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ECONOMIC

AUTOMOBILES--GROPING FOR COEXISTENCE

Tokyo JAPAN QUARTERLY in English Vol 28 No 4, Oct-Dec 81 pp 518-527

[Article by Shimokawa Koichi]

[Text]

Introduction

TAKEN together, the auto industries of the United States, Europe and Japan account for more than 80 percent of the world's auto production. In particular, the Japanese auto industry has strengthened its competitive position markedly in recent years, and in terms of production volume it has forged ahead of the other two production centers. In 1980, Japan produced 11.04 million units (including trucks and buses). This represents an incredibly rapid 5.9-fold increase in 15 years from the 1.87 million units produced in 1965. More than anything else, this increase is attributable to the up-to-date production facilities that the Japanese industry has installed and which have translated into high labor productivity, high product quality and good maintenance service—advantages derived from having started later than the other competing markets.

Also bolstering Japan's competitive position have been changes in the domestic as well as overseas markets which have taken place to the advantage of the Japanese auto industry. For instance, from around 1960, when Japanese automakers geared themselves for mass production, the Japanese economy began to gather steam, triggering a wave of motorization throughout the country which, in turn, boosted the domestic demand for automobiles. Similarly, the sharp increase in U.S. demand for imported subcompacts (1600cc-2000cc piston displacement), especially those made in Japan, which occurred in the wake of the first oil crisis of 1973, coming as it did when Japan's domestic auto demand was in the doldrums, helped the Japanese automakers sustain the forward momentum of their production.

What contributed most to turning the overseas market conditions favorably to Japanese cars, however, were the steep increases in fuel prices. As OPEC raised its crude prices, overseas demand, notably in the U.S. market, for fuel-efficient cars grew rapidly. This proved a great boon to the Japanese auto industry, which had long been concentrating on the production of such subcompacts. Following the gasoline panic that erupted in 1979, U.S. consumer preference shifted abruptly in favor of subcompacts. So abrupt was the shift, in fact, that U.S. automakers which had traditionally concentrated on the manufacture of full-size cars had to cut production drastically because of lack of demand. By contrast, their Japanese counterparts busied themselves expanding their production to meet the growing export demand.

It is true that good luck—favorable changes in overseas markets—had a hand in accelerating the growth of the Japanese auto industry. But much more than sheer luck, the major reason for its remarkable growth has been its superior competitiveness—an overall strength that combines the know-how of its supportive industries (crude materials, parts and components and machinery), improved productivity and dogged marketing efforts.

In the following pages, I would like to survey the current situation and characteristics of the Japanese auto industry, review the history of its development, examine the factors which helped it attain a competitive edge in the world's auto markets (particularly those which boosted its productivity), and finally discuss its outlook in light of the competition it faces in the world market for subcompacts, as dramatized by the trade frictions which Japanese auto exports have caused with the United States and Europe.

Current Situation

Along with steel and electrical machinery, automobiles are a leading industry in Japan, underpinning the development of the nation's economy. In 1979, Japanese auto production (including automotive parts and components and car bodies) amounted to ¥18,307.3 billion, more than 10 percent of the nation's industrial production. This percentage would be even larger if auto-related services (auto repairs, marketing and transport of autos for local distribution) were included.

In addition, the auto industry uses 16.3 percent of the nation's production of ordinary steel, 20 percent of special steel, 78.9 percent of aluminum castings, 71.8 percent of aluminum die-castings, 49.3 percent of rubber goods, 20 percent of paints and 34.6 percent of glass. In the area of employment, also, more than 10 percent of the nation's gainfully employed workers are accounted for by the auto industry.

Of the 11.04 million units Japan produced in 1980, light four-wheelers accounted for 1.11 million units. Almost all of the passenger cars were subcompacts; compact cars accounted for only 10 percent, and eight-cylinder engine vehicles less than 1 percent. Trucks accounted for 3.91 million units and buses 91,000 units.

Overall, passenger cars accounted for 63.7 percent, compared with 79.6 percent in the United States and 90.8 percent in West Germany. The lower percentage of passenger car production in Japan is attributable to the fact that commercial vehicles of the van type are counted as trucks and also because the percentage of truck production has traditionally been high in this country (in 1965, for instance, trucks accounted for more than 60 percent of the nation's total auto production).

The heavy concentration of production on small cars and trucks is a corollary of the country's physical conditions (narrow streets—inherited from the traditional city layout—and poor roads) and the high domestic gasoline tax (inevitable for a country which relies almost entirely—99 percent—on imported oil).

In 1976, export sales of Japanese autos leaped ahead of steel and since then have become the largest earner of export dollars. Automobiles account for 21.9 percent of the nation's total exports by value, and their export sales generate enough dollar receipts to pay one-half the nation's oil bills. In 1980, Japan exported 5.96 million units of cars and trucks, or 54 percent of its annual auto production of 11.04 million units. This represents a 2.5-fold increase in 10 years in terms of percentage of exports over the 20 percent it exported in 1970. The ratio of exports is the highest in the case of passenger cars (66.2 percent), followed by trucks (32.7 percent) and buses (1.1 percent).

In terms of destinations, the United States is the largest importer of Japanese cars (40.3 percent), followed by Europe (20.6 percent), Southeast Asia (9.7 percent), the Middle East (9.1 percent) and Latin America (6.4 percent).

By contrast, Japan imported a total of 44,871 units of cars (80 percent of which were from West Germany and the United States), a mere 1.1 percent of the cars registered in Japan. This low level of imports has become a source of recurring trade friction with the United States and Europe. Although the Japanese government has been trying to encourage auto imports by simplifying import procedures and by abolishing import duties on foreign cars, no appreciable increase has taken place yet, largely due to the stronger yen and the lack of price competitiveness of these imported cars.

In 1980, a total of 5.01 million units of automotive vehicles (including light four-wheelers) were newly registered, down 2.7 percent from the previous year. This represents the first decline in four years. Only light four-wheelers registered an increase (18.3 percent), thanks to the growth in demand for commercial vehicles; subcompacts and trucks, on the other hand, recorded a 6.9 percent decrease. This decrease reflects a weakened consumer confidence brought about by a decline in real income, the worldwide economic slowdown and the looming uncertainty of oil supply accentuated by the continuing war between Iran and Iraq.

However, the fact that the nation has managed to register five million units of new automotive vehicles a year bespeaks the existence of a strong replacement demand. In 1979, the nation owned a total 36.23 million units or 312 vehicles per 1,000 people. In the case of passenger cars, 57.2 percent of households owned cars as against 22.1 percent 10 years ago—an increase quite remarkable by any standard.

The rate of car ownership varies widely from one area to another—low (35 percent to 36 percent) in large urban centers (such as Tokyo, Osaka and Yokohoma) where the rapid transit systems are well-developed, and high (60 percent to 69 percent) in rural areas (such as Tōhoku, Shikoku, Kōshin'etsu, Tōkai and Hokuriku).

Characteristic of the recent demand for cars has been the predominance of replacement demand: 77 percent of new cars bought were for replacement purposes, while 18.6 percent represented original purchases. Reflecting this structural change in car ownership, sales of used cars have increased in recent years to a level matching or even surpassing the number of new cars sold (104.3 percent in 1980).

In terms of size, automobiles with a piston displacement of 1,000cc to 1,600cc (popular cars) and those with a piston displacement of 1,600cc to 2,000cc (subcompacts) accounted for 41.3 percent and 41.9 percent respectively, or for a total of more than 80 percent; compacts (those with a piston displacement of 2,000cc or more) accounted for 8.5 percent, light cars (those with a piston displacement of 550cc) 6.1 percent and sport cars and imports accounted for the remaining 2.2 percent.

The Japanese auto industry distinguishes itself from those of other countries in many ways. The most outstanding difference is the multiplicity of automakers. While there are only two or three—four at the most—automakers in Western countries, there are no less than 11 makers vying for a share of the market in Japan, each trying to out-specialize or out-perform the others. Hino Motors and Nissan Diesel specialize in trucks; Suzuki specializes in light cars and Daihatsu also devotes a major part of its production to light cars. Of the remaining seven makers, Toyota and Nissan are competing fiercely with one another for the leadership position in the production of passenger cars. In 1980, Toyota commanded a 37.3 percent share of the market (excluding light cars) and Nissan was pressing close behind with a market share of 29.2 percent. The third slot is contested between Mitsubishi (9.2 percent) and Toyo Kogyo (8.4 percent). Isuzu, which is largely devoted to the production of trucks, trails next with a market share of 4.9 percent and is followed by Honda, which is at 4.3 percent but exports a substantial part of its production.

Some of these leading makers have formed loose coalitions with each other, e.g., Toyota with Hino and Daihatsu, and Nissan with Nissan Diesel and Fuji Heavy Industries. Members of each group coordinate in the fields of production, commission the production of certain parts to one another and conduct joint research and development. In addition, Japanese makers have entered cooperative arrangements with overseas automakers, e.g., Mitsubishi with Chrysler, Toyo Kogyo with Ford and Isuzu with General Motors. Given the intensifying trade friction and the growing need for the adjustment of marketing interests among the auto industries of different countries, there have emerged growing signs of a movement toward international cooperation. Recent examples of such efforts include the talks that are going on between Nissan and Volkswagen, those between Toyota and Ford (though currently stalemated) and the licensed production of Honda vehicles by British Leyland.

As noted earlier, the Japanese auto industry has out-performed its competitors in terms of unit production. However, the dollar value of its sales lags far behind that of its Western competitors, largely because of the low price that its products command. For instance, Toyota, the largest automaker in Japan, had sales of $14 billion in 1979, while GM and Ford had sales 4.7 times and 3.1 times that respectively. In terms of profits, GM and Ford sales were 5.7 times and 2.3 times larger, respectively, than Toyota. In terms of size of sales as well, in 1979 Fiat, Peugeot-Citroen, Volkswagen, Renault and Daimler-Benz all ranked above Toyota. (In 1980, however, Toyota and Nissan sales grew sharply, while those of Western makers fell, and consequently the rankings mentioned above have changed considerably.)

The recent sharp deterioration in performance of Western automakers and the matching increase in sales of Japanese cars in overseas markets have underscored the potential competitive strength of Japanese cars—far stronger than the sizes of their sales and profits would indicate—and this reflects the rapid increase in the labor productivity which Japanese automakers have achieved in recent years. On the average, Japanese automakers require a far smaller number of man-hours per unit than their Western competitors. In 1979, GM employed 853,000 workers, Ford 494,000 workers and Fiat, the leading automaker in Europe, 360,000 workers; even lesser European makers employed more than 200,000 workers. By contrast, Toyota employed approximately 47,000 workers in 1980 (or 52,000 workers when the employees of Toyota Auto Sales Co. are included) and Nissan approximately 56,000 workers. In other words, GM required 16 times as many employees as Toyota to achieve sales 4.7 times those of Toyota, and Ford needed nine times as many employees to achieve sales 3.1 times those of Toyota. Of course, allowance must be made for the fact that both GM and Ford manufacture a much larger percentage of their own parts than either Toyota or Nissan and that the number of employees of GM and Ford cited above includes those engaged in non-auto business. Even allowing for such factors though, the fact remains that the Japanese automakers employ a far smaller number of workers for the production of one unit than do their Western competitors. In terms of value-added production per employee (recurring profit plus financial income plus depreciation plus wages and salaries), Toyota (since 1975) and Nissan (since 1978) have outpaced both GM and Ford. Despite the fact that the scales of production facilities of Toyota and Nissan are only a third or a quarter of those of GM and Ford, per capita capital equipment ratios of these Japanese makers are three to four times those of GM and Ford—and one has to reckon further with the fact that the Japanese production facilities are more up-to-date and advanced than those of their Western competitors.

Another feature of the Japanese auto industry is the fact that although the automakers contract out large percentages of their automotive parts needs, thanks to close coordination with their contractors and the availability of a large number of technically advanced parts manufacturers, they have not experienced any difficulty in obtaining supplies.

A third feature is the highly stabilized industrial relations and the high morale of Japanese auto industry workers. Hourly wages are lower than the UAW's $18 (which is high even by U.S. standards) but are equal to two-thirds of those of U.S. autoworkers or on par with those of European autoworkers. Although hourly wages have been rising yearly, the rate of increase has remained within the scope of increases in labor productivity. As a result, Japanese automakers have been able to strengthen their competitive edge on the world market and consequently increase their equipment investment.

History

Japan's first attempt to manufacture an automobile dates back to 1902, when Yoshida Shintarō and Uchiyama Komanosuke built a test model. It was quite some time later, however, that commercial production of automobiles started in earnest. In those days, the technological competence of Japanese steel mills, rubber factories and other crude materials manufacturers was not quite up to the job required, and the level of technological development of auto manufacturers, particularly casting, press, metal cutting and fabricating, was too backward to establish a mass-production system. On top of that, the knockdown cars assembled by Japanese subsidiaries of the American Big Three since the Kanto earthquake of 1923 came to control the market, leaving little room for domestic makers to grow. It was not until 1933 that the number of home-built cars reached 1,000 units. Meanwhile, the number of imported cars continued to increase from 15,000 units in 1929 to 36,000 units in 1933.

In these circumstances, the Japanese auto industry sought to gain a foothold in the domestic market by concentrating on the production of trucks. This move took place under the active encouragement and protection of the military, which attached great importance to the establishment of a home-grown auto industry. The military had been giving active assistance to domestic automakers from as far back as 1918, and in 1935 it helped enact an Automotive Vehicle Manufacturing Business Law with a view to protecting the domestic auto industry by restricting the import of foreign cars, especially those from the United States.

Sensing this growing preference on the part of the political leadership toward the development of a home-grown auto industry, Toyoda Automatic Loom Works, Ltd. (headed by Toyoda Kiichirō), which had a worldwide patent on the automatic loom, and Tobata Imono (foundry) Co. (headed by Ayukawa Yoshisuke), which had acquired the right to manufacture automobiles from the defunct Datto Motors, embarked upon the production of automotive vehicles. In 1934, both enterprises split from their parent companies and formed separate entities under the name of Toyota Motors and Nissan Motors, respectively. In the following year, when the Automotive Vehicle Manufacturing Business Law was enacted, they were formally licensed to produce automobiles.

Given the foreign competition and the limited technological resources, entry into the auto industry entailed great risks. So great were the risks, in fact, that even such firmly entrenched *zaibatsu* (financial combines) as Mitsui and Mitsubishi had to bow out of the race. Those which had accepted government licenses had overcome considerable obstacles, despite the generous encouragement and protection given by the government.

Soon the economy shifted to a war footing, and the two automakers were busily engaged in the production of medium-sized trucks for the military. In the process, parts manufacturers proliferated and gained technical competence. Some time later, Diesel Motors Corp. (which later changed to its present name, Isuzu) was licensed to manufacture trucks powered by diesel engines.

Following the war's end, these automakers, battered by spiraling inflation and deepening recession and plagued by recurring labor strife, barely managed to keep afloat, producing a combined total of 20,000 units of trucks a year with the permission of the Occupation authorities. As the years wore on into 1950, armed conflicts broke out on the Korean Peninsula and a growing wave of special procurement orders for military vehicles came forth from the U.S. Armed Forces in Japan. By riding on the forward momentum that these orders created, the automakers embarked on the production of passenger cars around 1952.

During the initial years of production, the bulk of orders came from taxi fleet owners rather than individuals. As the economy began to pick up in the wake of the Korean conflict, some of the leading automakers scrambled to obtain licenses from European automakers to make up their technological lag so that they might capture a share in the growing domestic auto market. Nissan tied up with Austin, Hino with Renault and Isuzu with Hillman. Such licensing arrangements were not confined to assemblers and a number of parts manufacturers also worked out similar arrangements with their European counterparts—all in an effort to acquire advanced basic technology for the designing and production of automobiles, components and key parts.

In retrospect, however, one finds that these licensing arrangements were of a stop-gap nature mainly relating to the basic technology for the production of small cars. Toyota, for one, elected to go it alone without the benefits of European technology. Nissan, which had had experience in the mass production of a mini-car, the Datsun, overcame its technological lag by drawing upon imported technology, and five years later it succeeded in exporting its New Bluebird to other countries.

