第14回原産年次大会 英語論文

1981年3月

社団法人 日本原子力産業会議

第14回 原産年次大会プログラム

3月10日(火)

開会セッション(9:30～12:15)

	議　長	永野重雄氏	(日本商工会議所会頭 日本原子力産業会議評議員会議長)
9:30	大会準備委員長挨拶	正親見一氏	(日本原燃サービス㈱会長)
① 9:50 ①	原産会長所信表明	有澤廣巳氏	(日本原子力産業会議会長)
10:20	原子力委員長代理所感	清成　迪氏	(原子力委員会委員長代理)

〔特別講演〕

	議　長	松井　明氏	(日本原子力文化振興財団理事長 日本原子力産業会議副会長)
10:45	「原子力発電－1980年代の挑戦」		
②		S. エクルンド氏	(国際原子力機関事務総長)
11:30	「エネルギーとアメリカの世界戦略」		
③		D. アブシャイア氏	(ジョージタウン大学戦略国際問題研究センター会長)

≪休　憩(12:15～14:00)≫

セッション1「エネルギーの安全保障と原子力」(14:00～18:00)

	議　長	若林　彊氏	(東北電力㈱社長)
14:00	「日本におけるエネルギーの安全保障」		
		平岩外四氏	(電気事業連合会会長 東京電力㈱社長)
14:40	「フランスの原子力産業の展望」		
④		G. バンドリエス氏	(フランス原子力庁産業応用局長)
15:20	「フィリピンのエネルギー事情と原子力開発」		
		Z. バルトロメ氏	(フィリピン原子力委員会委員長)
	議　長	宮崎　輝氏	(旭化成工業㈱社長)
16:00	「ブラジルにおけるエネルギー問題と原子力の役割」		
		H. カルバリョ氏	(ブラジル原子力委員会委員長)

16：40　「韓国における原子力発電の役割」

⑤　Y．リ　ム　氏　（韓国原子力委員会常任委員）

17：20　「アメリカのエネルギー政策と原子力開発」

⑥　S．ローゼン　氏　（アメリカ　エネルギー省国際原子力計画部長）

レセプション　（18：30～20：00） 日本工業クラブ≪3階大食堂≫

3月11日（水）

セッション2「原子力発電傾斜開発への課題」（9：00～12：00）

議　長　大堀　弘　氏　（共同石油㈱社長　電源開発調整審議会会長代理）

9：00　〔基調講演〕

「これからの原子力発電—合意形成と立地促進に何をなすべきか」

稲葉秀三　氏　（産業研究所理事長）

≪休　憩10分≫

9：50　〔パネル討論〕

稲葉秀三　氏　（産業研究所理事長）
及川孝平　氏　（全国漁業協同組合連合会顧問）
加治木俊道　氏　（関西電力㈱副社長）
笹生　仁　氏　（日本大学生産工学部教授）
須知邦武　氏　（福井県参与）
高橋正男　氏　（全日本労働総同盟副書記長）
比嘉正子　氏　（関西主婦連合会会長）

午餐会（12：20～14：15）≪赤坂プリンスホテル・ロイヤルホール≫ 所　感　田中六助　氏　（通商産業大臣） 〔特別講演〕　「人類の進化と科学技術」 今西錦司　氏　（京都大学名誉教授）

原子力関係映画上映（13：00〜14：00）≪都市センター・ホール≫

自　由　参　加

1. 「海に」

（昭和５５年，北陸電力株式会社製作・日本語２５分）

2. 「スーパー・フェニックス」

（昭和５５年，フランス原子力庁製作，英語１０分）

3. 「今日も世界のどこかで　エネルギーと市民」

（昭和５５年，電気事業連合会製作，日本語２７分）

セッション３「原子力産業の新しい展開」（１４：３０〜１７：３０）

議　長　　田島敏弘氏（日本興業銀行副頭取）

１４：３０　〔キーノート〕

「原子力産業の課題と今後の展望」

佐波正一氏（東京芝浦電気㈱社長）

１４：５０　「新型炉および核燃料サイクルを中心とした技術開発と産業化」

瀬川正男氏（動力炉・核燃料開発事業団理事長）

≪休　憩　５　分≫

１５：１５　〔パネル討論〕

石渡鷹雄氏（科学技術庁原子力局長）

浦田　星氏（㈱日立製作所常務取締役）

大島恵一氏（東京大学工学部教授）

末永聡一氏（三菱重工業㈱副社長）

高橋　宏氏（通商産業省資源エネルギー庁審議官）

堀　一郎氏（東京電力㈱副社長）

牧　浦　隆太郎　氏　（日本ニュークリア・フュエル㈱社長）

〔コメンテータ〕

D・カウチマン　氏　（アメリカNUS社筆頭副社長）

A・ベンメルギ　氏　（フランスEdF社建設局次長）

3月12日（木）

セッション4「原子力開発の国際的展開」（9：30～12：30）

〔国際パネル討論〕

議　　長　　垣　花　秀　雄　氏　（名古屋大学プラズマ研究所長）

〔パネリスト〕

S. エクルンド　氏　（国際原子力機関事務総長）

H. カルバリョ　氏　（ブラジル原子力委員会委員長）

⑦ W. シャーマン　氏　（在日アメリカ公使）

田　宮　茂　文　氏　（日本原燃サービス㈱常務取締役）

Z. バルトロメ　氏　（フィリピン原子力委員会委員長）

G. バンドリエス　氏　（フランス原子力庁産業応用局長）

M. ポップ　氏　（西ドイツ研究技術省エネルギー研究技術開発局長）

矢田部　厚　彦　氏　（外務省科学技術審議官）

セッション5「核燃料サイクルバック・エンドの確立にむけて」（14：00～17：00）

議　　長　　村　田　　浩　氏　（日本原子力研究所顧問）

14：00　「西ドイツにおける再処理と高レベル廃棄物管理の政策と開発」

⑧ C. サランダー　氏　（西ドイツ核燃料再処理会社（DWK）副社長）

14：30　「フランスにおける放射性廃棄物長期管理の産業化」

⑨ J. ラ　ビ　氏　（フランス放射性廃棄物管理庁長官）

≪休　憩　5　分≫

〔パネル討論〕

E・ウイギン	氏	（米国原子力産業会議副理事長）
金岩芳郎	氏	（動力炉・核燃料開発事業団副理事長）
C．サランダー	氏	（西ドイツDWK副社長）
島村武久	氏	（原子力委員会委員）
野村顕雄	氏	（日本原燃サービス㈱専務取締役）
J・ラピ	氏	（フランス放射性廃棄物管理庁長管）

CHECK AGAINST DELIVERY

Expansion of Nuclear Power Development in the World
and the role of the IAEA
Japan Atomic Industrial Forum, 10 March 1981

発表は 3 月 10 日 午前 11 時半
以降に願います。

EMBARGO UNTIL
10 March a.m. 11:30

NUCLEAR POWER - THE CHALLENGE OF THE 1980s

by

Sigvard Eklund
Director General
International Atomic Energy Agency

Nearly everything has been said in the last few years not once but many times about energy questions in general and nuclear energy in particular. Even if it thus is difficult to avoid repeating things which are already well known to you, I am happy to have been invited to address this distinguished audience representing so many decision makers especially in this part of the world.

I have called my contribution "Nuclear Power - the Challenge of the 1980s" which means that I will analyse available data to forecast what will happen in the nuclear field during the decade which has just started. With the word "challenge" I want to underline the potential which nuclear energy possesses to contribute to the solution of the world's energy problems. Existing energy systems have a remarkable inertia and that nuclear power now contributes 8% of the world's generation of electricity is in itself proof of the

If OPEC should continue to raise the crude oil price in the future for such reasons, it is evident that there will be a third and fourth oil crisis. In view of this prospect, the industrially advanced nations must make every effort to save on oil consumption and to adopt alternative energy in massive amounts.

The alternative energy to be developed and utilized must be cheaper than oil, immediately usable and available on large scale. On top of this, it must involve only a small outlay of foreign exchange. At present these conditions can be met only by coal and nuclear power.

Coal is the most promising alternative to oil because its deposits are abundant and are found in many parts of the world. In 1980, Japan imported 5,220,000 tons of general coal for such uses as boiler fuel and in the manufacturing of cement. In future, Japan's coal requirement will rise to 40-50 million tons. In order to secure such an enormous amount of coal, it will be necessary to develop coal mines overseas and to establish a coal chain for transporting coal from the producing to the consuming centers. A lead time of seven or eight years is necessary for this.

In order to effect a shift from oil to coal on full scale, liquefaction of coal is necessary. Many countries including Japan are pushing the development of this technology but we will have to wait until the early 1990s, at the earliest, for the construction of a commercial liquefaction plant.

As for nuclear power, a generation unit of the 1,000MWe class has already been commercialized, and 247 units with a combined capacity of 146,500MWe are in operation in 22 countries.

In the 15 years since the Tokai Nuclear Power Plant (GCR) became operative in 1966, a total of 21 nuclear power plants with a combined capacity of 15,000MWe have gone into operation in Japan. The average annual capacity factor last year was 61.2%. As a result, the generated output in 1980 increased by 11% over the preceding year. This increase represents a savings of 3,300,000 kiloliters of oil. The performance of all nuclear power plants in Japan in 1980 is equivalent, moreover, to an annual consumption of 18 million kiloliters of oil at thermal power plants.

