | Mitsui SRC (Solvent-Refined Coal Method)<br>Coal solvent<br>high temperature, medium pressure | Mitsui Mining Co<br>Mitsui Coke Industry<br>Mitsui and Co<br>Toyo Engineering<br>Yamatake-Honeywell<br>The Japan Steel Works<br>Ishikawajima-Harima Heavy Industries<br>Mitsui Shipbuilding and Engineering Co<br>Mitsui Construction Co<br>Mitsui Miike Machinery Co | '72 Mitsui SRC Cooperation elected.<br>'74 Principle Contract for Joint Development between American Gulf Oil and SRC.<br>'77 A 5 t/day SRC plant built in Ohmuta.<br>'80 Mitsui Coal Liquefaction established. Plant operation tested using Victoria brown coal from Australia. | '81 Participate in SRC II project jointly, pursued by Japan, U.S. and West Germany.<br>'83 Construction of a 6,000 t/day commercial plant to be started in Australia.<br>'86 Operation of commercial plants to be started. |
| [SUNSHINE PROGRAM PROJECT] | | | | |
| Japan Brown Coal Liquefaction<br>(KOMINIC group) | NBCL Method (Solvent Extraction Liquefaction Method)<br>high temperature, medium pressure | Kobe Steel, Ltd<br>Mitsubishi Chemical Industries<br>Nissho-Iwai Company Limited<br>(Above are three original KOMINIC companies)<br>Idemitsu Kosan Co<br>Asia Oil Co | '72 Basic research started.<br>'75 A 0.5 t/day experimental plant built.<br>'80 Japan Brown Coal Liquefaction established. Agreed upon making the Australian Victoria Brown Coal Liquefaction as a Japan-Australia Joint National Project. Supply of brown coal from Victoria guaranteed. | '81 Preparation for building a 50 t/day pilot plant.<br>'82 A 50 t/day plant to be built in Australia.<br>'83 Operational tests of the 50 t/day plant.<br>'85 A 5,000 t/day demonstration plant to be built. |
| Sumitomo Group | Solvent Extraction Liquefaction Method<br>Coal solvent<br>high temperature, medium pressure | Sumitomo Metal Industries<br>Sumitomo Coal Mining Co<br>Sumitomo Chemical Co<br>Sumitomo Chemical Engineering<br>Kureha Chemical Industry Co<br>Sumitomo Corporation<br>National Research Institute for Pollution and Resources | '76 A 3 t/day experimental plant built for production of caking agent.<br>'78 A 1 t/day liquefaction plant partially built. | '81 A 1 t/day experimental plant to be completed.<br>'82-3 A 1 ton plant to be operated; subsequently, a 250 t/day plant to be designed. |
| Direct Hydrogenation Group | Direct Hydrogenation Liquefaction Method<br>high temperature, high pressure | Mitsubishi Shipbuilding and Engineering Co<br>Nippon Kokan Kabushiki Kaisha<br>Hitachi, Ltd<br>Asahi Chemical Industry<br>Hokkaido Government Industrial Development Institute<br>Yamagata University | '78 A 0.1 t/day continuous testing device built.<br>'80 Nippon Kokan, Hitachi and Asahi Chemical Industry joined the group. | '81 A 2.4 t/day experimental plant to be built.<br>'83 A 250 t/day pilot plant to be designed.<br>'85 A 250 t/day plant to be completed. |

[Table continued on following page]