In 1955, the Ministry of International Trade and Industry (MITI) adopted a policy designed to foster the auto industry as a strategic industry. Policy guidance for the industry's development has continued since. Measures taken by MITI in 1955 included prior allocation of scarce foreign exchange to help automakers acquire foreign patents and import advanced production facilities, tax incentives, preferential treatment in the depreciating of plants and equipment and the enactment of the Law for the Development of Specified Kinds of Industry, a law designed to encourage the technological improvement of small- and medium-sized automotive parts manufacturers. These measures had the effect of eliminating the technological lag suffered by such supportive industries as casting, metal fabricating and machining.

From around 1960, Japan's export and import markets were progressively liberalized. Coinciding with this liberalization, the production of passenger cars grew dramatically, stimulated by the rapidly expanding economy and the growing wave of motorization. In addition to the big three automakers which had been operating since prewar years, Mitsubishi Motors, Prince Motors (formerly an aircraft maker), Hino (specializing in the production of diesel-fueled trucks), Tōyō Kōgyō (specializing in the production of machine tools and three-wheeled trucks), Fuji Heavy Industries, Honda (specializing in the production of motorcycles) and Daihatsu (specializing in the production of marine engines) entered the market, jostling with one another for a piece of the action. In the ensuing years, the market witnessed the construction of passenger car plants capable of producing more than 100,000 units a year, the alignment of parts manufacturers and the development of nationwide sales networks. During this period, Toyota and Nissan gained the lead in expanding their product mix to meet the diversifying demand ranging from high-class to popular cars, in establishing mass-production systems and in developing strategic models for the mass market. As a result, in this period disparities in scales of operation began to widen.

As the government liberalized international capital transactions in 1965, the auto industry suddenly found itself exposed to foreign competition and an industrywide shakeout was imminent. In an effort to prepare the auto industry for the inroads which the Big Three of the United States were expected to make, MITI floated a plan to realign the industry into coalitions headed by the three leading automakers. This plan, however, met with strong opposition from different automakers and did not materialize in its original form. In fact, the only merger that took place along the lines originally conceived by MITI was that between Nissan and Prince Motors. However, the aborted plan did play the role of triggering a wave of business groupings. Both Toyota and Nissan formed their own groups based on a loose coalition among participating members for the purpose of coordinating areas of specialization. Taken together, these two groups grew to a scale accounting for about 60 percent of the market—suggesting a growing tendency of concentration of production in the hands of a few automakers.

The three non-aligned automakers sought to tie up with the Big Three of the United States, partly at the urging of their affiliated banks. In 1969, Mitsubishi Motors signed up for business cooperation with Chrysler, and in the following years Tōyō Kōgyō entered into a similar arrangement with Ford and Isuzu with General Motors. As a result, the 11 automakers operating in Japan were divided into three camps: the two largest home-grown groups each headed by Toyota and Nissan, the three foreign-affiliated groups and the two independent automakers (Honda and Suzuki). In August, Suzuki announced that it will establish business ties with General Motors and Isuzu.

Since around 1968, unit export sales of Japanese cars have continued to increase at a rapid pace. This is attributable to computer-based automation of mass production, advanced production technology, improved know-how of parts manufacturers, close coordination between auto assemblers and parts manufacturers and stable industrial relations and the high morale of workers, both nurtured by Japanese-style participatory management.

International Competitive Position

We have seen in the foregoing that the competitiveness of Japanese cars, strengthened continuously since around 1970, has resulted in an increase in their unit export sales. What are the factors which boosted Japan's international competitive position and productivity in the face of the trials caused by the oil crisis of 1973?

These factors may be divided into internal (or micro) factors and external (or macro) factors. First, on the macro level, the reasons relate to the support given the auto industry by the government and banks. There is no gainsaying the fact that the industrial policy pursued by the government in the early years played a crucial role in fostering and strengthening the fledgling auto industry. The banks also actively supported this industrial policy. The role played by the banks was particularly effective in helping automakers establish mass-production systems in the first half of the 1960s and in bringing about the reorganization of the auto industry. Today, however, the role played by such macro (or external) factors has considerably diminished in importance. The automakers are no longer in need of a massive infusion of funds, either from the government or from the banks. In fact, the government has become rather restrictive toward the auto industry, as is illustrated by the recall system, pollution control and the recent export restrictions imposed on the auto industry.

Another macro factor has to do with the fact that Japan was a late starter—later than other countries—in developing its own auto industry. This enabled Japanese automakers to reap the benefits of the latest and the most advanced production technology developed by others. In addition, their acquisition of such technology and production facilities could not have been better-timed, coinciding as it did with the rapid growth of the Japanese economy, which continued till it was braked by the first oil crisis, and then followed by a booming export demand from the fuel-conscious overseas market that developed in the wake of that oil crisis.

The third macro factor is the competitive climate that prevailed in the domestic market. It was because of such a competitive climate that Japanese automakers constantly sought to introduce new facilities and technology and to rationalize their operations through better quality-control systems and other control techniques.

A further macro factor, which should not be overlooked, concerns the constantly improving production techniques of crude materials (particularly steel. rubber goods, aluminum castings and glass) and also those of the parts manufacturers which fabricate the crude materials into automotive parts. An automobile can only be as good as its supportive industries, and consequently the qualitative improvement of crude materials and of the automotive parts made out of those is of critical importance to the viability of the auto industry.

Let us now turn to the micro (or internal) factors. The first micro factor which contributed to strengthen the international competitiveness of the Japanese auto industry was the excellent industrial relations of the industry. These industrial relations would be inconceivable were it not for the company union. Even in Japan, where the company union is an established fact of corporate life, there are few industries other than the auto industry which can boast a strike-free record of nearly 30 years. The auto industry's industrial relations are distinguished not merely by the absence of strikes, but also by the active contribution of workers to the business performance of the company through the instrumentality of quality circles (a participatory practice unique to Japan), the continuing improvement of labor productivity and management-labor cooperation for the achievement of technological innovations. Thanks to the rationalization of operations initiated by line workers and the active cooperation of the union in tapping collective ingenuity, the company is helped to improve the quality of its products on a continuing basis. Such cooperation of the company union in the improvement of product quality and labor productivity can be coaxed only by job security and improved wages and working conditions. The Japanese auto industry, thanks to the continuing growth of its business, has been able to satisfy these preconditions.

Another factor, no less important than these harmonious industrial relations, is the strong cohesion and mutual loyalty that exist between automakers and their parts manufacturers. In the United States, where automakers produce the bulk of their parts requirements themselves, the specialist parts manufacturers guard their independence zealously, to the extent that they insist on an equal footing with automakers in negotiating contracts. The automakers thus feel no moral obligation to place orders with a given parts manufacturer beyond the contractual obligations they have undertaken. By contrast, the coalescence that exists in Japan between an automaker and its parts manufacturer inherently carries an assurance of continuing business for the latter and enables the automaker to reap systems benefits unknown to U.S. counterparts. Under such an arrangement, the automaker supplies its parts manufacturer with all the necessary technical information and particulars of its requirements, advises on the improvement of production know-how, extends financial and technical assistance for the installation of new facilities and guarantees a steady flow of orders. When it comes to the question of delivery and prices, however, a strictly at-arm's-length relationship is maintained, and the products and their delivery are thoroughly scrutinized. As a result, the parts manufacturers are under constant pressure to offset rising costs with increased productivity and to grapple with technological problems such as pollution control.

In addition, it must be emphasized that the introduction of industrial robots and other labor-saving devices, the Japanese-style management techniques as typified by the quality circles and the concerted efforts of management and labor to achieve technological breakthroughs have effectively combined to generate a continuing improvement of labor productivity and, by extension, a steady advance in the international competitive position of the Japanese auto industry.

Conclusion

The auto industries of the world have come to a crossroads. Recurring oil crises have shaken to the foundations the premier position once held by Detroit, and some of the European automakers have similarly been driven to the wall. Amidst such tumultuous change, the Japanese auto industry has stood head and shoulders above the rest, unshaken by the oil crises because of the competitive edge it enjoyed by coming late to the race. This has given rise to trade friction which Japan has tried to defuse by voluntary cutbacks on its exports.

In the meantime, automakers here and abroad are in for fierce competition in the development of new technologies capable of producing fuel-efficient and good-quality cars. This will entail the development of new materials, new sources of power, reduced body size, electronic engine control and a host of other innovations.

As U.S. automakers complete their retooling program for the production of subcompacts and start producing world cars, the competition will escalate even more. For the Japanese auto industry to survive the forthcoming round of international competition, it will need to strengthen its basic research activities with a view to achieving sweeping and long-term technological breakthroughs.

As far as the current trade friction is concerned, Japanese automakers should not become preoccupied with putting out the brush fire by curtailing their exports; instead, they should pursue a forward-looking international strategy (overseas production, technology exports, licensed or joint production and joint research and development) and seek to establish a relationship of coexistence with their foreign competitors.

At present, the world's automakers are largely divided into two classes: those which are capable of producing a world car on their own and those which cannot. Given the threat of a worldwide shakeout of automakers, major auto-producing countries may not be averse to resorting to political means to preserve their auto industries. Therefore, a successful blending of a cooperative relationship with foreign automakers in international marketing strategy, along with a strategy for domestic technological development, will either make or break the future of the Japanese auto industry.

CSO: 4120/146

ECONOMIC

MITI PLANS TO KEEP AUTOMOBILE EXPORTS TO U.S. AT 1.68 MILLION

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 20 Jan 82 p 1

[Text]

MITI, which is scheduled to announce in late March the limit for the quantity of automobiles to be exported to the US in fiscal 1982, has consolidated its plan to fix this limit at 1,680,000, or the quantity established as a limit for fiscal 1981, plus alpha. The reason is that there is the growing expectation that the US automobile market, which made a poor showing in 1980 and in 1981 as well, will recover in the second half of 1982, with sales reaching the level of nine million to ten million on an annual basis. Within the US Government and in Congressional circles, however, voices are strong for the reduction of imports in fiscal 1982 to a level similar to or lower than that for fiscal 1981, partly because of the dissatisfaction with the deficit amounting to more than $18 billion a year in the trade account with Japan. An official proposal has not been made until now, but even MITI says that it cannot foresee the trends of the situation after the opening of the Congressional session in February. Not a few people fear that the moves to strengthen restrictions will take concrete shape. In view of such a situation, MITI is contemplating an additional increase which is not to irritate the US side. It wants to determine the export quantity smoothly by the end of March, without adhering to the decision made in May last year. The final decision is feared to be delayed, however, if a new request is presented by the US side hereafter.

After the automobile war that raged between Japan and the US from the year before last, the then ITI Minister TANAKA issued a statement on May 1, last year, to make it clear that Japan has decided to take the following steps in the three years until March, 1984: (1) to fix annual exports at 1,680,000 in fiscal 1981; (2) to add a quantity equal to 16.5 per cent of the increase in sales, in fiscal 1982; and (3) to study, in fiscal 1983, whether it is proper to continue such quantitative restrictions, with consideration for the trends of the US market for passenger cars. The US side, too, recognized that Japan took "appropriate measures."

If this decision is to be obeyed, it will be reasonable for MITI to clarify to the public, by the end of March, the total quantity of automobiles to be exported to the US in fiscal 1982. The export quantity will be determined, above all, according to the expected sales in the US as a whole in fiscal 1982. MITI thinks that the US market will recover more conspicuously than in fiscal 1981. According to the sales records collected by US automobile manufacturers at the beginning of this month, 8,510,000 cars were sold in the US in 1981. Sales in fiscal 1981, too, are expected to be rather smaller than the original expectation of nine million. MITI expects, however, that automobile sales in the US will recover and amount to more than nine million in fiscal 1982. There is also the view that the level of ten million will be reached. The reason for such expectations is that the consumers can no longer postpone their purchase of new cars in place of old ones, although the trends of business and interest rates, too, must be taken into consideration.

If sales in the US are to increase by one million, it will become possible for Japan to make an addition of 165,000 to its automobile exports in fiscal 1982. However, US Senator DANFORTH, who conferred with ITI Minister ABE at MITI on the 13th, asked the Japanese side to keep automobile exports in fiscal 1982 at the level of the previous fiscal year. He thus made it clear again that the US, which is asking for the opening of the Japanese market in accordance with the principle of reciprocity, is taking great interest also in the measures to be taken by the Japanese side to curb automobile exports. Also, ITI Minister ABE, who is visiting the US at present, is said to have been unofficially requested to strengthen voluntary export controls.

ITI Minister ABE declined the request of the US side, saying that "We are prepared to exchange opinions with the US side, but will follow the formula we established last year." MITI is scheduled to determine an export quantity reflecting the increase in sales.

CSO: 4105/53

ECONOMIC

DISSATISFACTION EXPRESSED OVER EXPANSION OF EXPORT OF AUTOMOBILE PARTS

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 21 Jan 82 p 11

[Text]

At this time when the Japan-US automobile friction is about to flare up again, Japanese automobile parts industry circles are beginning to express dissatisfaction, saying that "We are not convinced by the US side's way of doing things." Criticism against Japan on the export of parts to the US is also becoming strong, day after day, like in the case of finished cars, but they say, "The increase in exports to the US is due to the purchases of Japanese parts by GM (General Motors) and Ford. We will be placed in a tight corner if we are told by US parts industry circles that 'the expansion of exports is outrageous,' in spite of that." Within the industry circles, the following defiant voice is also heard: "If the national interests of the US are to be protected, is it not reasonable for US parts manufacturers to make requests?"

It seems that the exports of automobile parts to the US (on a customs clearance basis) in 1981 were limited to some ¥237,200 million, up 10.2 percent over the preceding year. The exports in 1980 amounted to ¥215,300 million, up 27.1 percent over the preceding year, and therefore, the increase rate (in 1981) slowed down greatly. Even so, they were fairly firm when compared with parts exports as a whole (up 8.5 percent over the preceding year). This is because the direct supply to US automobile manufacturers increased, whereas the supply to the main-stay market was sluggish.

US automobile manufacturers' procurement of Japanese parts is tending to increase further. Following GM's recognition last year of the plant of Nippon Oil Seal Industry as a top-level designated plant, Ford qualified six plants of five electric equipment manfacturers, including Toshiba, NEC, and Nippon Denso, to be permanently designated for the delivery of products. Chrysler also is recently sending parts-purchasing missions to Japan, one after another.

If this situation continues, it is expected that exports of parts to the US will increase to a certain extent, despite the sluggishness of those to the market. It is likely that this will rub against the grain of

US parts manufacturers more sharply than ever. When the "US Automobile Parts and Accessories Trade Mission," sponsored by the US Department of Commerce, came to Japan in November last year, the participating manufacturers requested Japanese automobile manufactuers to "purchase more US-produced parts." In addition, they said to parts manufactuers with a sharp look as follows: "We want you to exercise self-control on your exports to the US."

Partly because the rate of internal manufacture by automobile manufacturers is high in the US, most parts manufacturers are medium and small enterprisers, with the exception of some manufacturers. Many of these manufacturers have ties with GM and Ford, with the market as the main body. For such reasons, it is probably difficult, in some respects, for them to tell the automobile manufacturers, who have overwhelming power, to stop buying Japanese parts. Therefore, the criticism against Japanese parts is refracted, and the fear is gaining strength that the creak in the parts friction will expand in the future.

CSO: 4105/53

SCIENCE AND TECHNOLOGY

MITI INITIATED FULL INVESTIGATION ON USE OF 'STIRLING ENGINE'

Tokyo TECHNOCRAT in English Vol 14 No 10, Oct 81 pp 44-47

[Text]

The "Stirling Engine", an external-combustion engine, has higher thermal efficiency when compared with currently available internal-combustion engines, as well as having such advantages as being energy saving, and causing little noise and pollution. As such, it has been attracting much attention, and creating a desire for its rapid development and being made commercially available. First, the Agency of Industrial Science and Technology, Ministry of International Trade and Industry (MITI) has initiated full investigation towards making practical use of the Stirling engine by a large project costing approximately ¥6 billion over a 6 year-period starting in FY1981.