As of September 1980, the comparative generating cost of one KWh of electricity was roughly ¥18.00 in the case of oil-burning thermal power plant while it was almost half, or about ¥9.00, in the case of nuclear power, and ¥13.00 in case of coal-fired plant. In terms of foreign exchange outlay to procure fuel, nuclear power generation needs only about one-eighth that of oil-burning thermal power generation. In addition, fuel requirement of a nuclear power plant is a mere one-ten thousand of an oil-burning thermal power plant. Moreover, a nuclear power plant can be run for almost a year with a single fuel charge, showing that nuclear power is outstanding from the point of view of energy security.

However, the construction of nuclear power plants in Japan is not progressing as smoothly as desired. According to a study made by JAIF, France which has very little oil resource has scheduled a program to start up five new nuclear power plants every year. Even the Soviet Union, which is the world's biggest oil producer, plans to commission about four nuclear plants every year. In Japan, however, not a single new nuclear power plant went into operation in 1980. In the next five years, Japan plans to start up only two plants a year on the average. It goes without saying that a country like Japan which depends for the greater part of its primary energy on imported oil needs to push nuclear power development more vigorously.

In November last year, the Japanese Government adopted for the first time at a Cabinet meeting a target for development of energy alternative to oil. The target that was adopted is to start operating by 1990 new nuclear power plants with a total output of 51,000-53,000MWe. This Cabinet decision reveals the Government's strong determination to push nuclear power development. Responding to the Government decision, we in the nuclear industry must, as a matter of course, promote nuclear power development more vigorously than ever before. In view of the fact that nuclear power development will largely affect the fate of the Japanese economy of the future, it should be promoted not only by the nuclear industry alone but also in cooperation with Japanese industry as a whole.

The biggest bottleneck in promoting nuclear development is the siting problem. The problem of safety is a big factor in siting. The results of public opinion surveys show that three out of every four Japanese are in favor of nuclear power development. However, it is also a fact that many people are emotionally opposed to the construction of a nuclear power plant close to where they live. That the Mayor of Kubokawa Town was removed from office in a recall vote held recently, is an expression of this sentiment. We must draw a lesson from this that we have lacked in efforts to persuade anti-nuclear residents.

We have already accumulated 25 years of experience in ensuring safety, and the safety of nuclear power plants, compared with that of plants of other industries, has reached a stage of maturity. Morevoer, confirmation of safety is being conducted with national authority and on the responsibility of the Nuclear Safety Commission for the public, through the system of double check carried out by the safety reviews of the competent ministries and of the Nuclear Safety Commission which is burdened with public trust and commitment. I think that the public can place confidence in this double checking.

The residents of a nuclear power plant site have the right to receive benefits. The discount in electricity charges for residents of nuclear power plant sites which will be started in fiscal 1981, subsidies for the maintenance of public facilities and for the development of industries in those prefectures which supply electric power (prefectures which consume less power than they generate) are measures designed to benefit residents of nuclear power plant sites. Private industry, too, must continue to make greater efforts to the development of local industries and to the welfare of local people, as well as to gaining full public understanding on the safety of nuclear power plants.

Regarding the currently escalating problem of fisheries compensation in places affected by nuclear power plants, opinion is gaining ground that a set of rules should be established and that measures should be taken to promote the fishing industry of the entire prefecture where a nuclear power plant is located. On this point, too, the problem must be fully studied from the point of view of a program for the future promotion of coastal fishing.

Whether the Japanese economy will be able to overcome the third and the fourth oil crisis depends on the development of energy alternative to oil and particularly to the smooth determination of sites for nuclear power plants. The next five or six years will be critical in this respect. We must fully realize that a delay in the construction of nuclear power plants will have adverse effects on the economy and that this in turn will eventually increase the burden on each member of our society. With this in mind, we must promote nuclear power development.

While promoting nuclear power generation, we must also promote development of nuclear fuel cycle and advanced power reactors. At the last JAIF annual conference, I reported that the Japanese nuclear fuel cycle had been all but completed, though on a small scale. Subsequent developments include the expansion of the Ningyo-Toge Uranium Enrichment Pilot Plant and the start of designing of the prototype plant with a capacity of 250SWU/year. Moreover, the power industry has announced its basic policy of playing a central role in building a commercial uranium enrichment plant. As for spent fuel reprocessing, the Tokai Reprocessing Plant has begun full-scale operation since January this year, while Japan Nuclear Fuel Service Co. has begun making preparations for the construction of the second reprocessing plant (a commercial plant), including the selection of its site.

As for advanced power reactors, a plan to construct a demonstration Advanced Thermal Reactor (ATR) with a capacity of 600MWe is being studied, and the Atomic Energy Commission is expected to hand down its final decision on this shortly. The construction of the prototype FBR "Monju" is scheduled to start in fiscal 1981. The FBR Engineering Co. was established by manufacturers as a private organ to engage in FBR development, while the FBR Development Preparation Office was set up under the supervision of the Federation of Electric Power Companies on behalf of users.

This is evidence that the private sector is getting organized to grapple with the development of the nuclear fuel cycle and of advanced power reactors. Steady progress is being made towards commercialization. Adequate consideration must be paid so that these technology and services may be able to contribute not only to the domestic needs alone but to the development of peaceful uses of atomic energy of the world , as well.

In connection with nuclear power development, further stepped-up efforts are needed in the field of raioactive waste disposal. We will have to postpone the projected experimental disposal of low-level radioactive waste into the sea because we have not been able to obtain the understanding of Pacific Ocean countries on this plan. However, technical measures have all but been completed.

Regarding the disposal of high-level radioactive waste, development of disposal technology is progressing. Judging from the situation in other countries, the direction of the development of disposal technology is obvious, and there is no doubt that the technology currently under development will be perfected shortly.

The Atomic Energy Commission in November last year drew up a policy on the research and development program concerning vitrification and final disposal of high-level radioactive waste in order to carry out experimental geological disposal in 2015 as scheduled. Under this policy, it is essential for us to grapple vigorously with the development of geological disposal technology as a national project through the combined efforts of the Government, academic circles and the private sector. As a way to obtain public understanding, it is vital to start now to inform the people about the system of geological disposal.

It is the responsibility of each country to dispose of the high-level radioactive waste it produces. However, I think that universal international standards are necessary as a guideline on high-level radioactive waste disposal. The advisability of safety checking not only by the disposing nation but also by an international surveillance organ at the time of disposal must be studied.

Nuclear power, which is the most effective energy alternative to petroleum, will become an important energy source even in countries which have not yet started nuclear power generation. No country can be prevented from developing nuclear power. As stipulated in the Non-Proliferation Treaty of Nuclear Weapons (NPT), all countries that have ratified NPT should be given positive international cooperation in utilizing atomic energy for peaceful purposes. A number of ways to facilitate international cooperation for peaceful uses of atomic energy are conceivable. One of them is to place on the international market under the full-scope safeguards of IAEA not only atomic reactor components and materials but also nuclear fuel and its services and to standardize internationally the quality assurance of such components and materials.

The advanced nuclear countries should open their doors widely to countries wishing to undertake research on peaceful utilization of atomic energy in the future, and help them in accordance with each country's stage of development. I think it is desirable and most efficient for an international organ like IAEA to provide comprehensive basic education and training to nuclear power engineers.

It goes without saying that such international cooperation measures must be promoted gradually but in a comprehensive manner which matches the situation, policies and development of each country. The RCA Project

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This means that nuclear energy already possesses a substantial amount of inertia and will be with us for a considerable time even in the event its further growth is not actively promoted by decision makers.

Although we love to think that the future is ours and can be formed according to our wishes and intentions, it is a fact that the next few years, let us say five, are already committed for developments decided upon by people in charge before now.

As a consequence, the developments in nuclear energy within our societies in the next five years can be foreseen with a rather high degree of accuracy under the assumption, of course, that peace will prevail and the need for energy will develop along the same pattern as in the past, based upon reasonable industrial growth and other relevant factors. It is unfortunately much more difficult to interpret the signs of the crystal ball as to what may happen in the energy field five to ten years from now.

Before proceeding further I would like to say a few words about conservation of energy. It is obvious that waste of energy should be avoided, whenever it is possible, and remarkable results have already been achieved in a number of countries by different conservation measures. I would here especially mention the promising development of heat pumps which, driven by electricity from, for example, a nuclear power station, seem to offer tremendous possibilities for energy conservation for individual house or district heating. Heat pumps for 10 MW will soon be common in several industrialized countries. In the Federal Republic of Germany heat pump sales increased from 36,000 units in 1979 to some 100,000 in 1980 and in my own country, Sweden, they have been doubling every year over the past few years. I would also like to point out that when man's ingenuity has enabled him to produce almost unlimited amounts of cheap energy, it is a pity not to make full use of that ability in order to improve his living conditions.

Consequently, I don't agree with those who, in Sweden, say that although surplus electricity is available and electricity is a very convenient form of energy for heating apartments and houses, it should not be used for such purposes because of the large power stations required which don't fit the philosophy of the green wave.

In other words, I believe that the good times will return again when people appreciate that there is energy to be used and, at the same time, will understand and, through democratic means, approve of its production.

Now to my topic. First ten slides to demonstrate the actual situation and the most probable forecast up to the year 1990. The term OECD countries refers to the 24 countries members of OECD, including Japan. OECD Pacific is composed of Australia, Japan and New Zealand. CPE stands for countries with a centrally-planned economy and is comprised of the 13 socialist countries.

The first slide (Fig. 1) presents the number and power of reactors now operating or under construction and their distribution over different geographical areas. In spite of the nuclear situation in the USA the nuclear power plants under construction there will almost treble the installed capacity by 1990. The same will be true for Canada. The only other industrialized countries which have large rates of increase are France - 4x higher in 1990 - Japan - 3,3x higher and the USSR - 4-5x higher as compared with 1980.