| Liquefaction Group | Liquefaction Method and Characteristics | Participating Corporation and Institution | Past and Present | Future |
|---|---|---|---|---|
| Mitsubishi Group | Solvolysis Method Using Asphalt, high temperature, normal pressure | Mitsubishi Heavy Industries<br>Mitsubishi Mining Co<br>Mitsubishi Cement Co<br>Mitsubishi Oil Co<br>Mitsubishi Corporation<br>Mitsubishi Chemical Industries<br>Electric Power Development Co<br>Chubu Electric Power Co | '79 A 1 t/day experimental plant built. | '81 A 40 t/day pilot plant to be designed. |
| [INTERNATIONAL COOPERATION PROJECTS] | | | | |
| Japan Coal Liquefaction Technology Development | EDS Method (Solvent Extraction Liquefaction Method)<br>Coal solvent<br>high temperature, medium pressure | Idemitsu Kosan Co<br>Esso Standard Oil Co<br>Toa Nebryo Kogyo Co<br>Mitsubishi Corporation<br>General Oil Company<br>Mitsui and Co<br>Kawasaki Heavy Industries<br>Tokyo Electric Power Co<br>Kansai Electric Power Co<br>Chubu Electric Power Co | '76 Japanese participation in EDS project requested by Exxon.<br>'78 Japan Coal Liquefaction Technology and Development established, joined to work for EDS project. Construction of a 250 t/day pilot plant began.<br>'80 The above plant completed. | '81-82 A 250 ton plant to be operated.<br>'83 A 10,000 ton/day demonstration plant to be designed.<br>'84 The 10,000 ton plant construction to be started. |
| New Company for SRC II (not named yet) | SRC II Method (Solvent Extraction Liquefaction Method)<br>Coal solvent<br>high temperature, medium pressure | Mitsui Coal Liquefaction<br>Nippon Steel Corporation<br>Nippon Mining Company<br>Maruzen Oil Company<br>Daikyo Oil Company<br>(Above 5 major companies and pending participation of some 20 other companies) | '78 Japanese participation in SRC II project requested by President Carter at Japan-U.S. Summit Conference.<br>'80 An agreement for proceeding in SRC II project jointly by U.S., Japan and West Germany signed. | '81 A new company to represent Japan to be established.<br>'81 Construction of a 6,000 t/day demonstration plant to be started.<br>'85 The 6,000 ton plant to be operated. |



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and the difference between the price of coal and the price of oil is narrowing. If the coal price rises in a linked fashion with the oil price, the coal liquefaction business can never be profitable. If OPEC wants to impede the progress of the coal liquefaction venture, it can pull the trick whenever desired by "temporarily reducing the crude oil price."

According to the energy supply outlook compiled recently by Japan Research Institute for Energy and Economy (director, Toyoaki Ikuta), the 1990 projection for oil from liquefied coal in Japan will be only 350,000 kl, which is sharply different from the 22.6 million kl projected by the government. Taking into consideration the risks involved in coal liquefaction ventures, the projection by JRIEE may be at this point of time closer to the actual energy predicament. To what extent it will more closely approach the projection by the government depends upon the efforts to be exerted in the days to come. We have no choice but to hope that the five powerful coal liquefaction groups will engage in heated competition in trying to be the first to put the project into practical use.



## Advanced Technology Flexibility Needed

Tokyo DENKI SHIMBUN in Japanese 17 Dec 80 p 3

[Text] The Japan Research Institute for Energy and Economy held the 13th Energy and Economy Symposium on both the 4th and the 5th. The theme this time was "Oil Crisis--Can Japan Achieve Oil Independence." The panel discussion, which may be called the highlight of the symposium, appointed Toyoaki Ikuta, the director of JRIEE, to act as the host, and invited the following five experts to take part in the discussion: Professor Shinkichi Eto, the Liberal Arts Faculty, University of Tokyo; Akihiro Kasai, director of Policy Sciences Research Institute; Shigeru Kimura, chief researcher of Asahi Shimbunsha Research Institute; Katsu Yoshitomi, general chief research officer of the Economic Planning Agency; and Masao Sakisaka, president of JRIEE. There, opinions regarding the following subjects were pronounced--Trend of International Politics in Connection with Energy, State of the Middle East and Japan's Position, Oil Crisis and Japan's Economy, and the Proper Setting for Talks between Oil-Producing and Oil-Consuming Countries.

The 13th Energy and Economy symposium gave reports on five subjects: (1) Japan's medium and long term economic growth and energy supply and demand, (2) Energy saving and culture, (3) OPEC's long term strategy and energy policy trends in oil consuming countries, (4) The extent of achievable transition from oil--focusing on power generation sector, and (5) Direction of Japan's petroleum industries in the decade starting from 1985.