After forming the project's initial policy, full-scale investigation was started. This project aims initially, at using the engine mainly for cooling and heating, as well as for power generation, and comes under the "Moonlight Plan", covering research and development projects on overall energy-saving technology, sponsored by AIST. Secondly, various industries which have participated and advanced their technology for the "Marine Engine Development Project", are now very eager to commercialize their technology obtained during the implementation of the project. That particular project has been sponsored by the Ministry of Transport (MOT), over a 5-year period from FY1976. And thirdly, Tokyo Gas Co.'s and Aishin Seiki's respective projects, subsidized separately by AIST's "Vital Technology Development Expense Subsidizing Plan," have been verifying the practical future success of their versions in their respective fields. There are some other activities as well. From now on, the Stirling engine will be the focal point, being highlighted as the new engine to meet a new era's needs, and as such requires rapid development and commercialization.

1. Short History of Stirling Engine

The story of the Stirling engine begins with the invention of a double acting pneumatic engine by Rev. R. Stirling of England in 1816, as an alternative to an engine requiring a boiler. This engine utilized air rather than water vapor and thus had less dangerous risk of explosion than with steam.

Ever since, improvements or theoretical analyses have been made both in Great Britain and Germany, but the Stirling engine has been unable to compete with the diesel engine due to its inferior thermal efficiency, weight, and compactness, and has survived only as a kind of small-output engine hand-made.

However, in 1938, Philips of Holland noticed the Stirling engine as having potential as a portable electric power supply source for radio. They were also particularly interested in the low noise and vibration characteristics of the engine, and initiated further development of a compact Stirling engine which has been showing some remarkable progress since then.

At present, Philips is the only organization which has both basic as well as developed technical know-how on the engine. They invested approximately $100 million between 1938 and 1970, and succeeded in completing five classes of experimental engines. Among them, a 30hp engine achieved 38% thermal efficiency and a 200hp engine was installed on a bus for demonstration. During a 5-year period, between 1971 and 1975, a joint research and development project was carried out by United Stirling of Sweden, Ford Motor Company of U.S.A., and Philips of Holland, spending approximately 50 million. The project was participated in by more than 200 researchers.

The companies undermentioned, which became licensees, participated in further development of the Stirling engine. They are: United Stirling of Sweden, MAN/MWM of West Germany, and Ford Motor Co. of U.S.A. Among them, United Stirling of Sweden (USS), a joint venture of FVV, a Swedish Government-owned enterprise, and Kocomes Shipbuilding, became a licensee of Philips in 1968. USS is well-known by its trial production of 3 classes of experimental engines, namely 54hp/4,000rpm, 101hp/2,400rpm and 203hp/2,400rpm. They are installed on boats, buses, passenger-cars, trucks and elsewhere.

However, the center of present developments has moved to the U.S.A. Commissioned by the Department of Energy (DOE), the following companies, since 1979, have joined in development activities in their respective areas.

(Total commission US$25.5 million)

Engine:	Ford Motors, Mechanical Technology, United Stirling, American Motors, IITRI, Hoster Miller, and others
Materials:	General Electric, Carborundum, and others
Seals:	Boeing, Shaker and others

The original target of the project was to develop an engine for highway use, but it is now aiming to develop a large-scale stationary generator as its present and revised goal. Hoster Miller has been developing a 1,500hp class engine for a coal-fired power generation plant.

2. Moonlight Plan

Research and development of the Stirling engine in Japan has been selected as the Industrial Science and Technology

Agency's "Leading and Fundamental Energy-Saving Technology Research and Development Project" and has been promoted since 1976. The center of this project is located Technology Research Institute of Machinery (TRIM). Tasks for 1980 were: 1) Trial production and operational test of a Stirling engine, and 2) Design, trial production, and evaluation test of sealing devices.

TRIM has already implemented "Operational Experiment of Stirling Engine Powered by Electric Heater". The following is its outline:

The Stirling engine outlined roughly in Fig.1 shows a crank-drive displacer type engine which is modified from commercially available air-liquidizing machinery. This engine is the same as an operationally cool thermal engine, but naturally the hot temperature portion, such as cylinder head, heater and other parts, have been modified. Displacement volumes of expansion and compression spaces are vary with a 90-degree phase-difference and their scavenging volumes are 115cm^3 and 242cm^3, respectively. The water cooler portion consists of 216 small tubes, 1.2mm inside diameter and 59mm long. The newly-installed hot-temperature portion, SUS316, has 20 pairs of heated tubes, 4mm inside diameter, wall thickness 0.5mm, and 391mm overall length, which connect between the cylinder head and regenerator housing. These heater portions are indirectly and uniformly heated by a tin bath heated by two 2kW coiled electric heaters. By defining heater tube temperature at the cylinder outlet as "heater temperature", input to the electric heater was controlled at 400°C in each experiment. This rather low temperature of 400°C was selected because certain insulation problems occured.

A regenerator, of a thermal-energy-saving type heat exchanger is one of the most important components of the Stirling engine. Roughly speaking, a Stirling engine has the efficiency of a Carnot cycle, but it can only be said by perfect functioning of the regenerator. But, as the regenerator influences the engine's performance via pressure loss, heat transfer, thermal capacity of the matrix and the volumes of empty and filled spaces, the task of optimum engine design is very difficult to achieve. Pressure loss measurement, extraction of a thermal loss at the regenerator, regenerator loss, by the engine's internal energy-flow analyses method and internal temperature distribution measurements at the regenerator on 4 kinds of matrix materials were performed in attempts to grasp regenerating characteristics.

Regenerator characteristic's variations versus rpm and mean pressure in the case of (A) Mesh 200 metal-net was used as matrix material are shown in Figs.2 and 3. Q_h, additional amount of heat, Q_c, cooling thermal amount at cooler, W_e, indicating expansion work, and $W_t (W_t = W_e - W_c)$, indicating output, increase proportionally, as either rpm or mean pressure increases. In a higher speed region beyond 1,000rpm, W_{out}=

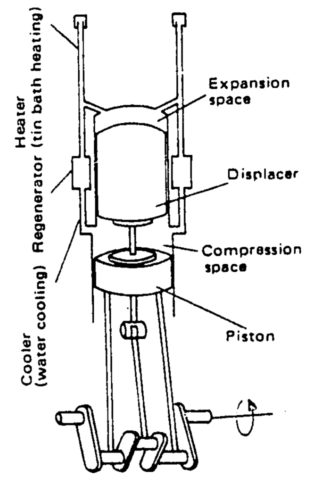

Fig. 1. Stirling Engine (high-temperature engine)

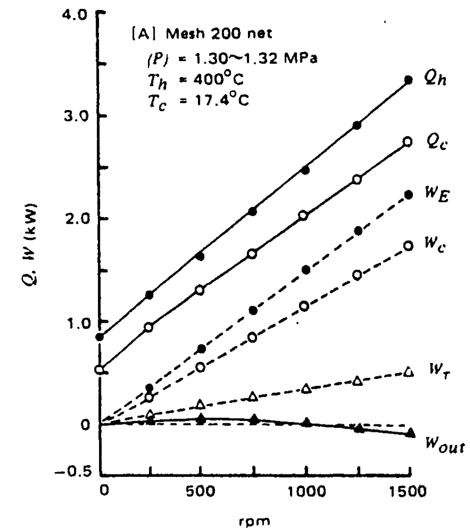

Fig. 2. RPM Dependability on Engine Characteristics

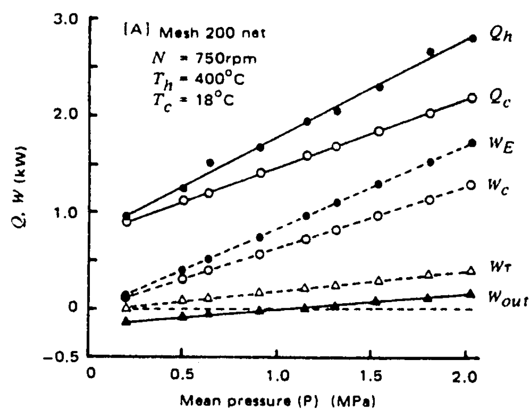

Fig. 3. Mean Pressure Dependability on Engine Characteristics

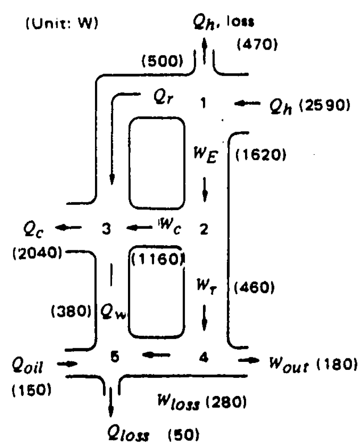

Fig. 4. Energy Flow

shaft horsepower and belongs to a minus motoring region. This fact is due to a reason that W_{loss} ($W_{loss}=W_t-W_{out}$), mechanical loss, is increasing about 1-1/2 power to rpm. Comparing such a relationship with rpm and W_{loss} which has less dependability on mean pressure, shaft horse power increases as mean pressure increases, as in Fig. 2.

Fig.4 shows energy flow distribution of the engine. Besides Q_r, regenerator loss, Q_h loss, thermal loss at heater, Q_{oil}, thermal input by hot temperature holding oil; Q_{oss}, radiating loss from crankcase; and Q_w heat transfer from crankcase to cooler, are newly introduced into the chart. Analytical results of all experimental data revealed that Q_r, regenerator loss, maintains a constant value of 500 watts regardless of the nature of the matrix, rpm, and mean pressure. As heat transfer loss via the regenerator housing comprises the greater part of total regenerator loss, all matrix materials have been functioning to regenerate the heat within the limits of measuring accuracy.

3. R&D of Stirling Engine for Practical Use

Among recent research and development activities in Japan, "R&D on Stirling Engine as a Marine Engine" has been implemented by MOT and approximately ¥600 million has been spent over a 5-year period starting in FY1976 The following have participated in this project: Ship Research Institute of MOT, Japan Shipbuilding Research Association, Daihatsu Diesel, Nippon Piston Ring, Mitsubishi Heavy Industries, as well as Tokyo University, Tokyo Institute of Technology, and Meiji University. Recently this project has succeeded in operating an experimental engine with maximum of 89.2hp at 556rpm, with an integrated efficiency of 21% as in Fig.5. The Ship Bureau of MOT observes that as all problematic points concerning components and plans for their resolution have been found, all participating industries are now realizing that ways to commercialize the Stirling engine are now becoming clearer.

In addition to the above, by receiving a "Subsidy on Vital Technology Development Expense" from AIST, some development projects such, as Tokyo Gas Co. for power generation, fueling, cooling and heating of buildings (1976–1977), Aishin Seiki for automobile engines (1978–1979), have been implemented. In Tokyo Gas project under guidance from Tokyo University, a 7.02kW/1,120rpm trial engine, built by Aishin Seiki, attained a thermal efficiency of 21.8%. Through this achievement, it is now realized that prospects of their endeavors can be used for home cooling and heating. Tokyo Gas considers that they just need to wait for "higher efficiency engine development and a technological break-through on materials". Aishin Seiki succeeded in building a Stirling engine SHP, 41kW/ 2,000rpm with 28% thermal efficiency. If success to make the engine more compact is realized, the engine can be installed in an automobile or small vessel.

As a similar but different news topic, under a subsidy

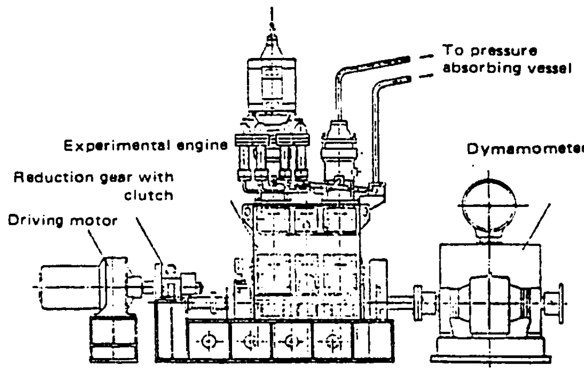

Fig. 5. Ministry of Transport (MOT) Engine Combination

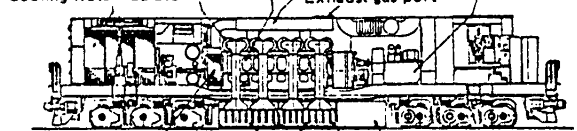

Fig. 6. Coal-Fired 3,000HP Stirling Locomotive Engine Designed for Canada

from the Canadian Ministry of Transportation, research institutes in Japan and Canada have jointly completed the first conceptional design of a "Coal-Fired Stirling Locomotive Engine". This locomotive engine is expected to have 3,000hp with 40% efficiency and if so, will be competitive with current diesel locomotive engines.

With such background information, AIST has been planning to further promote the "Moonlight Plan" for FY1982 as an extension of the similar FY1981 project. They aim to find prospects on making practical use of the Stirling engine by 1987. For future application areas of the engine, AIST is aiming to apply this technology in the field of cooling and heating devices, such as room air-conditioners, stationary type agricultural machinery, and an electric power generator, instead of the earlier proposed use as an automobile engine.

CSO: 4120/144

SCIENCE AND TECHNOLOGY

SUPER ALLOYS FOR NUCLEAR STEELMAKING

Tokyo TECHNOCRAT in English Vol 14 No 10, Oct 81 pp 47-49

[Text] Current steelmaking adopts a continuous system in which molten metal from a blast furnace charged with ore, fuel, and other materials is led to a converter to produce steel by blowing oxygen through the molten metal. Although rated high in industry, steelmaking consumers scarce coke in large quantities; the total energy used in steelmaking in 1973, amounted to about 20% of Japan's total use. Moreover, steelmaking is burdened by pollution problems, as NOx, SOx, etc. are generated. As a solution to these problems, nuclear powered reduction of ore has attracted interest as a new smelting method.

This method utilizes thermonuclear energy from a high-temperature gas reactor (HTGR) to produce a reducing gas from asphalt, an abundant petroleum byproduct, and then the resulting gas is heated for direct reduction of iron ore. The method has been expected to save energy and resources, as well as to help solve environmental difficulties by adopting a closed system.

Of high-temperature materials employed in nuclear steelmaking, heat-transfer tubes (top left in Fig.1) of an intermediate heat exchanger provided to ensure safety are exposed to the severest conditions: outside the tubes from HTGR flows helium gas (primary He) at 1,000°C and 40-atm pressure, that heats 45-atm secondary helium to 925°C running inside the tubes. Primary He contains H_2, CO_2, CH_4, etc. at 1–300ppm because of oil or moisture leaks from HTGR, thus causing faster corrosion than under normal atmospheric conditions. This is because the oxide film developed on the tube surface offers less protection compared with that when in the air, and this greatly affects its creep rupture property. In addition, a variety of equipment and tubing (center in Fig.1) to produce the reducing gas using 925°C, secondary helium must also withstand attack from the reducing gas or steam. Alloys to survive this intense environment were not available originally, so that novel materials had to be developed.