On the other side, the developing countries have limited plans, and we see no great increase in the number of developing countries with a commitment to nuclear power in the 1980s from the eight countries now with nuclear power plants in operation or under construction. Some 4 to 5 new countries are now considering nuclear power, like Egypt, Greece, Indonesia, Portugal and Turkey, but not all are likely to make a commitment.

The first two tables present the estimates of total and nuclear electricity generating capacity in the world and its breakdown into industrialized and developing countries (Table 1) and by country groups (Table 2). In 1980, nuclear capacity in the world was 136 GWe or 7% of the nearly 2,000 GWe installed total capacity in the world including all types of power generation. Industrialized OECD and centrally-planned European countries have almost 98% of the nuclear capacity in the world, whereas in developing countries the corresponding figure is only 2%. In 1990 nuclear generating capacity will be about 458 GWe or about 13% of the estimated total generating capacity in the world.

The next two tables present estimates of total electricity generation and contribution by nuclear power on a worldwide basis (Table 3) and by main country groups (Table 4) up to the year 1990. The nuclear share of electricity generation is slightly higher than the percentage of nuclear capacity as nuclear power plants are normally used for base-load generation. It proves again that OECD and centrally-planned European Countries will continue to be the countries with the largest contributions to nuclear generation in the next 10 years. It also proves that Asia - without Japan - and Latin America will start to show substantial electricity generation by nuclear power at the end of this decade.

The next slide (Fig. 2) depicts the age distribution of operational reactors older than 8 years. As shown, a total of 97 reactors have been in operation for more than 8 years and 32 for periods between 8 and 10 years. 159 reactors are less than 8 years old out of the 256 reactors operating in the world. Six reactors have already been in operation for more than 20 years. Altogether around 2200 reactor years of experience have now been accumulated, and the technology of nuclear power has reached a state of maturity, safety and reliabiligy.

How have these reactors performed? The slide (Fig. 3) summarizes the load and operating factors between 1975-1979. The load factor is a performance measure in that it is the energy actually produced divided by the energy which could have been produced with operation at maximum power the whole of the time concerned. The operating factor is a measure of availability, being the time in operation divided by the total time.

It is interesting to note that since 1975 there has been a slow increase in both factors until 1979 when both dropped significantly. We still have to confirm this by analysis of data but it appears that the drop is due to regulatory action after the TMI accident. As the 1978 and 1979 data are based on 156 and 176 reactor units respectively, there is no doubt about the significance of the drop.

In this context it should be mentioned that data from the last World Energy Conference indicate that the "unavailability" of nuclear units has generally been similar to that of fossil-fuel plants in a comparable size range - namely, about 30-35%.

Referring to the next slide (Table 5) the year 1980 was again not promising in terms of new orders. Only 15 reactors with a total capacity of 14,6 GWe were ordered in France, the Federal Republic of Germany, the Republic of Korea, Romania and the UK. However, 12 orders for reactors - with a total capacity of 13 GWe - were either cancelled or postponed in the USA, which corresponds to a net capacity increase of only 1,6 GWe.

Comparing the general nuclear situation in 1980 with the period up to 1990 it seems at first view that we have reached the lowest point now. However, appearances are deceiving, which I would like to underline with the next two slides. Fig. 4 depicts the amount of nuclear capacity to be added yearly for the period 1981-1990 based on reactors under construction or fully committed for construction. In 1981 about 43 GWe will be added to nuclear capacity, for the period 1982-1985 a yearly addition of between 30 and 35 GWe will be made and beyond 1987 the nuclear capacity addition per year will be in the range of 15 to 25 GWe. The picture becomes worse, however, considering the starting date of reactor construction for the same period (Fig. 5). Slightly more than 10 GWe will start construction in 1981 and about 52 GWe in 1982. Beyond 1983 construction in nuclear power plants already committed reduces drastically to about 12 GWe in 1983 and 1984 to figures below 5 GWe beyond 1985. The last two slides give me reason to draw your attention to the large difference which exists in different countries in lead times from commitment to commercial operation for plants now under construction. The averages of these lead times are for Japan (8 plants under construction) 61 months, for France (29 plants) 63 months, for the Federal Republic of Germany (7 plants) 82 months and for the USA (81 plants) 121 months. The difference may be almost exclusively related to the more or less complicated regulatory procedures for construction permits, operating licenses etc. If new individual plants are not committed now, taking into account the long lead time, as just mentioned, a general slow-down of nuclear power programmes beyond the year 1990 is likely with serious consequences for the nuclear industry. I am sure it is not necessary to elaborate further on the situation.

After this outline of nuclear power reactor development in the 1980s it is natural to turn to the provision of fuel during the decade and to other aspects of the fuel cycle. The challenge concentrates on the very beginning and the back end of the fuel cycle. Again a few slides will underline my statement. The challenge of the 1980s with regard to natural uranium is to reconcile a much-reduced requirement for uranium for existing and planned nuclear reactors with the present and indicated future overcapacity in the uranium mining industry.

Industry-based forecasts of uranium requirements and production, as shown in Fig. 6 are therefore quite pessimistic at the present time and they reflect the industry's concern about uncertainties in forecasting the rate of future additions to installed nuclear generating capacity.

Since it reached its peak in 1978 the market for uranium has experienced a more or less continuous decline. In February 1981 prices for uranium sank to US $ 65 per kg of U on the spot market, which in real terms is less than half its value in 1978 of 112 US $ per kg of U. Because of the general perception that additional uranium will be readily available from new production and stockpile liquidations there is little hope for a turn-around in market conditions. This emerging trend will cause fairly drastic changes in the geographic distribution of uranium production as shown in Fig. 7. During this decade uranium production should grow considerably in Australia and Canada where large new mines are under development, while production from the US and Africa should remain static and decrease in relative importance. This forecast also implies that developing countries will have little chance to attract capital for new uranium ventures and will be particularly subject to the economic impact of low uranium prices.

One additional point should be made with regard to the availability of assured supplies of uranium now and in the future. Table 6 shows an estimate of maximum, technically attainable production capabilities from the known resource base for the years 1980, 1985 and 1990. These figures are considerably higher than those for estimated uranium requirements and production and they indicate the large reserve capacity built into the existing industry. But until the dismal conditions of the present uranium market are reversed there should be considerable worry about the uranium industry's ability to define and develop additional production centres for the decades beyond 1990. Delineation and preliminary engineering of many promising uranium occurrences are being neglected world-wide and their financing cannot be obtained at today's depressed prices. It is to be hoped that this situation can be changed before the industry's production base becomes too weak to support the requirement for uranium beyond 1990.

Most of the reactors in operation or planned for the decade require enriched uranium. The next slide (Table 7) presents the capacities of isotopic enrichment plants in 1980 and 1985. Taking into account that the estimated total nuclear capacity of 458 GWe in 1990 requires a capacity of approximately 50.000 tons SWU per year, which will be available in 1985, over-production could be expected in the near future if all newly-committed facilities were to be implemented.

A similar situation can be expected in respect of the capacity of fuel fabrication plants (Table 8) as the available capacity of around 9500 tons uranium per annum in 1985 is in accordance with the requirements of the estimated 310 GWe capacity in the same year.

Again, the forecast of spent fuel storage capacity shows that during the 1980s until 1990 on a world-wide and regional basis no major problems are foreseeable. However, it must be stressed that an overall comparison of spent fuel arisings and available storage capacity does not reflect the real situation because the spent fuel cannot be freely distributed among the available storage locations. Therefore, some individual States and utilities will have inadequate storage capacities and some alternative storage techniques will have to be used - transshipments to other pools, cask storage, double stacking of spent fuel, etc.

The major problems are likely to occur in the following decade - 1990-2000. The next slide (Fig. 8) shows a summary of data available to the Agency from the INFCE and ISFM studies. The 1990 data would imply that the problems might be resolved on a regional basis whereas the data for the year 2000 indicate that major alternatives for storage must be explored. Due to the lack of new reactors the at-reactor storage capacity essentially stabilizes while the arisings continue to be generated. This implies that the additional needs for spent fuel management will have to be accommodated by away-from-reactor storage as well as reprocessing or disposal capabilities. The studies show that even if the projected reprocessing capacities become operational as scheduled, there will be a significant amount of fuel to be stored or disposed of.

For reasons of completeness only I would like to make a few remarks on reprocessing. As shown in the next slide (Table 9) the available capacity in 1980 of 1150 tons of uranium per year corresponds only to approximately 20% of the capacity needed to reprocess all irradiated fuel; in 1985 the theoretically available capacity of 5075 tons uranium/annum would be enough to reprocess around 50% of the spent fuel arisings. Everybody will agree that urgent decisions on the political level are needed first of all to demonstrate the technical feasibility of large scale industrial reprocessing which should be the basis for long-term commitments, international institutional arrangements and the restoration of confidence in this part of the nuclear fuel cycle, which is so important for the introduction of fast breeder reactors.

Finally, another important challenge of the 1980s is the management of radioactive waste disposal. We all know that during the 1970s it became evident that the safe management and disposal of radioactive waste is of central importance for the further development and acceptance of nuclear power. However, among nuclear waste managers it is generally agreed that proper disposal of radioactive waste can provide the necessary long-term isolation and therefore protection of both man and the environment. The two requirements for proper disposal are: first to prepare and condition the wastes and secondly; dispose of them in suitable underground sites.