The panel discussion began after these series of reports were made. In the discussion, Eto stated that the core of Japan's energy strategy should be "the diversification of supply to cope with the unpredictable turns of events. Also, we should cultivate technological competence to counter the energy drought." Followed Kasai, "Japan's only bargaining power is technology. We must decisively invest money and human resources, get good results and come out ahead of the game." Kimura also pointed out: "Technological competence is essential."

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## Advanced Technology Flexibility Needed

Tokyo DENKI SHIMBUN in Japanese 17 Dec 80 p 3

[Text] The Japan Research Institute for Energy and Economy held the 13th Energy and Economy Symposium on both the 4th and the 5th. The theme this time was "Oil Crisis--Can Japan Achieve Oil Independence." The panel discussion, which may be called the highlight of the symposium, appointed Toyoaki Ikuta, the director of JRIEE, to act as the host, and invited the following five experts to take part in the discussion: Professor Shinkichi Eto, the Liberal Arts Faculty, University of Tokyo; Akihiro Kasai, director of Policy Sciences Research Institute; Shigeru Kimura, chief researcher of Asahi Shimbunsha Research Institute; Katsu Yoshitomi, general chief research officer of the Economic Planning Agency; and Masao Sakisaka, president of JRIEE. There, opinions regarding the following subjects were pronounced--Trend of International Politics in Connection with Energy, State of the Middle East and Japan's Position, Oil Crisis and Japan's Economy, and the Proper Setting for Talks between Oil-Producing and Oil-Consuming Countries.

The 13th Energy and Economy symposium gave reports on five subjects: (1) Japan's medium and long term economic growth and energy supply and demand, (2) Energy saving and culture, (3) OPEC's long term strategy and energy policy trends in oil consuming countries, (4) The extent of achievable transition from oil--focusing on power generation sector, and (5) Direction of Japan's petroleum industries in the decade starting from 1985.

The panel discussion began after these series of reports were made. In the discussion, Eto stated that the core of Japan's energy strategy should be "the diversification of supply to cope with the unpredictable turns of events. Also, we should cultivate technological competence to counter the energy drought." Followed Kasai, "Japan's only bargaining power is technology. We must decisively invest money and human resources, get good results and come out ahead of the game." Kimura also pointed out: "Technological competence is essential."

Sakisaka also stressed the importance of technological competence, although in different words: "It is necessary to have flexible adaptability to cope with changes. We must build a society flexible with energy."

Summing up the discussion, the host, Ikuta, concluded: "I believe Japan can live through the energy crisis. However, there is not much left for selection, and we must be flexible. There have been many taboos regarding energy problems in the past, but we must remove them and be more objective. For instance, it was a taboo to reduce the consumption of petroleum products, but now nobody has objections. Oil companies have changed the statute so that they can handle something other than products manufactured from petroleum.

Also, coal thermal power generation was a taboo, but now it is in the mainstream. According to the scenario shown by JRIEE, we can manage ourselves with 5 million barrels/day of oil imports if the economic growth is 4 percent. However, we are not yet ready to meet an oil crisis which may erupt in the future."

The following is a summary of the opinions expressed by the participants during the panel discussion.

[Ikuta]: "The present panel discussion was titled "Oil Crisis and Japan," simply because our security and prosperity rely greatly upon how to recognize oil crises. Specifically, there emerged several crises, but the whole thing did not start from 1973. Since World War II, the international oil supply-demand structure has been fluctuating considerably, and the structural changes have been manifested as a phenomenon of the oil crisis. The purpose of our discussion is to determine how Japan can cope with these developments.

Reports by this research institute indicated the scenario, but the propriety and the rationality of the scenario must be evaluated. Parallel to this, the big question is whether Japan or oil consuming nations can live through the crises, or what strategy we should use to cope with the crises.