Consequently, the "Research and Development of Direct Reduction Using High-Temperature Reducing Gas" was estab-

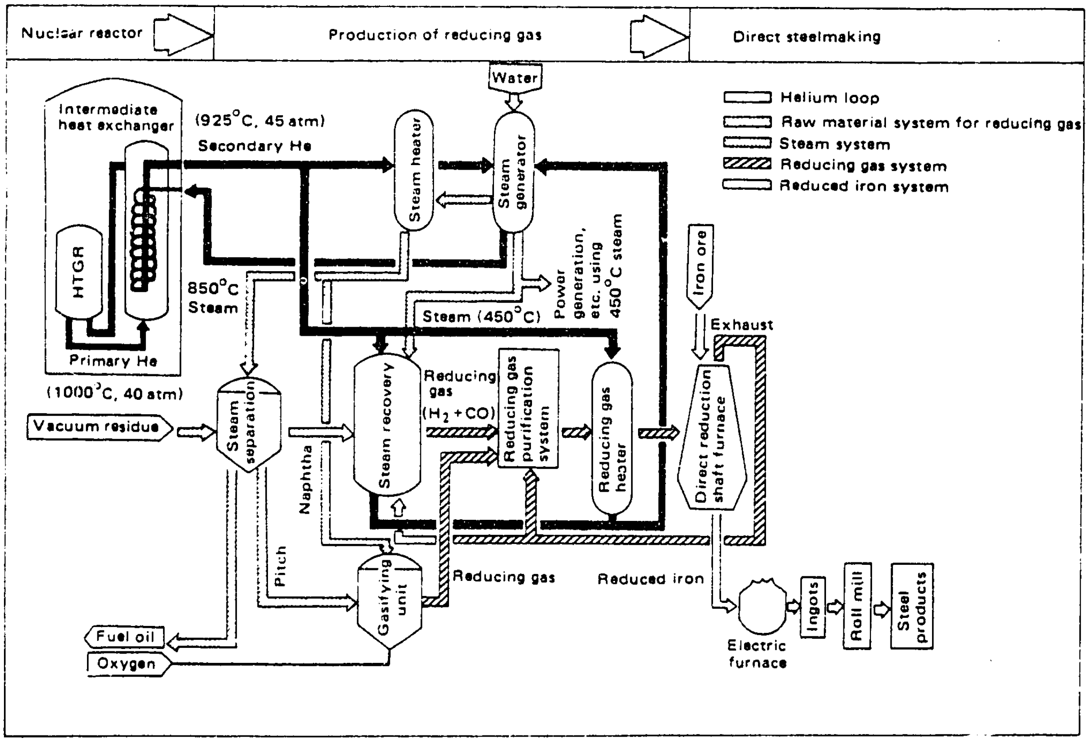

Fig. 1. Conceptual Diagram of Nuclear Steelmaking System

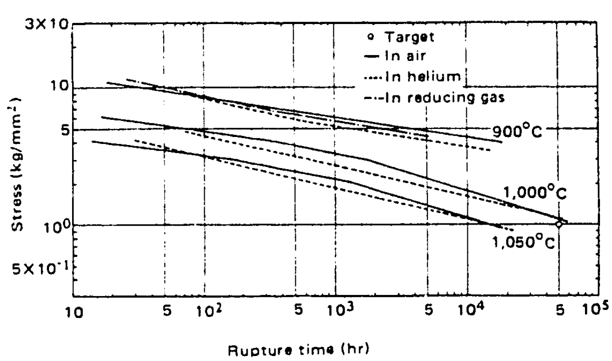

Fig. 2. Stress-Rupture Time Curves of Ni-Cr W Alloy in Air, Helium, and Reducing Gas

lished in 1973 as one of the large-scale projects by MITI's Agency of Industrial Science and Technology, and its subthemes included study on highly heat-resistant alloys. Performance targets of the alloys at the time were specified as follows:

(1) Alloys should have a creep rupture strength of 1 kgf/mm^2 or greater after 50,000 h in 1,000°C helium.

(2) Alloys should be weldable, workable into tubes 25mm O.D., 5mm wall thickness and more than 7m long, and be capable of secondary processing required to manufacture heat exchangers.

(3) Alloys should exhibit the above creep rupture strength in actual operation as is or by adequate surface treatment.

This project ended in fiscal 1980, and the Science and Technology Agency's National Research Institute for Metals, having conducted performance tests for super alloys developed by interested companies, has recently published the following summary of results.

Each firm proceeded with alloy development independently by setting optimum composition, manufacturing process, and heat treatment for each possible alloy, to select 11 materials of 3 Fe-bases and 8 Ni-bases in fiscal 1973 and 1975 projects. These 11 alloys were scheduled to undergo the following 3 examinations:

(1) Fabrication tests on melting and drawing.

(2) Workability tests on secondary bending and welding.

(3) Various performance tests, such as creep rupture, elevated temperature corrosion, hydrogen permeability, conduction of heat, thermal expansion, and material deterioration.

The most suitable alloys providing the desired qualities were then to be chosen by comprehensive evaluation, with priority given to the institute's performance tests including creep rupture results.

From among 5 alloys proposed in fiscal 1973, two were considered to meet the objectives based on creep rupture data at around 1,000°C in normal atmosphere, but one of them, containing as much as 30% of cobalt, was excluded because of induced radioactivity that was unavoidable. The other, along with six cobalt-free alloys suggested in fiscal 1975, was subjected to performance tests for final selection.

Fig.2 shows the stress–rupture time curve in air, helium, and reducing gas of a Ni-Cr-W alloy, of the material found to have the best creep rupture property among the seven proposed alloys. The creep rupture strength of the material is clearly above 1 kgf/mm^2 after 50,000 hours at 1,000°C in both air and helium gas. Additionally, one or two more alloys were selected as possible candidates to suit requirements.

These performance tests, the institute claims, have furnished extremely useful information on the differences of creep rupture behavior between each alloy in air and other atmospheres; the effects of oxidation, nitriding, carburizing/decarburizing, etc. in the presence of sample surfaces on high-temperature properties; material degradation by stress aging, and others.

CSO: 4120/144

SCIENCE AND TECHNOLOGY

INDUSTRY IN VLSI PRODUCTION WAR REPORTED

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 16, 17, 18, 21 Dec 81

[16 Dec 81 p 5]

[Text]

The Japanese semi-conductor industry will join the new ¥1-trillion industries as early as fiscal 1981. As if to fall in step with the rapid expansion of the market scale, the development of ultra-modern technology is also making rapid progress, and the industry circles are now in the midst of a VLSI (very large-scale integrated circuits) war. Competition in the mass production of ultra-modern products is being accelerated, on the one hand, while on the other, severe struggles among various companies are being developed for the obtaining of large users. Also, US forces are eagerly watching for a chance for counter-attacks. The peripheral equipment industry also is on the alert, in search of business opportunities. The front line of this VLSI war is reported as follows:

NEC Hastening Monthly Production of One Million 64-Kilo-Bit RAM's

At 10:30 a.m. on November 2, NEC Vice-President Atsuyoshi OUCHI took out several sheets of data from an inner pocket of his suit, as soon as he entered the Directors' drawing room on the 22nd floor in the Head Office building in Tamachi, Tokyo. He said to a reporter who visited him, "Our company also has decided to produce one million 64-kilo-bit RAM's (memories to write in and read out, from time to time), monthly."

In the data which Vice-President OUCHI read, a plan for greatly increasing the production of 64-kilo-bit RAM's was written. This is a fresh plan which was decided through talks between Vice-President OUCHI and President Tadahiro SEKIMOTO, which were held at the end of October, only several days before. The scale of production of 64-kilo-bit RAM's by this company at the end of October was 300,000 RAM's monthly. Under the plan, this is to be increased by 150,000 RAM's every month from November, and it is to be brought to a structure to produce 1,050,000 RAM's monthly at the end of March next year. It is a bullish plan for increased production, to increase the output by more than three times in half a year. In this company, monthly production of 64-kilo-bit RAM's has already exceeded 500,000 RAM's in December this year.

NEC has announced the plan for the great increase of production because it was stimulated by "Hitachi, a fair competitor" (NEC Board Chairman Koji KOBAYASHI). On October 26, prior to NEC's announcement of its plan for increased production, Hitachi Managing Director Yasuo MIYAUCHI said as follows at the meeting to announce the interim settlement of accounts in September: "At the end of March next year, the monthly output of 64-kilo-bit RAM's will be increased to one million RAM's." Thus, the plan for increased production to increase the scale of production at the end of September -- 500,000 RAM's -- double in half a year was quickly declared internally and externally.

This news on the increased production by Hitachi promptly spread to NEC's semi-conductor plants which are scattered throughout Japan. The newspaper report saying that "Hitachi will produce one million 64-kilo-bit RAM's monthly" was put up the next day at various places of the plant of Kyushu NEC, which is the biggest production base. Thus, it was eagerly waiting for a decision by the top management at the Head Office, saying, "What on earth will our company do?"

Typical "Industry of Sure-Victory-by-the-First-Move Type"

Semi-conductors are a typical industry of the sure-victory-by-the-first-move type. "If ultra-modern products are produced belatedly, there will arise the vicious cycle of buyers being taken away when the products appear on the market, and not being able to recover the next investment because the price falls rapidly" (Hitachi Board Chairman Hirokichi YOSHIYAMA). Some semi-conductor manufacturers of the US retreated from or gave up the production of 64-kilo-bit RAM's because they firmed up the judgment that if they start production in the face of the big offensive by Japanese manufacturers, it will be too late.

NEC and Hitachi, which rank first and second in Japanese semi-conductor industry circles, have started increasing the production of 64-kilo-bit RAM's in competition with each other, simply because they are thinking of securing a position which is even slightly advantageous, by going ahead. As is often said, the 64-kilo-bit RAM is the first round of VLSI products. It can be said that the competition between NEC and Hitachi, with an eye on the 256-kilo-bit RAM, which is the next ultra-modern product, has just been started.

Toshiba, whose development of independent VLSI products has suddenly become active among the companies engaged in similar business, with a side glance cast at such moves of NEC and Hitachi, has recently announced that it has developed 64-kilo-bit RAM's of the static type and will start full-scale shipments from March next year. NEC and Hitachi are planning to increase the production of 64-kilo-bit RAM's of the dynamic type. Compared with the 64-kilo-bit RAM's of the dynamic type, those of the static type require a degree of integration which is three or four times as high, to obtain the amount of memories of the same capacity. However, they have the advantage that the designing of circuits to be connected with other LSI's is easy, and that the electric power to be consumed is small, too.

The degree of integration of the 64-kilo-bit RAM's of the static type, which have been developed by Toshiba, is nearly three times that of the dynamic type, amounting to 400,000 pieces, and the cost is higher, too. However, it is thinking of making up for its lag behind NEC and Hitachi by cultivating a new market for OA (office automation) equipment, measuring instruments, etc., which are well adaptable to the static type.

Sony and Sharp Mass-Producing CCD's

Sony and Sharp are doing their utmost for the mass production of CCD's (charge coupled devices) which are being brought into the limelight as an eye of new electronics. The scope of application of CCD's is wide, including facsimiles, video cameras of small size and of light weight, and magnetic cameras of the future, which do not require film. They are VLSI's whose rapid growth is expected in the field of public welfare.

In Sony, the development of CCD's is a President project. From the spring of next year, when the special plant whose construction is being pushed at present in Kokubu, Kagoshima Prefecture, will be completed, mass production of CCD's will be started in the unit of 10,000 devices per month. Sharp also is constructing a CCD mass-production plant at its Tenri Plant in Nara Prefecture. It will produce 20,000 to 30,000 devices monthly in June Next year.

It can be said that this is a manifestation of the budding of moves to survive in the VLSI age through the development of independent products, avoiding frontal competition with NEC and Hitachi, which lead the industry circles by improving the degree of integration of memories.

VLSI's require huge amounts of funds for research and development and facilities investments. According to tentative calculations by ICE, which is an influential semi-conductor consultant company of the US, there is a result of surveys to the effect that the cost for the construction of a standard VLSI plant will increase from the $23 million in 1980 to a little more than $50 million in 1985.

The amount of facilities investments in the semi-conductor sector of NEC, which holds top place in the industry circles, in fiscal 1981, is ¥41 billion. This accounts for 12 percent of the estimated sales in this sector -- ¥342 billion. Other companies engaged in similar business criticize NEC, saying that "NEC makes excessive facilities investments." However, it can be said that NEC is thinking that it must make such a huge amount of investments to live through the VLSI age.

It seems that various semi-conductor companies are being pressed to make a severe choice -- whether to stand the burden of huge funds and survive through competition in mass production, or whether to live through the VLSI age through the development of independent, favorite products.

Major Manufacturers' Plans for Producing 64-Kilo-Bit RAM's

(As of the end of March, 1982; unit: 10,000 RAM's)

NEC:	105
Hitachi:	100
Fujitsu:	60
Toshiba:	30
Mitsubishi Electric Machinery:	30
Oki Electric Industry:	30

(Reporter KATO)

[17 Dec 81 p 5]

[Text]

The rapid fall in the price of 64-kilo-bit RAM's, which are said to be the first round of VLSI (very large-scale integrated circuits), was much in the newspapers in early September this year. At that time, a director of a certain major semi-conductor-manufacturing company challenged a reporter, saying as follows: "Do you know how much injury our company suffered because of the newspaper report on the sharp fall in the price? It is ¥5 billion!" At the Tokyo Securities Exchange, the prices of main-stay electric machinery shares fell rapidly from the middle of August because of foreign investors' over-selling. Above all, the worsening of the semi-conductor market, represented by 64-kilo-bit RAM's, accelerated the lowering of the prices of major electronic shares of NEC, Fujitsu, etc. In the case of the above-mentioned manufacturing company, which was scheduled to issue debentures convertible at the market price in Europe, the plan for procuring funds was greatly upset because the stock price fell, and this resulted in the "protest" by the director.

The trend of the product market is extremely important in grasping the whole picture of semi-conductor business. The 64-kilo-bit RAM, in particular, appeared with great fanfare as a product telling the opening of the VLSI age, and therefore, the impact when the tremendous speed of the fall in the price was spotlighted was great.

Since the fall of last year, Japanese and US semi-conductor manufacturers have begun to deal with this product with ultra-modern technology unanimously and on a full scale. The price of each sample shipped was ¥20,000. However, it fell to ¥2,000, one-tenth, in September this year, one year later. It is natural for the persons responsible for sales in various companies to have turned pale at this sharp fall. However, the worsening of the market was true.

Mass Production of 64-Kilo-Bit RAM's Runs Ahead Alone

The "learning curve" is a term which has become well-known at a bound as a result of surveys by the Boston Consulting Group of the US. This is a rule of experience in semi-conductor business, to the effect that when a cumulative output increases double, the price falls by about 30 percent. "Manufacturers with large amounts of production are more capable of lowering cost, and they are able to increase the profit rate. As a result, they can have an advantage in share competition. When the share increases, this rebounds on the increase in the output, and this leads to more favorable conditions."

The Japanese semi-conductor industry caught up with the US forces in "Silicon Valley," which is a mecca of semi-conductors, because it adopted the management strategy of giving primary thought to the effect of mass production, as a faithful adherent of the "learning curve."

The phenomenon of the fall in the price of the 64-kilo-bit RAM, which phenomenon was described even as a "tragic aspect," originated from the attempt to carry out this rule of experience intensively for a short time. As a conclusion, the competition for increased production among various semi-conductor companies escalated, when it was not accompanied by users' demand, and only the price ran ahead under the situation where many things did not appear at the stage of distribution. This brought about the sharp fall in the market to one-tenth in one year, which fall had not been experienced by the persons connected with semi-conductor business.

Why did the competition overheat to such an extent? As a memory product, which is the ace in semi-conductor business, the 64-kilo-bit RAM has appeared this year, after the golden age of the 16-kilo-bit RAM continued for four years. It is said that the 256-kilo-bit RAM in the next generation will appear from 1985. This is an "Olympic item" whose memory capacity increases by four times and which is replaced by another main-stay item every four years.

"Destruction of Price" Calms Down, at Long Length

"VLSI technology will decide the rise and fall of the electronic industry in the 1980's." So saying, all the major semi-conductor manufacturers of Japan announced themselves as suppliers of 64-kilo-bit RAM's. Mitsubishi Electric Machinery, which is a late-comer in the 16-kilo-bit RAM market one generation ago, and even Oki Electric Industry, which had no actual record at all, participated for the first time. It is for this reason that it is bantered as an "Olympic item on which there is significance in participation." It is a natural consequence that the price will fall rapidly if the amount of supply increases tremendously when it is not accompanied by actual demand."

This "destruction of prices" is now calming down, at long length. Even so, the prospect is strong that the price of the 64-kilo-bit RAM will become ¥1,000 early next year. Correctly, it can be said that such a downward curve until the beginning of this fall as to "slide down a cliff" is returning to the "step of the ordinary fall in cost for memory products at a gradient of 45 degrees."