Many countries have extensive programmes to explore the suitability of repository sites in geological formations in their territories and have established national systems for the long-term management of radioactive wastes. Some countries have special national organizations to deal with these issues. In addition much progress has been made on the various conditioning and packaging techniques for all types of radioactive wastes that are necessary prior to storage and disposal.

In the coming decade I expect many more countries will define appropriate waste management systems for their national nuclear power programmes. This will include the management of low-intermediate-level waste, the interim storage of high-level waste and the establishment of repositories for high-level and alpha-bearing waste. In several advanced countries, I expect that high-level wastes will be solidified and prepared for storage on an industrial scale.

As is the case now, the storage and disposal of radioactive wastes will be a matter for national control. However, regional and even international solutions may be sought for the storage and disposal of high-level wastes. This offers an advantage to countries with small nuclear programmes and with few sites with which to store or dispose of their wastes. This plan will have to be examined in an international forum in order to meet the needs of all parties.

The Agency's radioactive waste management programme in cooperation with other international organizations in this field, will take the lead in reaching a consensus on the safety requirements to ensure safe disposal of radioactive wastes. In this regard, the Agency plans to hold a major International Conference on Radioactive Waste Management in 1983 which will address these issues to find solutions that will ensure the safe disposal of all types of radioactive wastes.

A review of the challenge of the 1980s is, however, not complete without mentioning the economic aspects of energy supply.

The dramatic rise in energy costs, driven by oil price increases since 1973-1974, has played a significant role in world-wide inflation and consequently economic recessions and unemployment. All countries - both industrialized and developing - are faced with finding reliable energy supplies at acceptable costs. Nuclear power has the potential to offer an alternative immediately.

Today's oil prices are such that nuclear-generated electricity is cheaper than electricity from oil-fired power stations. In the comparison of costs of electricity from nuclear and coal-fired power plants, the outcome depends on a number of factors and there is no single global answer. However, the picture is generally favourable to nuclear.

The key economic factor for coal-generated electricity is the cost of coal. For nuclear power, the key factors are the plant's investment cost and its performance. One of the challenges for nuclear power in the 1980s will be to achieve shorter licensing and construction times, in order to reduce nuclear plant investment costs.

Certainly, nuclear power plants are much less affected by the costs of fuel resources than are fossil-fueled power plants. Doubling the price of uranium used to fuel current nuclear plants would increase the cost of nuclear generated electricity by only 10%, whereas a doubling of fossil fuel prices would lead to a 65% increase in the costs of electricity from fossil-fired power plants. Thus, those utilities and countries with large commitments to nuclear power are less affected by price increases for fuel.

Realization of this potential, however, will require concerted action to overcome the present problems with public acceptance of nuclear power, which have prevented more wide-spread deployment to date. This has resulted in the continuing large-scale use of oil and coal for electricity generation, even though the economics favour nuclear. For example, large nuclear power plants can produce electricity at costs as much as 25-50% below the costs from coal-fired power plants, depending on the costs of coal and uranium. Over 30 years of operation, this would save enough money to build one or two new nuclear power plants. The savings are even greater in relation to oil-fired power plants.

The technical improvements in proven reactor types during the 1980s will probably only be minor and mainly based on the experience gained during the three decades nuclear power reactors have been operating and, as mentioned earlier, during which time 2200 power reactor years of experience have been accumulated. It should be recognized that experience will increase rapidly during the 1980s. In the beginning of the decade 250 reactor years are to be added each year, in the middle about 450 and in 1990 some 600, i.e. the accumulated experience then will be some 6000 reactor years.

This should make possible the increased standardization of plant design through cooperation between manufacturers, owners and regulating authorities which, besides its direct impact on costs, would also decrease the licensing time and lead times from commitment to commercial operation, to say nothing of its contribution to the safety of the plant.

The regulatory requirements make plants more complex and a balance must be maintained between the purpose of new requirements added and weaknesses which may be introduced by the increased complexity. It is to be hoped that the extreme difficulties caused by backfitting during construction and operation can be avoided. These requirements, not new reactor orders, now keep the nuclear industry busy.

The rapid development of control and instrumentation systems and the use of data processors may lead to instances where the control and instrumentation systems will be exchanged completely during the lifetime of a plant.

A fundamental question is represented by the behaviour of structural materials under the circumstances prevailing in a reactor system (intense radiation, coolant-material interface etc.).

Reports about these problems appear time after time and it is of utmost importance to learn what causes the defects and to determine their real significance. These questions are fundamental for determination of the lifetime of a plant and have, in the Federal Republic of Germany, led to the development of a programme called base-line-safety including considerations of material choice, material casting, manufacturing, welding, corrosion resistance and long term behaviour under irradiation and stress. The programme is supported by research and "lessons learned" from operating plants.

It is appropriate to point out that there will be failures in power reactor systems also in the future as there is a risk of failure associated with every complex technology. But it must also be recalled that up to now there has not been a single fatal accident caused by radiation in a nuclear power plant for peaceful purposes. The many barriers incorporated to prevent release of dangerous amounts of radioactivity to the biosphere surrounding a nuclear plant have, up to now, fulfilled their purpose.

The increased use of nuclear power should also be followed by its incorporation as a natural part of our environment in the minds of people and news media so that a steam-valve leakage or turbine-trip in a nuclear power station would be given the same news value as similar happenings in a conventional power station. Words are misused these days and if, for example, the TMI incident is referred to as "a catastrophe", one would hope that any future accidents could be similar "catastrophes".

I cannot end my comments here without making reference to the tens of thousands of nuclear weapons in storage in different parts of the world, the existence of which is accepted calmly by people, although they should know that these weapons represent a total explosive power corresponding to 3 tons of TNT for every individual now living.

There is a shocking difference in the criteria applied, which has led to the quiet acceptance of nuclear weapons and to an artificial excitement being generated against nuclear plants for peaceful purposes.

But TMI was a catastrophe from an economic point of view, and it will probably be mandatory for utilities in the future to see to it that they, by internal arrangements, share the economic burden which an accident may impose on them.

To what extent will developing countries make use of nuclear power during the decade? I have already demonstrated the growth of nuclear power in a few developing countries in my first slides. An elevenfold increase is foreseen but is limited to half a dozen countries. The reason is that the promotion work in the field of nuclear power has to consider the consistent trend by designers and manufacturers towards units with a generating capacity of 1000-13000 MWs. Units of such size require the existence of a prepared infrastructure in the receiving country. I am here referring to an electric grid of sufficient capacity as well as to the manpower and facilities necessary to cope with routine maintenance and emergency situations.

An old rule of thumb says that no generating unit in an electric grid should generate more than 10% of the total generating capacity. Economy of scale has led to the development of the very large stations which means that they can only be incorporated in systems with capacities of at least 5000 to 7000 megawatts, which in turn leads to the conclusion that these large reactors can only be introduced in a very few developing countries. We have recently learned that some reactor manufacturers are now studying the possibility of constructing much smaller nuclear power reactors where what has been lost with regard to economy of scale is compensated for by simplification in the design, while still maintaining the same degree of safety incorporated into the larger units.

It is certain, however, that developing these small units, marketing them and getting them licensed will take a considerable time. In the meantime, I can only hope that the switch to nuclear energy by developed countries will ease the pressure on the crude oil market and make it possible for developing countries to expand their conventional electric systems to the size and infrastructural maturity required for the incorporation of nuclear reactors.

Two other topics will certainly remain in the forefront in developing nuclear power during the 1980s, viz. safety and safeguards.

Developments in Nuclear Safety can be said to fall into three different categories, viz. Regulations, Operational Safety and Safety Systems.

The primary challenge during the 1980s will be to set regulatory priorities among the outstanding safety issues in such a way that the occurrence of significant disturbances in old and new nuclear plants is minimized. In this context it is appropriate to recall the importance of international harmonization of nuclear standards, in particular of the level of basic criteria and approaches and the contribution made by the NUSS (Nuclear Safety Standards) programme of the IAEA. Another point to be made is the assurance of public safety through a balanced trilogy of design-operation, siting and emergency planning.

Operational Safety has been improvved by a marked development in two major areas, efforts which, however, will have to continue, viz. evaluation of operating experience and consideration of human factors. A principal difficulty in the evalutaion process is to identify the few significant items out of an increasing flood of event reports from national and international exchanges. The human element has, after TMI, been recongized as a factor which influences safety through design, operation, maintenance and management of plants. The IAEA should, in full cooperation with Member States and with full consideration of different conditions prevailing in different countries, attempt to establish competence criteria for operating and maintenance staff. The use of simulators also for analysis of systems behaviour should become standard.

Much effort has been spent on hypothetical core melt accidents. The evolutionary changes which are expected for heat removal, its power supply and emergency cooling will probably make work on theoretical core melt accidents less urgent.

The Agency's conference in September 1982 on Three Decades of Nuclear Power Operation should give Member States and their utilities a most valuable survey of the vast amount of experience already accumulated today over some 2200 years of reactor operation.

I would now like to turn to the future evolution of safeguards and the related question of supply assurances which is the object of a study by a Committee on Assurance of Supply (CAS) appointed by the IAEA Board.

We all understand how sensitive the nuclear supply policy question must be for a country like Japan. Being dependent upon imports for both fossil fuels and uranium, the only possible avenue at present towards a measure of energy independence seems to be in the development of the breeder, and it is understandable that reprocessing must, because of this, be important for Japan. We are also aware of the problems and uncertainties you face in this regard. I hope that 1981 will bring a satisfactory solution enabling you to continue along the road you have, in my view, wisely chosen.