In the case of France, the oil ratio is expected to drop to 30 percent in 1990, but this is a strategy. In the United States, an emergency plan for the time when oil resources will be depleted is being contemplated on a large scale by the leadership of the Department of Energy. Now, I would like to hear the experts' views on the issues peripheral to the energy problems."

[Eto]: "I would like to discuss primarily the optional international political patterns that affect the artificial modification of oil supply and demand. In the 1970's, both the United States and USSR tried to work for detente, but differed in opinion on principles, and the relationship between the two nations has soured. The United States seriously hoped for detente, but the USSR thought it workable only after an agreement was reached, and continued struggling in other fields. Their struggle took the form of interventions in Angola, Ethiopia, South Yemen, Afghanistan, etc, which they obviously interpreted as not contrary to detente.

Under the circumstances, there is no chance that the two superpowers will cooperate in oppressing medium and small nations. Hence, there are three predictable patterns for the future international relations to be shaped.

The first pattern displays Soviet supremacy and the development of a Soviet type world. This is not preferable, and hardly likely to come true.

The second pattern displays the resurgence of a strong United States, and the world in an American style structure. This is better than the former, but unlikely to take shape.

The third pattern is of an intermediate type. It is highly predictable that the multipolarization of the world will continue led by the five countries--the USSR, EC, China, Japan and the United States.

The situation of the USSR-U.S. conflict turned worse in the 1970's and Japan and EC, meanwhile, gained a greater voice. The overall picture indicates an increase of mutually dependent relations. An all-out showdown between the United States and the USSR will never occur, but local battles will occur.

Therefore, Japan should make an effort to improvise a policy which can contain conflicts in a small capsule under the American system in order to shape the world into a place where the market mechanism is workable.

Additionally, referring to the international flow of oil, major oil companies single-handedly controlled the supply and demand in the past. OPEC was organized; it weakened the major oil companies and relaxed the control over supply and demand. Now, we are in the process of setting up a consumers' cartel, and it is the policy of Japan to facilitate it.

Summing up, it is necessary to maintain the American type market mechanism. We must work toward our goal in spite of highly potential unpredictable occurrences."

[Kasai]: "Looking at a long span of 50 years or so, fast breeders, nuclear fusion and new energy will make an appearance as energy sources. For example, oil is now the pro baseball player, but nuclear fusion will be the player in the pro baseball game 50 years later. During the transitional period, light water nuclear reactors, LNG and coal will play their role as high school baseball players. However, the players during the transition must play well to avoid a calamity.

Realistically, nuclear power, coal and LNG are excessively evaluated. These resources require port facilities, environmental measures and a back-up policy for reaching the target values. If these requirements are not properly met, these resources will become unusable.

If use of nuclear power is postponed to 10 years later, it is still necessary to build power stations, and public acceptance is essential for it. Under these conditions, we cannot help but to use oil a little while longer.

Yet, there are very few policy options for ensuring the stable supply of oil. Well, let us look at the Middle East situation. The first Arab summit conference was held in Amman from 25-27 November, but resulted in a serious break-up. The effect of the Iranian revolution and the religious factional strife also caused the break-up, which will inevitably influence the nations along the Gulf. Now, the question is how to handle these situations. But first, we must ponder how Japan can cooperate with these nations to pursue their national projects.

Secondly, we must plan to secure oil by calculating the factor of safety ratio relative to the overall Middle East political conditions. As we know very well that our policy options are quite limited, we owe it to ourselves to gather information, analyze it, calculate the factor of safety and formulate the actual programs in line with the findings."

[Yoshitomi]: "The oil crisis structurally progresses and erupts at times. After the initial oil crisis, Japan's economy indicated an ideal pattern. That is, it controlled inflation, it created a stronger yen and it encouraged the increase of private equipment investment. Then, the second oil crisis developed, and the world economy looked very likely to be slowly impoverished, unlike the situation experienced in association with the initial crisis.

Now, let us look at the world economic factors that allowed us to deal successfully with the initial crisis. There are three.