For the various semi-conductor companies, the sharp fall in the price of the 64-kilo-bit RAM went against the grain. This is because establishment of the prices was upset greatly under their sales plans for this year, when the commercial war as to this product was to be started. However, this fall in prices caused a "welcome miscalculation," on the other hand. The tremendous competition in the lowering of prices stimulated users' enthusiasm for purchases, and as a result, it caused the VLSI age to become full-fledged quickly.

In regard to the circumstances in this connection, Vice-President Atsuyoshi OUCHI of NEC, which ranks first in the industry circles, did not change the following prospect, from beginning to end: "It will be from 1982, that the 64-kilo-bit RAM will play the leading role in the semi-conductor market." Looking askance at other companies engaged in similar business, which raced ahead in the competition for increased production, NEC did not readily join this race. The "judgment" based on the marketing research by the information strategic units which NEC spread both at home and abroad, served as its self-confidence in the "view that the 64-kilo-bit RAM will play the leading role in 1982."

As Vice-President OUCHI read the information strategic units' research reports which he obtained after the start of November, he is said to have thought that "The rapid recovery of demand for the 64-kilo-bit RAM exceeds my expectations." In the reports, the names of about 130 enterprises which had reported on the passage of the examinations of the samples, which NEC had shipped to European and American users, were listed. It is said that among them, "Seven of the 11 major computer manufacturers in Europe and America, such as Honeywell, are included."

Shares Will Become Clear From Early Next Year

Even in the light of the single fact that facilities investments amount to a huge sum, the VLSI war, which was started with the appearance of the 64-kilo-bit RAM, is forcing Japanese semi-conductor manufacturers to engage in a heavy-load race. It can be said that the price competition was a "test" as to whether they can stand this race or not. As far as is viewed at the present time, no companies seem to have dropped out in the offensive-defensive battle among NEC, Hitachi, Fujitsu, Toshiba, Mitsubishi, and Oki Electric, which battle was developed as to what company will hold price leadership. However, there are also new moves, such as Toshiba's deciding to expand the kinds of VLSI products.

The results of the struggles for users will certainly become clear after early next year, in the situation where users' demand will mount, centering on computer and communications equipment industry circles. Real ability is yet to be truly questioned in the load race among the various companies which have outlived the price competition. (Reporter NONAKA)

[18 Dec 81 p 5]

[Text]

"I do not adhere to Buy American. We will buy even Japanese products, if they are good devices. This is what business should be, isn't it?" Board Chairman Gordon E. MOORE of INTEL, which is an influential semi-conductor manufacturer of the US, made such a remark recently and surprised the surrounding people.

INTEL is a well-known US enterprise following the principle of purchasing home-produced goods. Disco (Head Office in Tokyo), a Japanese wafercutting device manufacturer holding 80 percent of the world share, is delivering its products to most influential semi-conductor manufacturers in the world. Nevertheless, it deplores, "We cannot make an inroad into INTEL." All the more for this reason, the remark by Board Chairman MOORE is very interesting. Actually, INTEL has recently started contacts with several Japanese manufacturers as to devices to manufacture VLSI's, including the electron beam-exposing device.

Major US Semi-Conductor Manufacturers Adopt Japanese Products, Too

Not only INTEL but also IBM is moving to procure Japanese devices. At the Miho Plant in Ibaraki Prefecture, which is the VLSI-producing base in Japan for Texas Instruments (TI) of the US, the biggest semi-conductor manufacturer in the world, Japanese devices are introduced in large quantities. In the device industry circles, the following expectation is mounting: "With this as a breakthrough, TI itself also will move to introduce large quantities of Japanese devices, won't it?"

Japan Electronics has recently decided to receive an order for electron beam-exposing devices from the Bell Research Institute, which is a leader in the development of semi-conductors in the US, in competition with European and American manufacturers.

What do such moves show? The semi-conductor-manufacturing device manufacturers which have so far been noted by foreign countries have been chiefly manufacturers of devices used for the process of assembling semi-conductors, such as Disco and Niikawa (Head Office in Musashi-Murayama City, Tokyo), which manufacture wire bonders. At present, however, manufacturers of ultra-modern, nucleus devices to produce VLSI's and inspect their performance, such as Canon and Japan Optical Industry which manufacture exposing devices, Nichiden Anelba (in Fuchu City, Tokyo) which manufactures etching devices, and Takeda Riken Kogyo which manufactures LSI testers, are being spotlighted.

"In Japan, there are semi-conductor-manufacturing device manufacturers having real ability, though they have hardly advanced into Europe and America. If they advance into Europe, they will be of help to the semi-conductor industry in Europe, which is lagging behind those in Japan and the US, but ..." So saying, the sponsor of the trade fair and technological seminar which are to be held in the Netherlands in January next year, went round requesting the attendance of Japanese device manufacturers, when he came to Japan recently. Eyes have begun to be directed also toward device manufacturers, as central figures in the Japanese semi-conductor industry which is sweeping over the world with 64-kilo-bit RAM's (random access memories), which are the first VLSI products.

Will Win Come-From-Behind Victory in One or Two Years

When the semi-conductor-manufacturing device is grasped in the "VLSI war," it is on "another battlefield" which is being developed behind the battle on the semi-conductor market. The Japanese semi-conductor industry started with the introduction of US technology, and it is becoming the leading actor in the world in the VLSI age. However, as if chasing it several steps behind, the device industry circles are also trying to find a foothold toward the world market.

As to the Japanese market, persons connected with the industry circles take the common view that at present, "The ratio between US and Japanese devices is about 6 to 4, and US devices are superior." However, it is said to be certain that home-produced goods will win a come-from-behind victory in the next one of two years.

It is not that major US device manufacturers, who have so far been controlling the world market, are silent as to this. They are beginning to move toward large-scale counter-attacks. One of them is their plant advance into Japan. GCA, a device manufacturer ranking third in the world has announced that it will start local production jointly with Sumitomo Shoji from next year, and Applied Materials (AMT) which ranks fourth in the world and Materials Research (MRC), which is the biggest manufacturer of spattering devices, have announced the start of local production from 1983.

A major device manufacturer of the US says, "As to technology for the production of VLSI's in the future, comprehensive power to realize micro-processing by combining various devices from materials is a conclusive factor" (leader of Parkin Elmer, the biggest device manufacturer in the world). Its concept is to put various kinds of devices used for building circuits in the automation system. For this purpose, it has started the input of new and efficient devices and systems successively. Japanese manufacturers do not have such comprehensive power, and, moreover, most prototypes of ultra-modern devices have so far been developed by US forces. This difference in the power of development has not yet been ironed out.

Therefore, even if the day comes when the ratio of Japanese and US devices will be reversed on the Japanese market, it will not be very easy. This is because there are circumstances where the rapid growth of the Japanese market cannot at all be overlooked by US manufacturers.

Introduction of Highly Efficient Devices Will Be Conclusive Factor

"The semi-conductor industry of the US has brought about the result that it has been forestalled by Japan as to 64-kilo-bit RAM's, because it held down research and development and facilities investments during the long-term depression after the first oil shock. However, it is doing the same thing again during this depression," says AMT President James C. MORGAN. US device manufacturers, irritated at the US market which has not improved at all, are directing their eyes toward the Japanese market, naturally.

The burden of facilities investments in the semi-conductor industry, which is nicknamed "money-eating insect," is heavy. How to introduce highly efficient devices quickly is a big point of competition for semi-conductor manufacturers. When limited to the Japanese field of semi-conductors, especially IC's, more than 20 percent of sales are set side for facilities investments. In the production of VLSI's, this trend will not become smaller but will expand.

Under such circumstances, the "VLSI war" among device manufacturers is presenting an aspect in which Japan is a main battlefield. US device manufacturers are afraid that if they are defeated on the Japanese market, this will give an impetus to Japanese manufacturers' advance into the US, and that their footing may be threatened next time.

[21 Dec 81 p 14]

[Text]

In the VLSI (very large-scale integrated circuits) age, which has just started this year, it has become clear that Hitachi will ship 256-kilo-bit RAM's (random access memories) as samples as early as the fall of next year. For this reason, the VLSI war has flared up at one shot, and it has come to strengthen the aspect of a total war. What is about to occur in the semi-conductor industry circles? Reporters in charge held a round-table conference.

Contest in Physical Power Rather Than in Intellectual and Mental Power

Desk: New moves arise in the semi-conductor industry circles, one after another. This means that competition in development and sales is so tremendous.

A: Toshiba Managing Director Teruyuki NISHIJIMA made this interesting remark: "What is necessary for the persons in charge of semi-conductors at present is physical strength. Intellectual and mental power is of secondary importance." Although in the ultra-modern technological industry, fairly uncouth moves are being developed on the front line, centering on sales. Because of struggles for users and new sales campaigns, the leaders in charge of sales in all companies return home at mid-night, every day.

C: The legal period of depreciation of semi-conductor-manufacturing devices is fixed at five years, as an exception, with the severity of renewal of technology recognized. Actually, however, no devices stand up for five years. Therefore, the leaders of various companies are making this appeal: "Semi-conductor enterprises must recover their investments in three years." As they must put their business on a paying basis in such a short period of time, they cannot but become enthusiastic about mass-production and competition in the development of new products. When they think that there are prospects for the mass-production of 64-kilo-bit RAM's, they must work on 256-kilo-bit RAM's next time. Funds for facilities investments have increased rapidly, and the pain of those in charge of semi-conductors is communicated even when they are silent.

Desk: Looking back upon the moves of the industry circles this year, we find that the contest between NEC and Hitachi, which can be said to be a "Japan-Japan war," seems to have become severer than ever, but ...

B: The "patent dispute" over the method of manufacturing semi-conductors, too, was the severest in the case of the two companies. Hitachi President MITA is a gentleman in appearance, but actually he is fairly unruly. Taking over the tradition of "Hitachi, a wandering samurai," he has begun to wage an offensive against NEC, which holds top place in the industry circles. Hitachi has outstanding power as a general electric machinery manufacturer, but it has few individual products whose shares are highest in the industry circles. Within the company, there is arising the opinion that this should not be the case, and the semi-conductor sector is leading the van, in accordance with this opinion.

A: In the semi-conductor industry circles in the future, the trend toward concentration of high-ranking manufacturers will become increasingly strong, won't it? As mentioned earlier, the higher the degree of integration becomes, the more the funds for facilities investments will increase. The funds necessary for the VLSI plant, the construction of which is being pushed by Hitachi at its place of business in Sagamihara, Kanagawa Prefecture, amount to ¥27 billion. If competition becomes severe, some enterprises will become unable to stand such a burden.

B: On this point, there is in the industry circles the view that Hitachi, which is large in scale, has an advantage, though this may be a simple view. Some people say that the order in the industry circles will be reversed three years hence, with Hitachi outstripping NEC. A certain director in IBM Japan said that "We mark Hitachi, first of all, as to semi-conductors, too."

C: No. As far as semi-conductors are concerned, NEC also will try not to be beaten. Various companies in the industry circles are surprised at its posture of continuing facilities investments exceeding 10 percent of its sales, for the past several years, and carrying them out in the future, too. In addition to its spending a lot of money for this purpose, special units for sales are running about various parts of the world in search of information. A certain researcher at the Nomura Research Institute, who returned home from the US recently, said with surprise, "It was only NEC that came even to our office to collect information."

Enterprises From Third Place Down Will Find Ways of Living in Specialization

Desk: What are the moves of the manufacturers from third place down?

A: I am noting Toshiba's development and sales of 64-kilo-bit RAM's of the static type. Toshiba, looking at the tremendous contest between NEC and Hitachi, feels that if it plunges into it directly, it will be bathed with "return blood," doesn't it? I think that it has already firmed up the intention of becoming foremost in the uncultivated field of static-type RAM's. Sony's CCD (charge cupped device) specialization is in the same current.

C: There is Matsushita as an existence like a "dark horse." This time, Matsushita has decided to handle personal computers in real earnest, not only in Matsushita Communications Industry but also in Matsushita Electric itself. As a result, a big semi-conductor market for the future has opened within that company. The spread of the range of the group is also tremendous. I observed the 2nd Arai Plant in Niigata Prefencture, which was completed in November this year. In view of its new facilities and large scale, I cannot but think that it is entertaining a certain ambition for the future.

B: I feel that Mitsubishi, Oki, and so forth are likely to be forced to stage fairly painful contests, though this may offend the persons concerned. I feel that multi-polarization, pillared by bipolarization of the industry circles and their favorite products, will progress to a certain extent next year.

European and American Enterprises Selling Themselves, One After Another

Desk: What about the moves of semi-conductor manufacturers in Europe and America?

B: In the US, liquidation and curtailment of industry circles have already been started. There is no much fear in the case of major manufacturers including Texas Instruments, Motorola, and INTEL, but it is said that the number of medium and small manufacturers selling themselves has increased greatly. There is also the information that Robert Bosch, which is a major West German automobile parts manufacturer, is moving to purchase a prominent semi-conductor manufacturer in the US in order to strengthen car electronics. Such forward-looking cases as major manufacturers' plant advance into Japan and contracts for the exchange of technology will increase, but on the other hand, the plight of medium and small manufacturers will come to the fore successively and criticism against Japan will become strong, won't it?

A: The situation in Europe is more serious. Siemens is the only enterprise that is doing business properly. Leaders of SGG, a major Italian semi-conductor manufacturer, visited Japan and contacted Hitachi and Toshiba. They seem to have sought Japan's co-operation including technological aid.

To Fujitsu, there was a proposal from ICL, a British computer manufacturer with which it is co-operating, for selling a semi-conductor plant in Britain. There is also the probablity that some agreement will be reached between Japan and Europe next year, entangled with the problem of trade friction.

Desk: There is the view that Japan has an advantage as to competition in the development of ultra-modern technology, but ...

C: When I said this to NEC Board Chairman KOBAYASHI, he turned me down, saying that "That is far from the truth." He emphasized: "In mass-production and merchandising technology, Japan is certainly superior to the US, but in ultra-modern technology, Japan is lagging 10 years behind it." He means that it is ridiculous to say that Japan's electronic technology is advanced, when it is unable to launch a single space shuttle. As to manufacturing devices, too, the US is superior in the power to develop basic technology. The Japan-US differential in the field of software has not yet been narrowed, either.

A: In the case of specific LSI's which are being produced for space and military projects in the US, the production cost per piece is as high as $50 or so. The cost for those for industrial use is on the $1 level. I think we must not despise the technological power of the US which is developing ultra-modern technology by spending that much money.

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SCIENCE AND TECHNOLOGY

PLUTONIUM EXTRACTED TO BE USED FOR LWR NUCLEAR POWER GENERATION

Tokyo MAINICHI SHIMBUN in Japanese 31 Dec 81 p 1

[Text]

According to what was clarified by a nuclear energy policy official on the 30th, Japan has decided to use the plutonium which is extracted through the re-processing of spent nuclear fuel at nuclear power plants, as fuel for light-water-reactor-type nuclear power generation now in operation, as early as the first half of 1982, ahead of the rest of the world. For this purpose, it will resume Japan-US nuclear energy negotiations as early as March and obtain US agreement to use plutonium. On the other hand, it will obtain final confirmation on such problems as the construction of a second re-processing plant in Japan. As a result, commercialization of the Japanese nuclear energy industry will begin to move on a full scale toward completion of the nuclear fuel cycle.

Two Committees for Commercialization; MITI's Policy

The fear is strong that use of plutonium as a fuel (pluthermal) in light-water reactors, which account for nearly 80 percent of the reactors at the nuclear power plants in the world at present, will make the manufacture of plutonium atomic bombs easy. Therefore, it has been strictly restricted, from the standpoint of preventing nuclear proliferation. However, plutonium is accumulated every day in nearly 270 reactors in the world, which are already in operation. Even in the light of the economic feasibility inherent to nuclear energy, to the effect that fuel once spent can be used again, the necessity for pluthermal has been pointed out.