In the broader international context, it is my view that we are not likely to see any major new institutional arrangements for the strengthening of safeguards in the immediate future. The international plutonium storage scheme may come into existence but on a limited scale and seems unlikely to attract the half dozen countries that are now, or may in the future, operate unsafeguarded fuel cycle facilities. None of the other institutions or arrangements identified by INFCE is yet showing any vigorous signs of life.

In these circumstances, it is all the more important to maintain and strengthen the non-proliferation means that we already have at hand, in particular, the NPT, the Tlatelolco Treaty and the IAEA safeguards operation. For the remainder of the century, the non-proliferation regime will rest on these foundations. As the two NPT Review Conferences have shown, full implementation of the NPT by 1995, when it is due to run out (and hopefully beyond then) will be difficult enough and should receive all our attention, including that of nuclear-weapon States. This task could be much easier if the latter could agree on a comprehensive Treaty banning every form of nuclear explosion as well as on positive measures to encourage adhesion to the NPT. A hopeful development has been the recent accession of Egypt to the NPT coupled with the announced letter of intent with France which may represent the start of an ambitious nuclear power programme.

There are still about half a dozen countries with significant nuclear programmes outside safeguards which have sofar not joined the NPT. The possibility that a non-nuclear weapon state outside the NPT might explode a nuclear device during the 1980s is thus an ominous prospect indeed. The international community should ponder well over the implications of such a development in the realities of the world in which we live today. Wisdom and prudence dictate that no further time is lost and no effort is spared in creating conditions which would generate the necessary political will among these countries also to join the NPT, thus making it universal.

International consensus on supply assurances may not be easy to reach. The positions of some of the countries chiefly concerned are still far apart. On the one hand, there are the concepts reflected in 1978 US legislation - the Nuclear Non-Proliferation Act - in which the exporting country would have a major voice in determining the fuel cycle of its trading partner and, in particular, whether the latter would be permitted to develop reprocessing and fast breeders. To this should be added the possibility the US has to stop any deliveries of equipment which in the receiving country may have a damaging impact on the environment or with regard to safety, lead to the introduction of, from the US point of view, non-acceptable risks. At the other end of the spectrum, there is a reluctance of some threshold countries to accept the full-scope safeguards which would probably be regarded as an essential component of any agreement.

While CAS deliberates, the nuclear industry, beset by so many difficulties, cannot afford to wait. One must, therefore, expect that there will be some ad hoc solutions to the supply problem, like the Agreement that Australia has recently concluded with France which gives, in effect, blanket advance agreement to reprocessing for purposes of energy production and spent fuel management within a defined fuel cycle programme and under IAEA safeguards.

It seems likely that other major suppliers will have to chart their own routes to agreement with their major customers, perhaps along lines similar to the two supply agreements I have mentioned.

This, of course, relates only to the supply of nuclear materials. For a nuclear industry which in some countries is showing signs of terminal disease, the export of plant is also crucial. I have often expressed the view that new supply agreements should require the application of full-scope safeguards. The much criticized London Guidelines focused, perhaps unfortunately, on the question of so-called sensitive technologies rather than on the need for full-scope safeguards. However, even those exporters which were once reluctant to require full-scope safeguards now seem to be edging towards this requirement, as the Egyptian case suggests.

The question of access to technology and especially the so-called sensitive technology, is difficult. Experience repeatedly shows that there is no way of permanently preventing other countries from mastering even the most sensitive fuel-cycle processes, if they are determined to do so. This has been the lesson of nuclear energy since 1945. Knowledge once given away cannot be retracted. On the other hand, no-one wishes to see an unnecessary proliferation of small enrichment and reprocessing facilities. Many solutions have been suggested, including the multi-national fuel cycle centre, which unfortunately up to now has not received political support. The answer certainly does not lie in a policy of denial. On the contrary, as we have recently seen, this is likely to achieve exactly the opposite of what it seeks, and to provide a spur to the proliferation of scattered small national fuel cycles instead of one or more internationally inter-dependent large fuel cycles. We must seek the solution at the regional as well as the international level and perhaps the Far East in which there are now a number of expanding nuclear power programmes could explore further the possibility of regional fuel cycle cooperation.

Suppose now that the development of nuclear power and associated activities will follow the pattern outlined for 1981-1990; how would the International Atomic Energy Agency react to these circumstances, quite different from those prevailing in 1957 when the Agency was established?

The changing environment for atomic energy is obvious from the fact that a number of Atomic Energy Commissions have been restructured to encompass in some cases energy questions in general.

Let us first recall some basic facts. The Agency has, at present, 110 Member States. Research reactors exist in 45 states and power reactors now in 22; at the end of the decade in perhaps 25 states.

As the Agency has to be useful also for Member States which don't possess a reactor, the work going on promoting the use of radiation and isotopes has to continue in spite of the fact that isotope techniques now are routine procedures in most sciences. Of special importance are applications in medicine for both diagnostic and therapeutic purposes, in agriculture and hydrology. The Regional Cooperation Agreements so energetically pursued by the former Deputy Director General, Professor KAKIHANA, and supported by Japanese Authorities, could serve as an efficient tool for such purposes in the Agency's technical assistance programme.

Another important activity in the Agency in the 1980s is safeguards, which I have already touched upon when I talked about assurance of supply.

It may be worth recalling that NPT Agreements between the Agency and States provide that the objective of safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of nuclear explosive devices or for purposes unknown and deterrence of such diversion by the risk of early detection.

This sounds good if pronounced quickly but has to be translated into goal quantities which can serve as feasible guidelines to safeguards approaches and inspection plans, for the evaluation of the performance of the Inspectorate etc.

In the late 1980s large bulk-handling facilities may come under safeguards where different detection goals may have to be defined and already ongoing work on these new approaches may lead as well to reconsideration of the goals applied at present.

One very important element here is the application of safeguards-oriented design for different types of nuclear facilities. Such designs could also be most helpful in covering the security requirements which have been specified in the Convention on the Physical Protection of Nuclear Material, now signed by 27 States as well as the Commission of the European Communities.

There has been a most remarkable development in the field of safeguards since the NPT came into force in 1970. Not only has the safeguard activitiy in the Agency increased considerably as seen from the budget increase from 1M $ in 1970 to 25M in 1981, but organizational arrangements have changed, the competence of the inspectors, not the least demonstrated by their professional organizations, and the sophisticated equipment available to them and last but not least, the national accountancy and safeguards systems which have been set up, all attest to a certain maturity.

It is expected that in the mid-1980s the workload of the Safeguards Department will level off with only a moderate increase in the number of facilities to be safeguarded. I personally think that in the 1980s, as a new development, Member States may become interested in making a fundamental study of the application of safeguards in the future in the light of the experience gained and for example, the establishment of international or national fuel cycle centres to which safeguards may be concentrated instead of to fuel element accounting for individual light water reactors.

Based upon available documentation now in the IAEA in the form of national forecasts and plans, I have tried to give you a picture of the actual nuclear situation and to indicate what we may expect in this field in the decade which has just started.

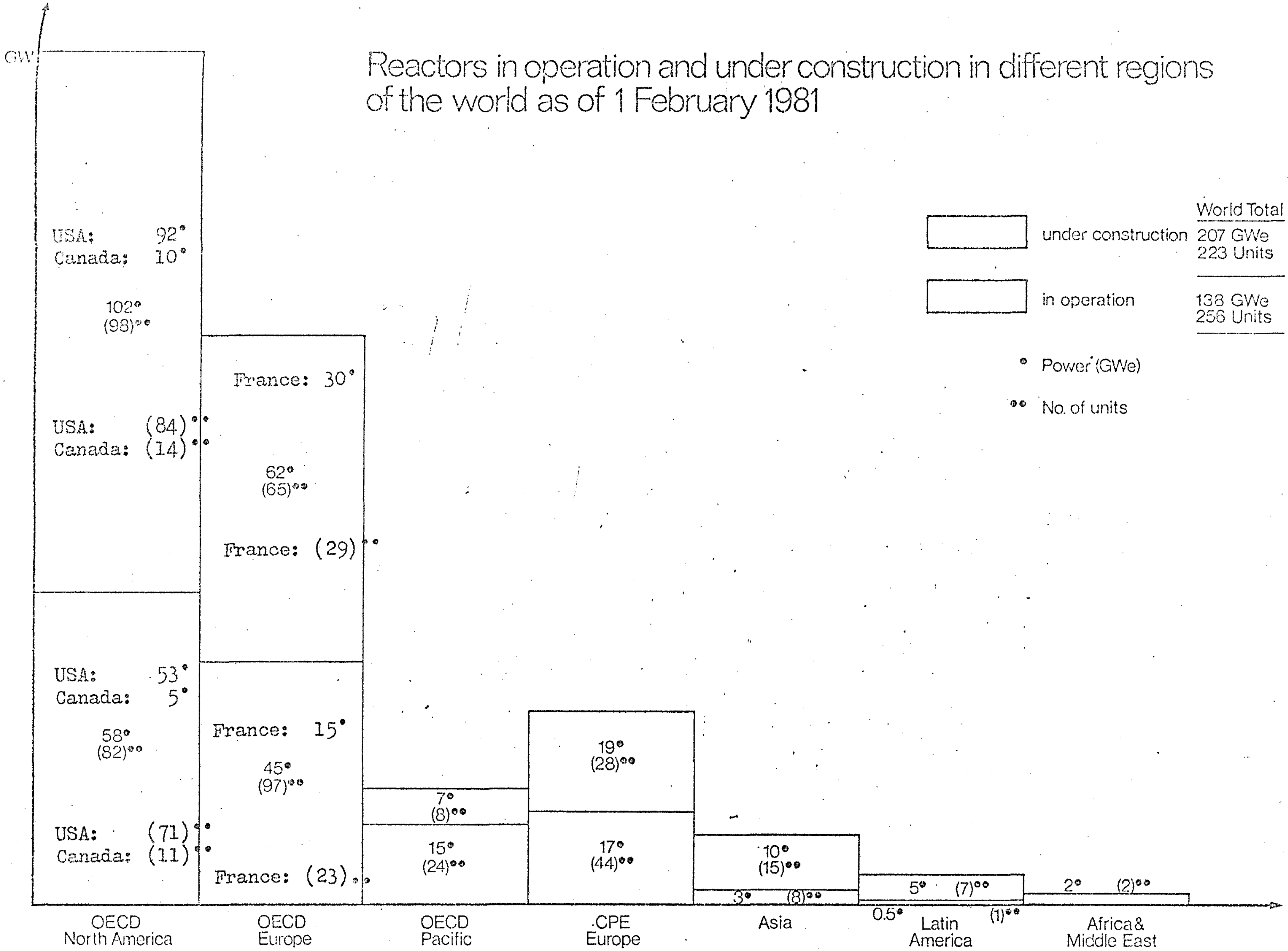
I should like to conclude my address by sharing with you my personal appreciation of the situation. There are a few things which I think have to be kept in mind. For example, there is a very vocal minority which does not want to accept nuclear energy and which has a considerable political influence. It may become pro-nuclear if faced with an energy shortage caused by an oil blockage, or if the energy-related financial burden will drastically affect the whole economy of a country and the social life and standard of living of its people which nobody wants to happen. It might become even more anti-nuclear if there were to be accidents in nuclear plants irrespective of these accidents affecting the nuclear part or not. Every effort must therefore be made to ensure objective reporting by the public media so that unfair comparisons are not made between failures in nuclear plants and failures in other technical undertakings of the same complexity.