First, up to 1975-78, the Americans played a role of a locomotive engine, and Japan could increase exports to the United States. In the days to come, we cannot expect to do the same for at least 3-4 years due to the aggravation of inflation in America.

Second, international loans to the medium income developing nations expanded their exports and kept the balance. Using the loans, the developing nations invested domestically, and expanded their export capacity. However, the limit of their ability to repay has become the problem, and they can no longer borrow unless they tighten their economy, which leaves little room for expansion.

Third, the size of the surplus in the current balance of OPEC was 68 billion dollars in 1974, whereas it was reduced by 5-6 billion dollars in 1978, which indicates the slowing of the import tempo in these nations. OPEC nations can no longer serve as a factor for the recovery of the world's economy.

The world's economy has a gloomy outlook. The Iran-Iraq War, if connected with the oil prices, might have invited a third crisis. However, this time, all nations are not engulfed at once, but the nations with severe stagflation (that is, England, France and Italy) are significantly affected.

Even Japan did not prevail by itself, but with the support of the international economy. When the oil supply side makes a large cut in exports, each nation scurries to stock up on oil, and thus the oil demand side tightens the use of oil. This leads to the destruction of the world's economy.

The economic policy we must now take to surmount the crisis is a belt-tightening and endurance race. One of the factors of this contest is how we can swallow the lowering of the real wage. The nations which cannot bear this must fall behind.

Under ordinary conditions, the third crisis is not likely to occur. Precisely, OPEC intentionally avoids cutting of supply and an excessive price hike. The rising of oil prices is expected to be moderate.

Therefore, we must make use of what we have learned in the past, maintain the health of Japan's economy and control the economic condition cool without over-heating. Following this course, Japan's economy will stay comparatively healthier than the world economy, owing to its floating exchange system."

[Kimura]: "Energy is the foundation for daily life, health and welfare. When the supply of oil becomes scarce, our personal effects will become insufficient or the price of these goods will rise. This is why it is necessary to secure the stability of the oil supply. If it becomes difficult to obtain oil, we must cause to materialize something that can substitute for oil.

Currently, solar energy, geothermal energy, wave power and wind power are being developed, and much effort must be thrown into these technologies and developments. However, studying the details of these developments, they are still at the stage of an infant or a child in kindergarten. We must after all depend on nuclear power. Nuclear power is criticized as dangerous, but no one has yet died from radiation, nor has it affected its environment.

Since 1966, when Japan started nuclear power generation, a few people died in the process of building the plant, which, however, has nothing to do with radiation. Compared to other energy, loss by human error is extremely low. Consequently, I think nuclear power as an energy source has entered into a considerably matured stage.

Also, from the standpoint of power generation cost, according to the data from the Ministry of International Trade and Industry, nuclear power costs 7.5 yen/kWh, coal 11 yen, LNG 12.5 yen, oil 15 yen and hydraulic power 15.5 yen. That makes the cost of nuclear power merely half the cost of oil.

Some argue that nuclear power generation is not advantageous, since oil is used to build nuclear power. This argument is misleading. Looking at the ratio of the input and the output, LNG which used energy during the liquefaction process is 1.46 fold, heavy oil 4.9 fold, light water reactor--BWR 15.73,--PWR 16.18 fold. These data alone can prove that nuclear power is beneficial, and suggests that we have no choice but to depend on it.

To give nuclear power a boost, it is very important to know how to win acceptance by the general public. The mass media can play a great role and is responsible for the acceptance of new technology.

Taking a poll, more than 60 percent were in favor. After the TMI nuclear power plant accident, the figure dropped to 50 percent, but it is again climbing. On the other hand, those objecting rose to 26 percent after TMI, but the figure was rolled back to about 23 percent later on. Naturally, people's opinions are tilted in favor of nuclear power."

[Sakasaki]: "I would like to give our attention to what Japan, an oil consuming industrial nation, should do from the international point of view.

First, political stability in the Middle East is essential, and we must cultivate their trust in us.