In Japan, too, plutonium as a fuel for light-water reactors is in a state where it can be used at two nuclear power plants -- the Mihama Nuclear Power Plant of Kansai Electric Power and the Tsuruga Nuclear Power Plant of the Japan Atomic Power Company -- and a go sign for imports from the US is being awaited. It is said that an international political decision and timing as to social environment are the only remaining problems.

In this situation, Japan has a bitter history of being the only A-bomb victim country, and therefore, both its control and surveillance structures are relatively complete in the world, as to nuclear non-proliferation. It has accumulated actual records as generally the only advanced nation as to nuclear energy, which has never been suspected of nuclear proliferation to the Middle East and South America. On such occasions as the INFCE (International Nuclear Fuel Cycle Evaluation) Conference, which was held under the CARTER Administration, Japan opposed the plan of the US, Britain and France for international monopoly of nuclear energy in the commercial field. Therefore, Japan has received the international evaluation that at present, there is no other country except Japan that can start using plutonium-use light-water reactors, with importance attached to economic feasibility.

Especially, Japan depends upon foreign countries for uranium resources, too, and when plutonium created through re-processing of spent uranium fuel is used again as a fuel for reactors, it can be regarded as a semi-home-produced fuel. Its meaning of security in the fields of economic feasibility and energy is very big. Therefore, the Science and Technology Agency, MITI, and electric power industry circles have been aiming at using plutonium as a nuclear fuel for nuclear power generation, from early on. In the case of "Fugen" (output: 165,000 KW), a prototype reactor for the new-type converter reactor (ATR -- advanced thermal reactor), the first power generation with the plutonium-uranium mixed fuel entered a demonstration stage this fall, and it is being tentatively operated at present. As to "Joyo" (not used for power generation), an experimental reactor for the fast breeder reactor (FBR), too, experiments will be started within 1982 to increase the output from the 75,000 KW at present to 100,000 KW. Thus, preparations for that purpose are being completed steadily.

Taking such actual records into account, nuclear energy policy officials are asserting that nuclear proliferation can be fully prevented, by attaching the condition that "Only the countries having high-level technology on the ATR, FBR, etc., can use plutonium as a fuel in limited, specific light-water reactors." They are scheduled to obtain the final agreement of the REAGAN Administration, which has already made a nearly 180-degree policy change from the prohibition measures under the CARTER Administration to easing measures.

In pushing commercialization, on the other hand, MITI will inaugurate, early in January, two committees as advisory organs for the ITI Minister -- a "Plutonium Re-Cycle Committee" (Chairman: Japan Atomic Energy Research Institute Adviser Hiroshi MURATA) and a "Fast Breeder Reactor Practical Use Committee" (Chairman: Tokyo University Professor Yoshitsugu MISHIMA). Its policy is to establish strategy for development and commercialization up till the year 2000, at these Committees.

These Committees will give long-term prospects for huge amounts of investments and a plan for constructing nuclear energy-connected facilities, which will require a period of more than 10 years each. The Ministry intends to urge private capital to participate in a positive way in the nuclear energy industry, which has already become a market amounting to ¥2 trillion annually.

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SCIENCE AND TECHNOLOGY

'DENKI SHIMBUN' DISCUSSES STRENGTHENING NUCLEAR FUEL CYCLE

Tokyo DENKI SHIMBUN in Japanese 9 Jan 82 p 1

[Text]

The Science and Technology Agency on the 8th clarified the details of its nuclear energy budget for fiscal 1982. According to this, the characteristic feature of the budget is that emphasis was given to the improvement and strengthening of the nuclear fuel cycle which is reaching the stage of demonstration, as well as to the continuation of large-scale projects for nuclear fusion, multi-purpose high-temperature gas furnaces, etc. As to downstream, in particular, detailed designing of a high-level waste liquid solidification pilot plant was approved, and one step forward has been taken as to the start of construction. In regard to low-level waste liquid, too, new measures are to be developed. As to upstream, adjusted designing of a uranium enrichment prototype plant and other matters were approved by the Finance Ministry, and the start of construction is to be awaited. Also, establishment of a Nuclear Energy Location Regional Measures Office in the Agency was approved. This is designed for comprehensive promotion of location as to nuclear energy facilities from the standpoint of the State. It will check into PA (public acceptance) as to location at the first stage and what regional promotion should be, and put it into practice.

Efforts To Be Made for PA at First Stage and Regional Promotion, Too

The said Agency's nuclear energy appropriations amount to ¥176,200 million (up 0.7 percent over fiscal 1981) in the general account, and to ¥66,800 million (up 12.2 percent over fiscal 1981) in the electric power special account, totaling ¥243 billion (up 3.6 percent). The appropriations in the general account exceeded the demanded amount by ¥1,100 million. This means a slight increase in the amount of cash, because the limited amount of liabilities on the Treasury was curtailed on a wide scale. The increase rate of the demanded amount, including that in the electric power special account, is 3.8 percent, and the amount of appropriations is somewhat smaller than that.

The characteristic feature of the contents of the nuclear energy budget is that new measures were worked out in the field of the nuclear fuel cycle, which is reaching the stage of demonstration, in addition to the continuation of medium- and long-range, large-scale projects for nuclear fusion, multi-purpose high-temperature gas furnaces, FBR's (fast breeder reactors), etc., as before.

In regard to downstream, detailed designing (¥1,500 million) of the high-level waste liquid solidification pilot plant by the Power Reactor and Nuclear Fuel Development Corporation was approved, following the basic designing. The policy of the Power Reactor and Nuclear Fuel Development Corporation is to push detailed designing in fiscal 1982 and 1983, start the construction of the plant in fiscal 1984, and start the operation thereof in fiscal 1987.

The demonstration of glass solidification techniques will be carried out, following the start of the operation of high-level radioactive materials research facilities (CPF) in the spring of this year. Development of techniques on the disposal of radioactive waste (¥200 million) and research on the standards for the disposal of radioative waste (¥70 million) are also new measures. In the case of the former, development of new techniques for the decrease of low-level waste, elimination of contamination, solidification, etc., will be publicly invited from private circles, and subsidies will be granted. In the case of the latter, research on standards will be carried out so that performance and so forth can be checked, in preparation for the practical use of new solidified plastics, as well as research on the so-called "bottom cuts" of low-level waste.

In the field of upstream, the uranium enrichment prototype plant is a star item. An appropriation of ¥960 million, including an adjustment expense (¥500 million) to prepare for the construction, has been earmarked, the sharing of funds between the Government and private circles has been decided, and the early start of the construction will be awaited. Also, an expense (¥100 million) for publicity measures concerning the nuclear fuel cycle to promote location as to the nuclear fuel cycle, including the second re-processing plant for private circles, uranium enrichment, and the "Monju" FBR, has been newly budgeted, and PR activities will be embarked upon from the standpoint of the State.

In the field of organization, on the other hand, it has been decided that a Nuclear Energy Location Regional Measures Office will be established. This Office will check cross-sectionally and comprehensively, from the standpoint of the State, into the nuclear fuel cycle, PA as to first-stage location of nuclear energy facilities including new-type reactors, regional promotion, etc., and put them into practice. Nuclear energy liaison co-ordinators (numbering 8) under the Office Chief will also be assigned to this Office, and co-operation with local self-governing bodies also will be made close.

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SCIENCE AND TECHNOLOGY

SUZUKI DISCUSSES ELECTRONICS REVOLUTION, ECONOMIC CHANGES

Tokyo NIHON KEIZA SHIMBUN in Japanese 11 Jan 82 p 3

[Interview with Fujitsu President Yamamoto by NIHON KEIZAI SHIMBUN First Industrial News Section Chief Suzuki; 11 January 1982, place not given]

[Text]

Our country's economy, which came to greet the new year, does not necessarily have a bright outlook. There can be seen a shadow on exports which have so far pulled the economy along, and the recovery of the materials industry is not yet complete. In this situation, the electronics industry, centering on computers, has been steadily growing, and it is going to change economic society from its foundation. On this occasion, Takuma YAMAMOTO, President of Fujitsu, a home-make computer manufacturer, and Takashi SUZUKI, Chief of the First Industrial News Section of this paper, talked about the electronics revolution.

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SUZUKI: This year's industrial world is not bright, from every angle. There are problems also in exports which have been the motive power up until now, and personal consumer spending has not recovered satisfactorily. Because finances are at a deadlock, public works are on the same level as in the preceding year, and the recovery of the materials industry is not conspicuous. Then, we cannot but rely on electronics, especially in the computer field.

Creation Sector Is Task

YAMAMOTO: The computer industry has a bright outlook. As the grounds, aside from Government offices, private enterprises are still enthusiastic about rationalization. Besides, multiplier effects, created by electronics and other industries together, are now activating non-electronics industries. I think that there are two such points.

Use of computers has appeared in some forms, which can be called office automation (OA), design automation (DA), which can be also called computer aided design (CAD) or factory automation (FA). Especially since around 1981, some machine plants have begun to save and eliminate human labor by the thorough-going introduction of robots. Partly because of this, FA will be further accelerated from 1982.

SUZUKI: When I went to a local district, I said to people there that the electronics revolution is now under way. Then, many people told me, "My factory also has introduced NC (numerically controlled) machine tools." There are also statistics which say that, on the level of medium and small enterprises, NC machine tools have been already introduced by 40 to 60% of them. From now on, MC (machine complex), robots, and CAD will be introduced, and the age of factory automation, that is, the age of the unmanned factory, will arrive, won't it?

YAMAMOTO: FA has not spread into all industries at all. It is about to start ... This expression may be correct. In plants, a tendency toward that has already risen on a full scale. But, the sphere of white-collar workers still remains. Concerning this, there are two points: introduction of OA, and improvement of the efficiency of the development of design. I call CAD design automation (DA). This will be the same as OA, or will become a more important theme.

SUZUKI: Since the first oil shock in 1973, Japanese manufacturing plants have rapidly promoted rationalization. Meanwhile, however, office rationalization has not made progress on a marked scale.

YAMAMOTO: Among human brain activities in offices, the repeating of simple calculations, and troublesome calculations, which take much time, can be done by computers, and efficiency can be increased. But, very creative brain activities and judgments must be accomplished by human beings, after all. Therefore, productivity will not increase so easily. However, it is true that this is a big sector remaining.

SUZUKI: In the past one or two years, Japanese computer manufacturers showed not only small-sized computers to be used for rationalization, but also large-sized computers, one after another. Have they finally caught IBM, which is the largest manufacturer in the world?

YAMAMOTO: In the field of the manufacturing of hardware, I do not think that that is saying too much. But, the development of products, from the beginning, is a rat race. Therefore, even if one manufacturer opens a lead over other manufacturers for a certain period, this does not mean that it opens a lead for good. I think that we should be aware that the heated race will continue from now on too. However, conversely speaking, we have now acquired power enough to run in a hot race.

SUZUKI: IBM has a 60% share of the computer market of the world, and IBM has so far surpassed all other computer manufacturers of the advanced countries. People have thought for a long time that the power of IBM is absolute and that it is impossible for enterprises of our country to catch up with IBM. If our country's manufacturers catch IBM in the hardware field, does this mean that a day when Japanese computers will conquer the world is near at hand?

YAMAMOTO: To manufacture a large-sized computer, we need a group which is able to design it theoretically, we need fast-access LSI (large-scale integrated) circuits and large-volume storages, and we need various technologies to join them together. As its base, we need the semi-conductor industry, concerning high-grade silicon, which semi-conductor industry produces LSI circuits, and we need the cable industry, concerning precise coaxial cable, etc. That is, we need a wide industrial base. The same can be said of software. If we gather people, we will be able to do things ... This is wrong. How many hundred mature software employees does a computer company have? Like this, it is a question which can be decided by whether a computer company has a base for that or not. To catch IBM, and to surpass it, we will still have to pile up efforts from now on.

SUZUKI: That may be correct. But, as conditions for the computer industry to have a foothold and to prosper, the country must be big, and it must have big cities. Further, a country, which is suffering from a depression at all times, is out of the question. Therefore, I think that it must have a rather high growth rate. In that sense, computer companies in our country are provided with conditions for growth. There are reasons for them to be able to become strong-minded, aren't there?

Japan Provided With Conditions

YAMAMOTO: When viewed from European countries, I think that Japan has a big market, and has population, industries, and an industrial base necessary for bringing up computers. The centralization of big cities is also necessary at the same time. When we are going to establish a computer sales network, we should not do things in the way of scattering things in a desert. If we do things in that way, personnel-disposition efficiency is bad. In this respect, in Japan, most big cities are centralized in the Tokyo area and in the Kinki area. Therefore, I think that there is obviously an increase in efficiency. But, America is blessed with more.

SUZUKI: One more thing, to establish a computer industry, it is necessary to strengthen the semi-conductor industry which can produce good semi-conductors at low cost. However, in the production of RAM (Random Access Memory) of 64 kilobits, which is said to be the entrance to VLSI (very-large-scale integrated) circuits, Japan completely surpassed the US by last year. Technology for the production of semi-conductors has developed. This point is very big.

YAMAMOTO: It is incredible, but that seems to be correct. Computer-related equipment is also an important factor which we cannot ignore. As a matter of fact, in the case of small-sized computers, the weight of price is heavier than the main body itself. The computer industry can be characterized by two points, that is, semi-conductors and software, after all. On this point, in Japan, software has been greatly developing. This fact is encouraging. At the same time, I think that the US has little actual injury at present, but is making an uproar.

SUZUKI: In American mass media, they have a strong view, to the effect that "as to software, the United States stands at an advantage over Japan." What do you think about this point?

YAMAMOTO: "Necessity is the mother of invention." There has been no case where necessary software was not developed in Japan. If and when necessity arises, the Japanese will never fail to achieve it. But, in American society, there is a system where it [software], as well as hardware, will walk big steps, one after another. Meantime, in Japan, we do not need grand-scale software, which will accompany the Space Shuttle Project or the Apollo Project. Therefore, Japan is behind as to that. But, I think that it is alright for us to be behind as to that. We do not need unnecessary things. But, I say to Americans, "It would be better for you not to relax so much."

SUZUKI: If VLSI circuits are developed, one after another, and if their prices are accordingly lowered, it will become a big plus to the future computer industry or to the electronics industry, won't it?

YAMAMOTO: I think that it will produce various multiple effects also with other industries, besides electronics, and that it will become a factor to activate various industries.

SUZUKI: If the price of semi-conductors is half, the price of computers will also go down on a marked scale, won't it?

YAMAMOTO: That can be said. But, semi-conductors to be used for computers belong to the production of many types and small quantity. So, even if the price of general memory equipment goes down, it does not mean that even LSI circuits, which will be used for the heart of computers, will also go down markedly.

SUZUKI: If we give a course of growth and development to the Japanese software industry, what is necessary?

YAMAMOTO: The problem, which we are now facing, is that there is a lack of personnel in the software sector. A university professor says, "Computers are no longer things of electronics technicians. They are assistants for human brain activities. So, while regarding it [software] as a third foreign language, universities should teach students to use computers, at their general education courses." Except some talented people, people in general cannot master a second foreign language. Therefore, I think that instead, they should teach them how to use computers.

SUZUKI: The electronics revolution, centering on computers, will create society different from the usual Japanese society and from advanced-country society. We have been carrying a series, titled "New Industrial Revolution," in the Nikkei Sangyo Shimbun, since last year. In this, we have been asserting that, as NC machine tools resolved problems such as the lack of hands in medium and small enterprises, difficulty of finding successors, and inferior products, it [electronics revolution] will create new industries and society in every field. The ape-men used tools and became men. The invention of the steam locomotive by James WATT ignited the First Industrial Revolution. They say that, at present, electronics will make everybody become the master of machine slaves.

YAMAMOTO: I think that the reform of economic society has begun to move, little by little. If there is work which people dislike, it can be assigned to robots. For example, in offices, word processors will carry out final documentation for secretaries. Accordingly, office workers will be able to raise productivity on a marked scale. There will be fewer work hours. But, there has been a marked increase in the number of people who write software programs to use computers and micro-processors. I think that there is this kind of industrial base at present. Also, generally speaking, there will be a decrease in the population of the secondary industry. Then, is it not that the weight of the service industry will increase?