Let us further recall that thermal reactor systems only represent a temporary contribution to the energy provision of the world, on a time-scale comparable to the oil period, and that a long-term contribution presumes the development of fast systems, breeders, whereby nuclear energy could make a long-lasting contribution to the world's energy problems; in other words, like coal, but with much less environmental impact although involving other problems as well. Unfortunately, the dynamics of the technical development is not considered when the politicians plan for the future.

Considering these different circumstances I have come to the firm conclusion that there will be a steady but slow growth of the nuclear fraction of the world's electricity supply during the decade, ultimately also including the commercial breeder at the end of the century. By saying that, I have, however, gone beyond the time-frame set for my address and I end by thanking you for your attention

(1) - Figure 1

Reactors in operation and under construction in different regions of the world as of 1 February 1981



(2) - Table 1

ESTIMATES OF TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY
BY MAIN COUNTRY GROUPS (UNIT: GWe)

COUNTRY GROUP	1980			1985			1990		
	TOT ELEC	NUCL	%	TOT ELEC average	NUCL	%	TOT ELEC average	NUCL	%
WORLD TOTAL	1995	136	7	2715	310	11	3585	458	13
INDUSTRIALIZED COUNTRIES	1700	133	8	2270	295	13	2885	425	15
DEVELOPING COUNTRIES	295	3	1	445	15	3	700	33	5

(3) - Table 2

ESTIMATES OF TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY
BY MAIN COUNTRY GROUPS (UNIT: GWe)

COUNTRY GROUP	1980			1985			1990		
	TOT ELEC	NUCL	%	TOT ELEC average	NUCL	%	TOT ELEC average	NUCL	%
OECD NORTH AMERICA	710	57	8	890	130	15	1065	150	14
OECD EUROPE	440	45	10	580	105	18	735	150	20
OECD PACIFIC	180	15	8	255	25	10	340	50	15
CENTRALLY PLANNED EUROPE	370	16	4	545	35	6	745	75	10
ASIA	130	3	2	235	10	4	400	20	5
LATIN AMERICA	100	0.3	0.3	130	3	2	180	10	6
AFRICA AND MIDDLE EAST	65			80	2	3	120	3	3

ESTIMATES OF TOTAL ELECTRICITY GENERATION AND CONTRIBUTION BY NUCLEAR POWER
BY MAIN COUNTRY GROUPS (UNIT: TWh)

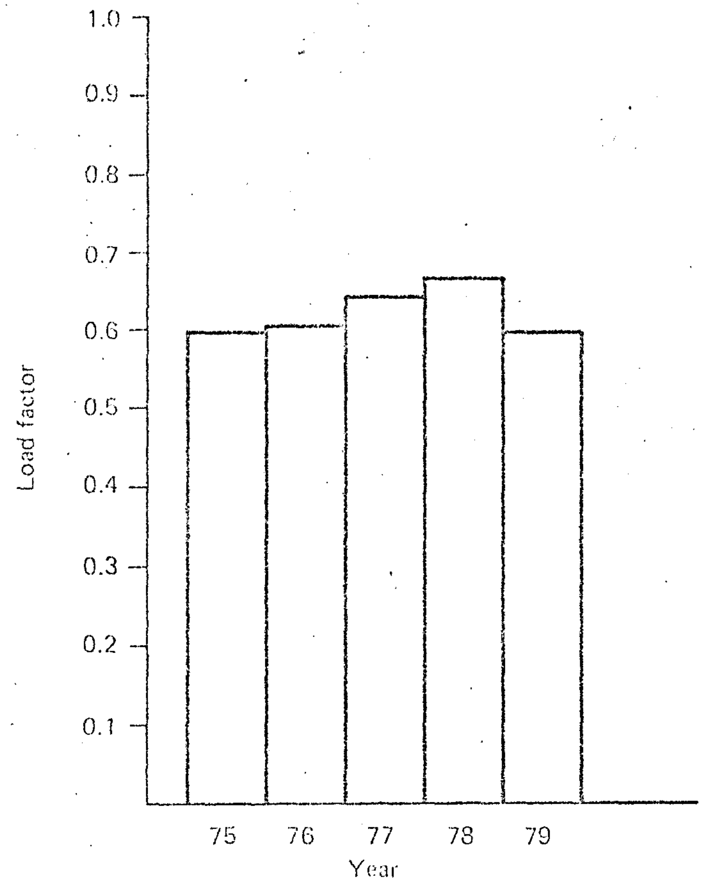
COUNTRY GROUP	1980			1985			1990		
	TOT ELEC	NUCL	%	TOT ELEC (average)	NUCL	%	TOT ELEC (average)	NUCL	%
WORLD TOTAL	8340	662	8	11 290	1905	17	15 115	2700	18
INDUSTRIALIZED COUNTRIES	7045	645	9	9 425	1815	19	12 125	2535	21
DEVELOPING COUNTRIES	1295	17	1	1 865	90	5	2 990	165	6

ESTIMATES OF TOTAL ELECTRICITY GENERATION AND CONTRIBUTION BY NUCLEAR POWER
BY MAIN COUNTRY GROUPS (UNIT: TWh)

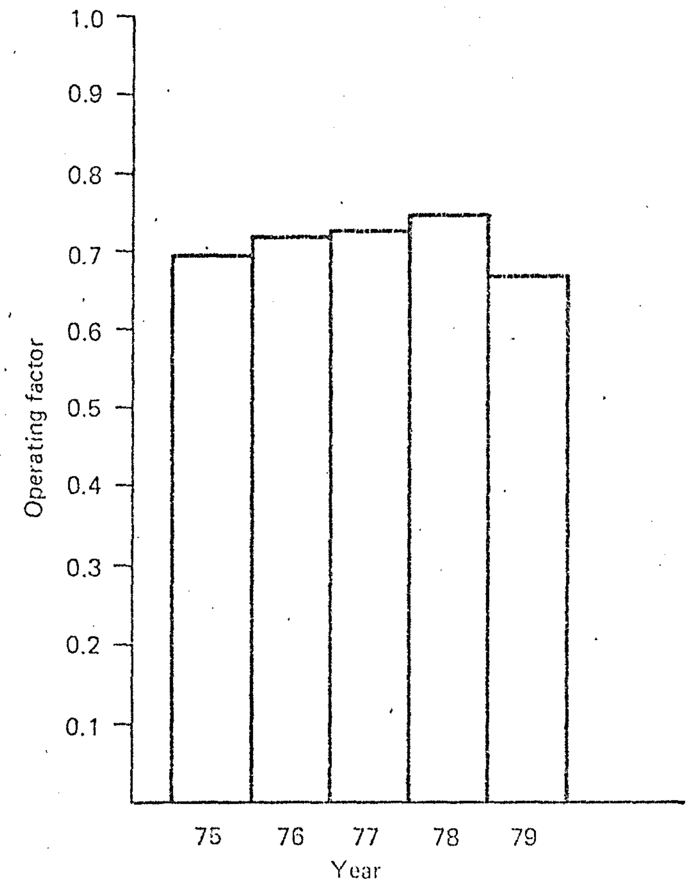
COUNTRY GROUP	1980			1985			1990		
	TOT ELEC	NUCL	%	TOT ELEC (average)	NUCL	%	TOT ELEC (average)	NUCL	%
OECD NORTH AMERICA	2760	290	11	3455	800	23	4230	885	21
OECD EUROPE	1780	215	12	2280	640	28	2890	885	31
OECD PACIFIC	725	60	8	1070	150	14	1430	315	22
CENTRALLY PLANNED EUROPE	1780	80	5	2620	225	9	3575	450	13
ASIA	665	15	2	1060	65	6	1815	100	6
LATIN AMERICA	375	2	0.5	485	15	3	695	50	7
AFRICA AND MIDDLE EAST	225	–		320	10	3	480	15	3

(7) - Figure 3

Load and operating factors 1975 — 1979



Average load factor of all plants excluding prototypes and those starting commercial operation in the second half of the year.