Second, we must enhance our negotiating power with OPEC. For this, we facilitate the development of oil substitutes in order to curtail oil consumption. In particular, for the advancement of nuclear power, we must appeal to the United States to change its nuclear policy.

Third, there is a question of how to solve the energy problems in developing nations, and from this standpoint, we must promote foreign aid. The special funds of OPEC and the industrial nations' foreign aid must be somehow brought together.

Fourth, oil money may be recycled to expand monetary aid to developing nations.

Fifth, we must produce settings for talks between oil producing nations and oil consuming nations. America shows a conservative attitude, but it is better to create an opportunity for a bilateral conversation with OPEC to blueprint a mutual direction.

Sixth, a workable emergency policy--for instance, international and national accommodation and stockpiling of oil--should be discussed under the leadership of IEA.

So far, I have listed six points. How to deal with these, I believe, is the question that an industrial nation must answer."

Increased Energy Budget Requested

Tokyo NIHON KOGYO SHIMBUN in Japanese 23 Dec 80 p 1

[Text] The Ministry of International Trade and Industry, facing the impending negotiation for resurrecting the 1981 fiscal budget starting from the 23rd, plans to request allocations for the following priority issues, predominantly on energy and smaller businesses, and bring out the final decision through the ministerial level negotiations: (1) To transfer oil tax revenues to an oil and coal special account by 400 billion yen. (2) To secure a 3 percent rate of increase for smaller business related budgets. (3) To create subsidies for power source measures such as a location cooperation subsidy for nuclear power generation facilities. MITI is also hoping to be able to conclude the negotiations on the vice ministerial level for other issues such as Next Generation Industry Basic Technology Research and Development System and YXX (next following civilian transport) Research and Development.

According to the original draft proposed by the Ministry of Finance, all the requests by MITI relating to new policies were revised to zero. MITI is, however, determined to "win the resurrection of all" (high ranking officers in MITI).

It is anticipated that the creation of subsidies for power source measures headed by the Nuclear Power Plant Location Cooperation Subsidy will go up to ministerial level negotiations, following suit to the issues relating to the smaller business budget growth rate and the total transfer level of oil tax revenues to the oil and coal special account. The smaller business related budget revised by the Ministry of Finance shows an extremely stringent figure of 244.4 billion yen, a 0.4 percent increase, compared to the original request of a 9.5 percent increase relative to the previous fiscal year (total for all jurisdictions, MITI, Ministry of Finance and Ministry of Labor). MITI intends to secure at least a 3 percent rate of increase" (an executive in Smaller Enterprise Agency).

Even the transfer value from oil tax revenues to an oil and coal special account did not exceed 312 billion yen in the proposal by the Ministry of Finance, in contrast to the initial request of 490.9 billion yen, a 4.9 percent increase relative to the previous fiscal year.

MITI asserts: "The portion of oil tax revenues retained in the general account has amounted to 400 billion yen" (an executive in the Agency of Natural Resources and Energy), and "We would like to bring it up to the sizable mark of 400 billion yen" (the same). MITI intends to treat it as the top priority issue at ministerial level negotiations.

Among the new policies completely wiped out and revised to zero, the greatest focal point is the creation of the Next Generation Industry Basic Technology Research and Development System. The creation of this system will serve as a key to realize one of the pillars of the next fiscal new policies, "Road to a State Founded on Technology." "If possible, we like to settle this matter through administrative levels up to the vice ministerial level negotiations" (an executive in MITI).

Other issues which will be treated as priority items are YXX Development and Investigation, and the Fifth Generation Computer Research, Development and Investigation.

Concerning the creation of four subsidies for power source measures such as the nuclear plant location cooperation subsidy, a "compromise" has been already indicated in preliminary negotiations: (1) Concentrate four subsidies to two subsidies for cities, towns and villages hosting nuclear power and hydraulic power generation facilities. (2) Shelve the bill for raising power source development and facilitation tax scheduled in December of the following year. It is forecasted that this issue will be settled at the ministerial level negotiation table.



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