SUZUKI: After the First Industrial Revolution, we have experienced times of unemployment and crises many times, up until reaching the stable economy in the 20th century. To enter new computer society in the future, we will probably need to change our awareness of policies, even when we take up robot unemployment as an example, won't we?

Education System Also To Change

YAMAMOTO: For example, I think that the education system will also be affected. Actually, there has appeared a change in the form of the fact that the rate of going to high schools has increased very much. I think that there may occur a change when will unavoidably change the education system. Also, internationally, plants will be constructed in countries where labor costs are inexpensive, and advanced countries will also earn profits. At the same time, merits will be brought to developing countries too. If FA makes progress, it will not become effective. Then, even the solution of the North-South problem, replacing the usual method, will probably change into a task as to what it will create, and it will change even the way of division of international economic labor.

SUZUKI: Some people say, "Only science-connected people or superior people can think about computer things." Therefore, aside from MITI, most Government officials and politicians do not want to think about that (laughter). President YAMAMOTO and other computer-company leaders may have to perform the role of an "evangelist" in the electronics age.

YAMAMOTO: I am not that excited (laughter). If there appears an opinion saying that "administrative people also must understand computers," that is our self-conceit. I think that the reason why Japanese industries have developed since the end of the War, is not that MITI and politicians completely understand even the contents of technology, but is that they have been relying on technology and on industries, adopting our opinions, and guiding us so as to utilize the vitality of private circles. Mutual relations of this kind will not change basically.

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SCIENCE AND TECHNOLOGY

GENERAL CONDITIONS OF JAPAN'S TECHNOLOGY TRADE

Tokyo DIAMOND'S INDUSTRIA in English Jan 82 pp 8-13

[Text]

Royalty

Mitsubishi Heavy Industries	¥16,700 million
Hitachi Shipbuilding & Engineering	¥11,300 million
Nippon Steel	¥9,800 million
Sony	¥4,900 million
Hitachi	¥4,600 million

The figures mentioned above are royalty incomes the respective manufacturers earned during fiscal 1980 ended March 31, 1981. In the case of the top earner, Mitsubishi, the royalty it earned and it paid are balanced. Mitsubishi's ordinary profits for the March 1981 term totaled ¥22,947 million, of which about ¥16,700 million (72.8%) were royalty incomes. The ratio of royalty incomes to profits is quite high.

During the past 20 years the Japanese economy achieved high growth, which was often described as a miracle. However, the economy underwent rapid changes during the latter half of that period, and through two oil crisis it entered an era of moderate growth. In fact, many industries have been suffering from sluggish consumer spending for the past five years.

The management of businesses issued orders: "Make whatever products that sell, and create new demand to survive the recession." Many firms enforced their research, development and planning divisions. Through a series of streneous corporate efforts, they polished their basic and applied technologies, and as a result, they developed new technologies and products both competitive in the world market. Corporate royalty incomes clearly show this. Of 60 big manufacturers, 35 are earning more than ¥500 million of royalty a year. According to a survey conducted on royalty earnings by the Science and Technology Research, nine of the 20 industries surveyed earned more from new contracts for technology exports than they paid for similar imports in fiscal 1980. However, the overall balance of Japan's technology trade remains in the deficit. The nation's technological standards in aircraft, nuclear energy-related facilities and other high-technology areas are still low, and Japanese manufacturers are paying large sums of money to American and European firms for their expertise.

The top leader of Japan's technological development is the iron and steel industry, which is headed by Nippon Steel. In technology trade, Nippon Steel has been earning more than it has been paying since 1969, and their balance is increasing. In 1980 it totaled some ¥9,800 million, that is, 14 times the amount it paid (about ¥700 million). The balance is estimated to total about ¥10,000 million in years to come.

Most of its earnings from technology exports is from payments for technological guidance and supervision in steel-making engineering. The Japanese iron and steel industry learned much from U.S. and European countries after the end of World War II. Now it is exporting technologies it has developed through the innovation of imported know-how or it has newly developed. The steel-making engineering of Nippon Steel began with its cooperation in the construction of Usiminas Steel Works in Brazil (launched in 1958). Since then the company has undertaken a number of engineering projects in various countries. They include the construction of Malayawata Steel Works (the basic plan was inaugurated in 1965) in Malaysia, consultant work in the Pohang Steel Plant Project (1970~1975: the first phase completed in 1973) of South Korea and cooperation in the total planning of the hot strip mill (annual output 3 million tons) and the electro-magnetic steel plate production plant of Wuhan Steel Works in

China, as well as engineering work for individual production facilities and operation know-how for these steel plants.

The company has provided the Usiminas Steel Works with computer-aided systems engineering for the total operation of integrated steel production plants. It has also provided application technology for a process computer incorporated into a converter in South Africa.

When it comes to licensing and the supply of industrial know-how, the converter waste gas recovery system, jointly developed with Kawasaki Heavy Industries in 1962 (then Yokoyama Kogyo and later consolidated by Kawasaki), has been used by U.S. Steel, Armco Steel (the U.S.A), the British Steel Corp. and other major steelmakers in the world. As of the end of March, 1981, Nippon Steel, the world's top steelmaker, had supplied 417 cases of steel-making technology, including engineering, expertise and licensing, to 95 firms in 35 countries.

Meanwhile, Sumitomo Metal Industries in fiscal 1980 earned ¥2,229 million in royalty incomes (while it paid ¥420 million to buy technology from others), compared with ¥952 million in the previous year. Of this, more than ¥2,100 million were incomes from overseas. The number of major technological assistance contracted in fiscal 1980 totaled 12 cases. Four new similar contracts were made during the first half of fiscal 1981, and royalty incomes are expected to increase in coming years. The company's partners are all big enterprises, like U.S. Steel, Bethlehem Steel and Jones & Laughlin Steel. Technologies exported by Sumitomo Metal are quite diverse. They include production technology for steel plates and seamless pipes, continuous casting techniques, process control technology and factory operation technology. These show that Sumitomo Metal owns high-standard steel production technologies.

This is also true of Kobe Steel and Kawasaki Steel. In the case of Kobe Steel, technology earnings are mostly engineering fees and operation guidance fees for exported plant facilities, rather than royalty for individual know-how. They account for about 80% of its total technology earnings. The exported technologies vary, covering not only steel-making but also other production facilities.

Software Income

An executive of a leading shipbuilding firm says his company is now a general heavy machinery manufacturer. This company is now expanding the system to market its expertise. Plant construction and engineering firms can no longer do business with hardware alone.

Among heavy machinery and engineering firms, Mitsubishi Heavy Industries is taking the policy of entering the fee for expertise separate from equipment costs in a contract for plant construction, rather than setting a package price for material costs and fees. Software is gaining importance from the standpoint of raising earnings. The new policy of Mitsubishi is a move toward establishing the system for full-scale software business. In August, 1980, Mitsubishi concluded a contract with China for technical cooperation in a plan to expand facilities at the Shanghai Chiangnan Shipyard. Under the ¥100 million, 2-year contract Mitsubishi provided advice and management techniques to carry out the plan. It was Mitsubishi's first contract with China to supply software expertise.

In October, 1981, Mitsubishi Heavy Industries exported technology for industrial robots to an Austrian general heavy machinery producer. Mitsubishi would receive an initial fee and royalties in proportion to output. During fiscal 1980 Mitsubishi had software incomes totaling ¥16,700 million, which included royalties from industrial property, earnings from industrial know-how and consulting fees. The figure represents a 60% increase over fiscal 1975 incomes of ¥10,400 million. Of the software incomes in fiscal 1980, the royalty income ranged from ¥700 million to ¥800 million. The remainder was incomes related to engineering.

Major earners in software are chemical plants, prime movers and ships. The three sectors earn 80% of the total. Japanese industry is advanced in production technology, and technology exports in this field are expected to increase in the future. Among promising sectors are robot, automated warehousing and plant maintenance system.

Opening of Patents

The Japanese electronic and electric equipment industry is known internationally for their semiconductors, computers, color television sets and video tape recorders. But its earnings from technology exports are still low, compared with product exports. In fact, the industry is still paying more than it is earning in technology trade, because many basic patents are held by American and European firms. Japanese electric appliance manufacturers have achieved big growth on the mass production of products by importing basic techniques from abroad and developing application technologies. This pattern obviously does not warrant their future survival.

Recognizing this, Hitachi, Ltd. takes a positive stand, trying to expand technology earnings and opening its patents to the public. In fiscal 1980 it paid ¥7,300 million for technologies, while earning ¥4,600 million. Both payments and earnings doubled in four years. The earnings represent 63% of the payments, although the ratio has been rising in recent years. Hitachi aims to balance technology trade and raise its gains to 10% of its ordinary profits in the future.

Among patents, Hitachi owns a basic patent named "resin mold type" for the manufacture of semiconductors using a gang lead frame. This technology is employed for about half of the semiconductor output, estimated at ¥1,000,000 million a year. If the royalty is set at 2%, it will reach ¥10,000 million a year. This is merely a simple calculation. Electric equipment makers own many different patents, which are being used widely by others. Therefore, even if a patent, like the one of Hitachi, is established, it does not mean that its holder can always receive its royalty in full.

According to the financial report to its shareholders, Sony had the following earnings from technology transfers in fiscal 1980:

Royalty Incomes from Non-Affiliates	¥1,077 million
Royalty Incomes from Affiliates	¥3,282 million
Technical Guidance Fee from Non-Affiliates	¥175 million
Technical Guidance Fee from Affiliates	¥383 million

Of the total technology incomes of ¥4,917 million, ¥3,665 million came from the company's affiliated firms both at home and abroad. This is a result of the policy of expanding production through subsidiaries. Technology earnings will continue to increase, since Sony owns promising industrial know-how for the manufacture of video tape recorders and video tapes. Victor Co. of Japan, another leading electric appliance maker, which developed a VHS system for VTR, will also gain technology incomes as the VTR market expands in the future.

Some manufacturers are exporting high technology, like Hitachi's industrial robots to General Electric and Nippon Electric's optical character readers (OCRs) to Burroughs. But many others are importing industrial know-how from abroad, especially in the fields of atomic energy and defense. Aiwa is earning a large sume of technology fees for its total earnings. Aiwa is the first Japanese manufacturer that developed a cassette tape recorder, and a large part of its technology income is related to cassette tape recorders. The company developed the popular tape deck system in which a single push-button operation stops the tape and ejects it.

Even in the recession, chemical firms are showing unexpectedly good performances. In many cases, their income of technology fees is just about balanced with payments for similar fees or surpassing the payments, though slightly. Among notable technologies are urea production technology of Mitsui Toatsu Chemicals, vinyl chloride production technology of Shin-Etsu Chemical, the polyethylene and polypropylene production technologies of Mitsui Petrochemical Industries and Mitsubishi Petrochemical, sythetic rubber production technology of Japan Sythetic Rubber, the butadiene extraction method and butane separation techniques of Japanese Geon, and Sumitomo Chemical's various techniques on farm chemicals. There are many other techniques developed by different firms, although they are small in scale. The chemical industry, too, is entering an era of technology export.

Mitsui Toatsu's urea production plant is an integrated system in which urea is produced by processing raw materials. This system has long been considered the world's best urea production method and exported to many fertilizer producing countries. This is described as a "mostly perfected process." Toyo Engineering is undertaking plant construction and engineering business for the system. Japan Synthetic Rubber and Japanese Geon are the leading firms in sythetic rubber production technology and in the butane and butaine separation techniques, respectively. The construction of petrochemical complexes has obviously peaked out in Japan. However, plans for such plant construction are still under way in many other countries, and there are many possibilities that the technologies of the two firms will be used in those complexes.

In technology imports, the field of biochemistry will emerge prominently in the future. In fact, various techniques of genetic engineering are being imported from the United States and Europe. Japan is lagging behind in this field and needs to rely on foreign techniques at present. For Nippon Paint, royalty is a major earner. Royalty incomes during the annual term ended April 30, 1981, totaled ¥1,227 million, or 45% of the ordinary profits. The company's royalty incomes are divided into two types of sources. About half of the royalty incomes come from its joint ventures and other firms which are producing paint in South Korea, Taiwan and other countries in Southeast Asia. The remainder comes from an American company which is producing and marketing printing plate materials of photo-sensitive resin under the license of Nippon Paint.

Bright and Dark Prospects

There are other firms whose royalty incomes are rising sharply. Asahi Glass and Toray Industries are among these firms. Promising in the future are high technology products, such as electronic cameras of Canon, "the third generation" antibiotics developed by Takeda Chemical Industries and Shionogi & Co., VTRs and VTR tapes of major electric appliance makers and industrial robots.

During the December 1980 term, Asahi Glass earned about ¥4,000 million from royalties. The similar earnings for the following term are expected to fall to half, since in 1981 its exports of TV picture tube glass production techniques to China decreased. However, it is expected to make a contract with Du Pont to export soda production technology using an ion exchange membrane. Therefore, the company's royalty incomes will follow an uptrend again. During fiscal 1980 Toray earned ¥2,303 million in royalty incomes. Of this, ¥1,882 million came from overseas, while its payments for industrial know-how, mostly to foreign firms, were merely ¥469 million. Similar earnings in fiscal 1975 totaled ¥1,200 million, while similar payments were ¥243 million. Both earnings and payments almost doubled in five years. Its new technologies are diversifying, but main lines are those that derived from fiber production technology, such as those for sythetic leather, carbon fiber and high-molecular products. Earnings from sythetic fiber technology are on the plateau.

Asahi Chemical Industry, too, doubled its royalty incomes in five years — mainly with technologies for tire cords and ion exchange membrane to China. Mitsubishi Rayon earns mainly from technologies on MMA resisn and acrylic fiber. The former technologies are exported to Du Pont and other firms in industrial countries, while the latter technologies are used in developing countries.

The automobile industry and the food industry have unexpectedly few technologies to export, although they have formed gigantic industrial sectors. The auto industry, unlike the aircraft industry, is more or less an assembly industry, which puts together about 20,000 parts, and what is used there is mostly applied technologies. And technology imports are also limited to a few, such as those of automatic transmission and transaxle. The food industry in Japan owns few monopolistic technologies. Many food producers built their production systems with foreign techniques. To be sure, they have developed their own technologies, but their transfers to other firms are exceptionally few. They usually provide them only for their subsidiaries.

The only exception is Ajinomoto. The company annually earns ¥2,000 million from royalty, which mainly comes from overseas subsidiaries producing "AJI-NO-MOTO (monosodium glutamate)," a popular seasoning in the world. A unique one is Nisshin Food Products, which is exporting industrial know-how to make instant Chinese style noodle in cups. Its income is still in a range of ¥100 million a year. But its growth is very much likely.

As regards Japan's technology exports and imports, Hiroo Iwai of the Planning Bureau of the Science and Technology Agency says: Various ways are conceivable to assess technological standards. Attempted below is an evaluation through the analysis of statistical data on technology trade published by the Prime Minister's Office and the Bank of Japan.

The first point is an international comparison. According to data by the Bank of Japan, technology imports during fiscal 1979 totaled ¥276,200 million, while similar exports were ¥75,000 million. In the data of the Prime Minister's Office, comparative figures were ¥241,000 million and ¥133,100 million.

Although there are discrepancies in the data, the comparison in indexes between Japan's technology imports and exports is approximately 100:40. Similar comparisons for other industrial countries are 100:46 for West Germany, 100:143 (1977) for France, 100:102 (1975) for Britain and 100:1,000 for the United States. The U.S. is far in excess of technology exports, because it abounds in the expertise of basic technology. In the case of Japan, about two-thirds of the technology exports are used in developing countries. In technological standards, Japan appears to be somewhat lower than the United States and European countries.

The second point to look into is changes in royalty incomes. Royalty payments in a given case of technology will usually increase in proportion to output. But the ratio of such payments to the total shipments of manufactured goods peaked out in the 1960~1970 period with 0.2%, and it showed a downward trend throughout the 1970s.