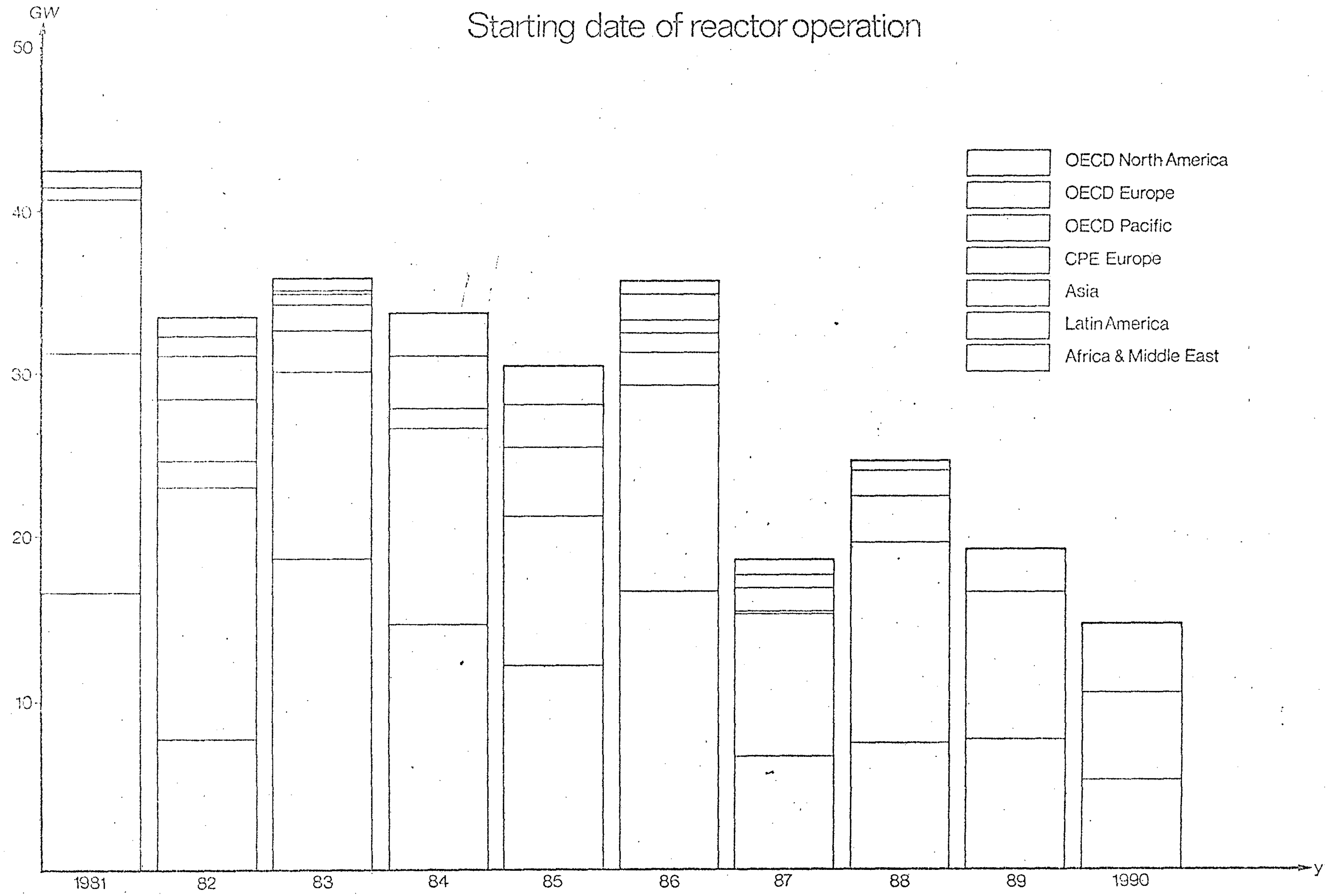
Average operating factor of all plants excluding prototypes and those starting commerical operation in the second half of the year

ORDERS AND POSTPONEMENTS OF NUCLEAR PLANTS DURING THE YEAR 1980

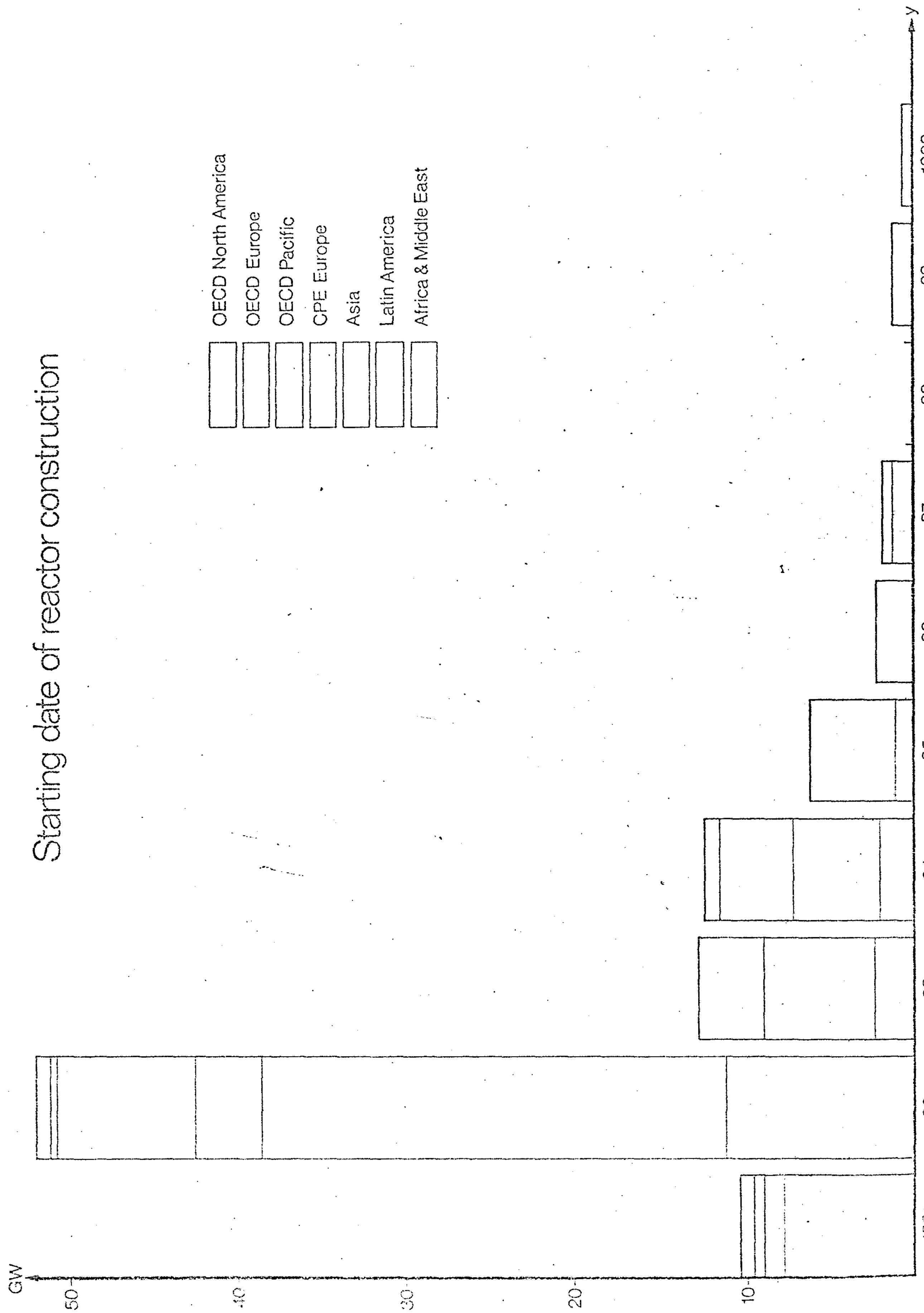
	ORDERS AND LETTERS OF INTENT SENT DURING 1980		CANCELLATION AND POSTPONEMENT DURING 1980	
	NUMBER OF REACTORS	POWER (GWe)	NUMBER OF REACTORS	POWER (GWe)
OECD NORTH AMERICA	–	–	12	13
OECD EUROPE	12	12	–	–
OECD PACIFIC	–	–	–	–
CENTRALLY PLANNED ECONOMY (EUROPE)	1	0.6	–	–
ASIA	2	2	–	–
LATIN AMERICA	–	–	–	–
TOTAL	15	14.6	12	13