According to statistics of the Prime Minister's Office, royalty payments in fiscal 1979 were ¥107,800 million more than similar incomes, when all new and old contracts that had been effective from the past were included. However, the balance of new contracts for technology trade turned into the surplus in fiscal 1972, and the figure reached ¥25,300 million in fiscal 1979.

The third concerns the general business trend of different industries. In the data for fiscal 1979, three industries registered surpluses in the balance of all newly concluded contracts and those in effect from the past. The surpluses were ¥11,900 million for the iron and steel industry, ¥11,500 million for the construction industry and ¥500 million for the chemical industry. In the balance of newly-concluded contracts alone, the chemical industry topped the list with ¥14,400 million, followed by iron and steel with ¥5,600 million and construction with ¥4,000 million. The balance of all new and old continuing contracts turned into the black in 1974 for the iron and steel industry. The general chemical fiber industry, a branch of the chemical industry, also registered a surplus in the same year.

The chemical industry has been making remarkable advances in technological development in recent years, and all major chemical companies have registered surpluses in technology trade. In contrast, the electric machinery industry is in the biggest deficit of ¥38,800 million in technology trade. Of this, ¥17,600 million was drained by the communications equipment and electronic and electric measuring instrument manufacturers. But even this sector of the industry has produced surpluses in some years since 1972, as far as the balance of newly-concluded contracts is concerned. This is an obvious indication of its technological advancement. On the other hand, the automobile industry – not a high technology industry – has constantly been in the red.

The problem facing Japanese industry is the future of its technology exports. It has two major tasks to deal with. One is the pursuit of middle advanced countries, which are making rapid technological advances. In fact, they have already affected the nation's textile and shipbuilding industries. Rising labor costs are making Japanese industry increasingly difficult to compete with middle advanced countries in various labor-intensive industrial sectors.

The second task is to eliminate trade frictions arising from the export of manufactured goods to the United States and Europe. Typical examples are exports of cars and television sets. Japan's small-size video tape recorders have generally monopolized the world market but they have not caused such a serious trade problem as those of cars of TV sets. This is obviously because Japan developed VTRs on its own and developed its markets in various parts of the world. This means that the way left for Japanese industry to survive international competition is to develop highly creative, original products. Signs of such development appear to be emerging in the field of carbon fiber, industrial robots and optical communications system.

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SCIENCE AND TECHNOLOGY

URANIUM ENRICHMENT SHELVED PENDING SOLUTION OF EXPENSE-SHARING

Tokyo DENKI SHIMBUN in Japanese 16 Jan 82 p 1

[Text]

According to what was revealed by electric power industry circles, it is likely that a fairly long period of time will be required before a conclusion is formed as to the problem of sharing (the expenses for the construction of) the uranium enrichment prototype plant between the Government and private circles. The cause of this is that the 10 electric power companies including the Atomic Power Company have informally decided to shoulder a 25-percent burden, while Government sources including the Science and Technology Agency are requesting that the rate of the burden to be shouldered by private circles be a majority, and that therefore, there is a wide difference in views between the two parties. However, as ¥960 million has been appropriated for the development of the prototype plant in the budget for fiscal 1982, the conclusion has come to be shelved, for the time being. As a result, establishment of a new company by the three centrifugal separator manufacturers and a new uranium enrichment company by the 10 electric power companies will inevitably be delayed beyond the initial schedule.

The uranium enrichment prototype plant is to follow the Power Reactor and Nuclear Fuel Development Corporation's pilot plant on Ningyo Pass in Okayama Prefecture. It is scheduled to have a capacity of 200 tons SWU and start operation in fiscal 1986. The construction expenses are tentatively calculated at about ¥65 million. However, the sharing of these construction expenses between the Government and private circles is an immediate task.

In electric power industry circles, the 10 electric power companies including the Atomic Power Company are showing the intention of bearing about 25 percent as due co-operation, while Government sources including the Science and Technology Agency are requesting that the rate of the burden to be shouldered by private circles be fixed at a majority, for the reason that the prototype plant also will be finally included among commercial plants. The electric power industry circles are showing strong reluctance as to the private circles' bearing a majority, because the development is to be led by the Government (the main body for the development is the Power Reactor and Nuclear Fuel Development Corporation).

In some quarters, information was circulated to the effect that an appropriation for the development of the prototype plant may not be approved by the Finance Ministry, unless the private circles' bearing of a majority becomes a premise at the time of the compilation of the fiscal 1982 budget. Eventually, however, an appropriation of ¥960 million was approved in the budget for fiscal 1982, as against the budgetary demand for ¥1 billion.

As a result, the settlement of the problem of sharing the expenses for the construction of the prototype plant between the Government and private circles has apparently been shelved. The Finance Ministry, however, is seeking that the settlement of the rate of the share between the Government and private circles be made a premise as a condition for implementing the fiscal 1982 budget. However, as the fiscal 1982 budget is centered on adjustment expenses to prepare for the construction, the view is strong in the electric power industry circles that even if the problem of the share between the Government and private circles is not settled, it will not pose an obstacle to the implementation of the budget.

This is due partly to the electric power industry circles' sense of distrust in the information that no appropriation will be made in the fiscal 1982 budget unless the problem of the share between the Government and private circles is settled. In relations with the budget, they think that they cannot but decide on the share between the Government and private circles before the framework for the fiscal 1983 budget, which will enable the concrete act of construction, is decided.

Reversely speaking, this means that a settlement can be shelved until the time of the compilation of the 1983 budget, at a maximum. Partly because the difference in assertions between the two parties is wide, the probability is strong that the settlement will be carried over to this time limit.

The Government sources are hoping for private circles' majority investments, with investments by centrifugal separator manufacturers added. However, the centrifugal separator manufacturers also are scheduled to make joint investments for the establishment of a new company. Prospects are that much cannot be expected from them.

The electric power industry circles want to settle the share problem even immediately, if they are to make a 25-percent investment. It is carrying through the stand that it is difficult to make any more investment, for the present, for such reasons as that their accounts from fiscal 1982 on will become extremely severe. They have also a sense of wariness that unreasonable conditions will be forced upon them if they move carelessly toward a settlement from their side.

Because of the delay in the settlement of the problem of the share between the Government and private circles, the probability has become strong that the establishment of a new company, which is being planned by the centrifugal separator manufacturers, and the establishment of a new company for commercial plants by the 10 electric power companies will be delayed beyond the initial plan.

The centrifugal separator manufacturers -- Toshiba, Hitachi, and Mitsubishi Heavy Industries -- are planning to establish a new company and start production from fiscal 1983 to complete a setup to supply 20,000 centrifugal separators for the prototype plant. They were scheduled to establish the new company in April this year, at the earliest.

On the other hand, the 10 electric power companies including the Atomic Power Company have the policy of constructing a large-scale plant with an annual enrichment capacity of 3,000 tons SWU, by investing a total of ¥600 billion. In preparation for this, they established a Uranium Enrichment Preparation Office in the Federation of Electric Power Companies in March last year. They also drew up a plan for establishing a new company in the latter half of this year, with this as the mother-body. In the electric power industry circles, however, the opinion is gaining strength that the formulation of a concrete concept for a new company should be refrained from until the share of the expenses for the construction of the prototype plant between the Government and private circles becomes clear. It is therefore likely that the establishment of new companies also will be delayed until the latter half of this year.

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SCIENCE AND TECHNOLOGY

CONSTITUTIONAL IMPROVEMENT, REORGANIZATION EFFORTS REPORTED

Tokyo SANKEI in Japanese 19 Jan 82 p 7

[Text]

Points:

(1) I will work for constitutional improvement by autonomous efforts.

(2) Re-organization of the industry circles is necessary, and now we see a chance for it.

(3) I have expectations on the housing policy of the Government.

We Have Reached Second Base Now, at Long Last

-- Can it be said that in the economic environment last year, where the materials industry was wholly visited by a depression, the aluminum-refining industry circles managed to have a somewhat bright outlook for 1982, for such reasons as that they obtained prospects, over the year-end, for exemption from the import duty (9%) and the lowering of the cost for electric power?

"As a result of our strenuous efforts, we have somehow reached second base, when they are compared to those in the case of baseball, but we did not hit a home run. Therefore, we must lead this to a score in some way or other, through our efforts from now. Upon reflection at present, there was the fear that some refiners may cause financial unrest, if there was a strike-out at that time."

(Aluminum refining consumes such a large amount of electric power that it is called canned electricity. Therefore, the aluminum-refining industry circles, which use expensive electric power compared with those overseas, suffered from the increase in costs, on the one hand, and on the other, they were driven by the offensive of less expensive imported ingot to the very limit. The deficits in the six refining companies are estimated at a total of ¥100 billion at the end of this fiscal year. Therefore, as concrete measures to save the difficult situation, they held negotiations with the Government and electric power industry circles and obtained agreement on the exemption from the import duty for one year and an actual reduction of the electricity rate. Due to these two measures, the burden of the aluminum-refining industry circles is expected to be lightened by about ¥23 billion annually.)

-- How will you lead it to a score?

"Various refining companies ought to be able to make rough calculations to see at what deficit they will stop through the two measures. If so, how to cover the deficit will be a problem of management strategy of each enterprise. At any rate, we have become able to stand at the starting line as to how we should consider the proper way of management, and therefore, there is no other way but to leave matters to the judgment of individual enterprises. I also will think of things fully until the beginning of spring, as President of Light Metals Industry."

-- What is your strategy as President of Japan Light Metals Industry, as one reference datum?

Basis for Revitalization Must Be Created

"I want to create a basis which will enable us to recover somehow within this year. Japan Light Metals Industry, which has a continuous aluminum-refining system, has a framework, certainly, but it has also a part of which it is ashamed, during this depression. Unless it corrects this part now, it will be unable to make development in a period of prosperity. The problem of the enterprise constitution must be improved by our autonomous efforts. If so, luck of the times will come round."

(The luck of the times pointed out by Chairman MATSUNAGA means improvement of the business cycle as to aluminum, the Japanese economy, and the world economy. This is because he thinks that although the aluminum industry also has problems in the refining sector, it is by no means a declining industry, when viewed as a whole, and that demand (for aluminum) as a material of the energy-saving type will rather increase stably. He means that "luck of the times will come around while we are going through hardships and privations.")

-- In regard to the aluminum-refining industry, the recent recommendation by the Industrial Structure Deliberation Council called for a production structure with an annual output of 700,000 tons. However, if this is to be produced under the six-company structure, is the number not too large?

"If 100,000 tons of aluminum is produced by three companies, for example, with the unit of one company becoming smaller, it will not pay. Producing 100,000 tons at one plant is far in accordance with economic rationality. Therefore, I think that it is necessary to make refining intensive. I emphasize this, too, at every opportunity. I would like to give advice if there are concrete proposals. However, intensive refining will not go well even if it materializes under the pressure of the Government and banks. After all, a decision must be made on one's own management judgment."

-- Now you have a chance for the re-organization of the industry circles, don't you? Will aluminum refining also not become stable on a long-range basis through this re-organization?

"I think it is wise to materialize it while (the aluminum industry) is designated as a structurally-depressed industry. If this period (until June next year) is missed, the problems connected with the Anti-Monopoly Law will be brought up vociferously, and therefore, I am expecting that voices calling for making refining intensive will arise not only from outside but also from inside the industry circles, but ... Concrete moves? You know about them better, don't you?"

Demand Will Increase, From Medium- and Long-Range Points of View

-- What do you think about the problem of imports through development overseas, as part of the measures to ensure the stability of aluminum ingot?

"Is it not very difficult to materialize new projects in the recent situation where the price of aluminum ingot is lower than the cost? We are utterly unable to make a 'go' decision unless we have such timing as to cause demand and supply to become stringent upon their recovery throughout the world, and eventually to cause the price to rise, too. However, overseas refining is not the only way to secure raw materials stably."

-- The aluminum depression last year was due largely to the depression in housing construction, in the field of demand. What about your prospects for demand this year? The Government also is making efforts to a certain extent for housing construction, but ...

"I think that demand for aluminum will increase, from medium- and long-range points of view. This is why I say that aluminum is not a declining industry. This year, the Government is making certain efforts for housing, and it is planning to construct 1,300,000 houses. There is also the problem of the actual income of those who are to purchase dwelling houses. However, if this plan is carried out, it will have certain effects also on the improvement of demand for aluminum, won't it? Last year, demand for aluminum declined greatly because of the stagnation of the Japanese economy and the world economy, but I think that demand for aluminum will move toward improvement this year, with the improvement of business."

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SCIENCE AND TECHNOLOGY

JAPAN-AUSTRALIA NEGOTIATIONS TO REVISE NUCLEAR ENERGY AGREEMENT

Tokyo DENKI SHIMBUN in Japanese 20 Jan 82 p 1

[Text]

The Japan-Australia negotiations to revise the Nuclear Energy Agreement between the two nations, which negotiations have been pushed for five years since 1978, have reached agreement. Minister TAJIMA of the Japanese Embassy in Australia and Australian Deputy Foreign Vice-Minister CURTIS initialed the new Agreement in Canberra at 4:00 p.m. on the 19th (2:00 p.m. on the same time, Japan time). The biggest point of the revision this time is that a package prior agreement (program approach), under which re-processing and overseas movement of spent nuclear fueld are approved by notice, if facilities to use Australia-produced nuclear fuel materials are decided upon between the two nations in advance, has been incorporated in the new Agreement. For Japan, the procedures in the case of obtaining prior agreement will be eased on a wide scale. The Government will present the Agreement to the current regular Diet session after it is officially signed, and seek ratification.

The Japan-Australia Nuclear Energy Agreement came into effect in 1972. After that, Australia announced a new policy for safeguards in 1977. It sent a plan for new nuclear energy agreements to 15 countries including Japan, and sounded them out. On the basis of this, the first round of negotiations for a revision were conducted in August, 1978, the next year.

Thereafter, seven rounds of negotiations were held until last fall, with the suspension of negotiations due to the operation for International Nuclear Fuel Cycle Evaluation (INFCE) in between. Informal consultations for negotiations to revise the Agreement were held in November and December, and as a result of negotiations through diplomatic channels, the new Agreement was initialed that day. The Agreement will be officially signed between the two nations after it was examined by the Legislative Bureau, and it will be presented to the current Diet session for ratification.

The contents of the revision are not to be made public until the official signing, in principle. However, it is expected that the revision this time will be fairly extensive. Above all, the biggest point of the revision is that the program approach was incorporated through the revision this time. This is to the effect that if facilities in which Australia-produced nuclear fuel materials will possibly be used are decided upon between the two nations in advance, processing and overseas movement will be approved by notice.

The application for prior agreement (MB-10) to the US on overseas movement for re-processing requires complex procedures. This became a subject for discussion in INFCE, too In INFCE, it was regarded as desirable that as to the bilateral agreement on re-processing and overseas movement, standards be established before the conclusion of a supply contract, as far as possible, and that a "foreseeable" form be taken. On the basis of this, the Australian side proposed the program approach formula. The negotiations had difficult going at one time, but agreement was reached in outline at the 7th round of negotiations.

The said formula is to include the re-processing with which the Tokai Re-Processing Plant and electric power industry circles are entrusting Britain and France. The 2nd re-processing plant for private circles is not included because it is still at the stage of being planned. However, it is said that the Australian side has generally agreed to add it at a stage where it has been materialized.

Prior agreement on re-rocessing has not so far been specified. However, as the program approach formula has been introduced, including overseas movement, a way has opened to obtain agreement collectively, instead of through "case-by-case" examinations, in cases of re-processing of Australia-produced uranium in the future, and the procedures will be simplified on a wide scale. Canada also is sounding out the idea of introducing this formula in the field of implementation of the Nuclear Energy Agreement. It is expected that bilateral agreements will generally shift to this formula in the future.

Also, as to exports of uranium ore under the "Ranger Project," the shipment of 120 tons to Shikoku Electric Power has been stopped, suffering a byblow from the revision of the Agreement. However, the shipment is scheduled to be made about June.

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