(9) - Figure 4

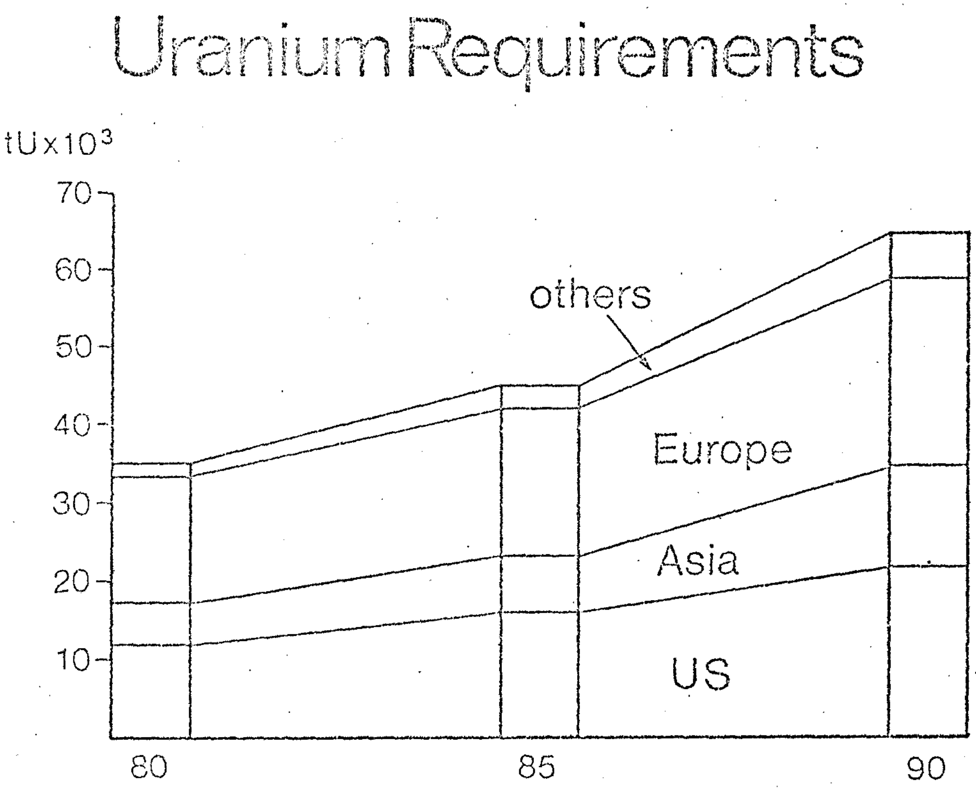
Starting date of reactor operation

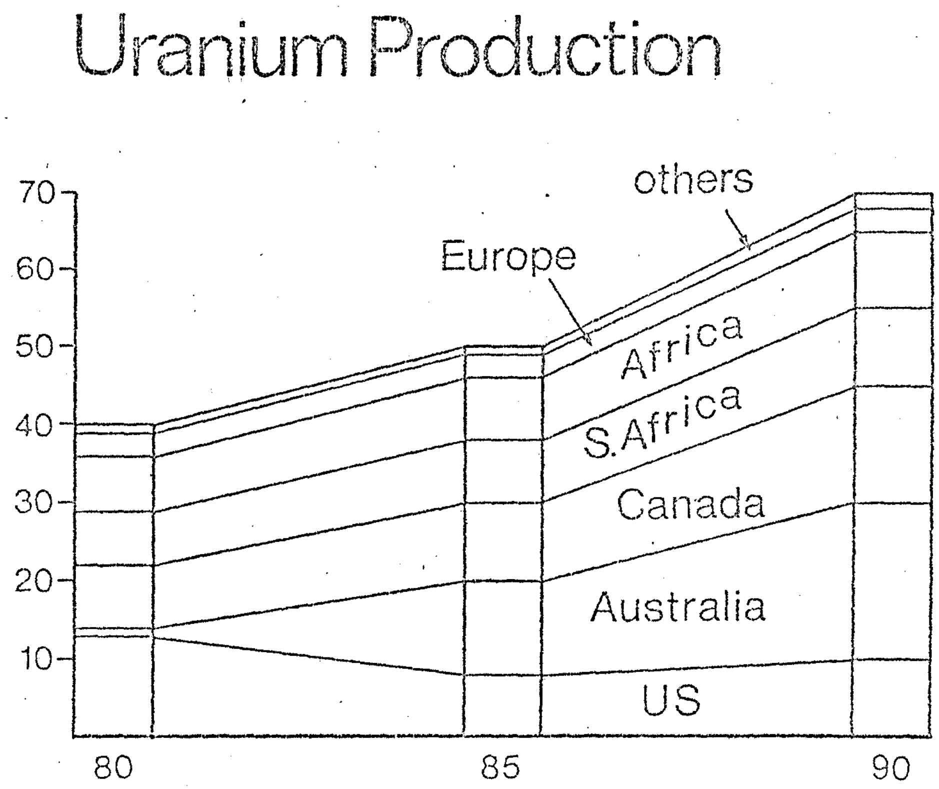


(10) - Figure 5

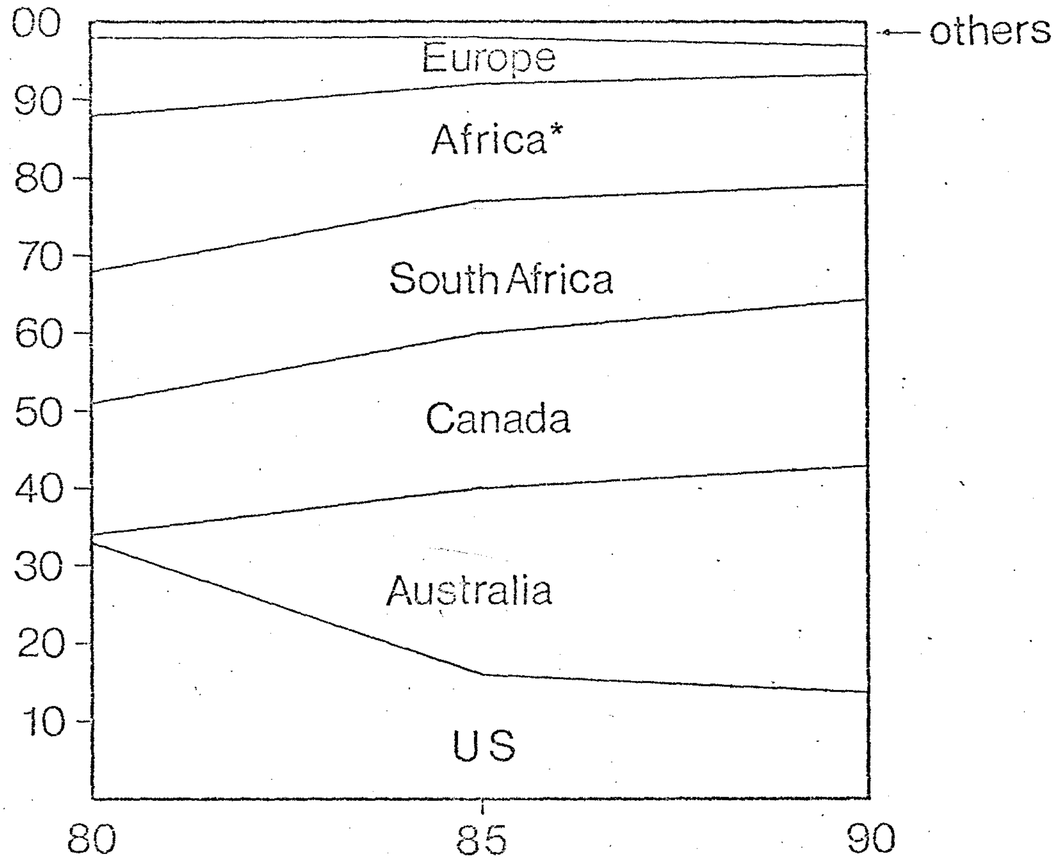


Starting date of reactor construction
OECD North America
OECD Europe
OECD Pacific
CPE Europe
Asia
Latin America
Africa & Middle East
GW
50
40
30
20
10
1981
82
83
84
85
86
87
88
89
1990
y


Uranium Requirements
tU x 10^3
70
60
50
40
30
20
10
80
85
90
others
Europe
Asia
US


Uranium Production
70
60
50
40
30
20
10
80
85
90
others
Europe
Africa
S.Africa
Canada
Australia
US

Relative Participation of Various Regions of the World in Uranium Production



* includes Namibia

ESTIMATED MAXIMUM URANIUM PRODUCTION CAPABILITY

	1980		1985		1990	
	NUMBER OF COUNTRIES	CAPABILITY ktU/y	NUMBER OF COUNTRIES	CAPABILITY ktU/y	NUMBER OF COUNTRIES	CAPABILITY ktU/y
OECD NORTH AMERICA	2	30	2	30	2	42
OECD EUROPE	3	4	3	5	5	7
OECD PACIFIC	2	2	2	14	2	21
AFRICA	4	14	5	18	6	23
LATIN AMERICA	1	<1	3	3	4	5
ASIA	2	<1	2	<1	3	2
TOTAL	14	50	17	70	22	100

CAPACITIES OF ISOTOPIC ENRICHMENT PLANTS

	1980			1985		
	NUMBER OF COUNTRIES	NUMBER OF PLANTS	10^6 SWU	NUMBER OF COUNTRIES	NUMBER OF PLANTS	10^6 SWU
OECD NORTH AMERICA	1	3	21 000	2	4–6	35 300–44 300
OECD EUROPE	4	7	3 880	4	9	12 880
OECD PACIFIC	2	1	30	2	3–4	300
CPE EUROPE	1	1	7 100	1	1	7 100
ASIA	–	–	–	–	–	–
LATIN AMERICA	–	–	–	1	1	180
AFRICA & MIDDLE EAST	1	1	6	1	1	200–300
WORLD TOTAL	9	13	32 016	11	19–22	55 960–65 060

ANNUAL NEEDS FOR 1 GWe–LWR: $\cong 110 \times 10^6$ SWU/Y

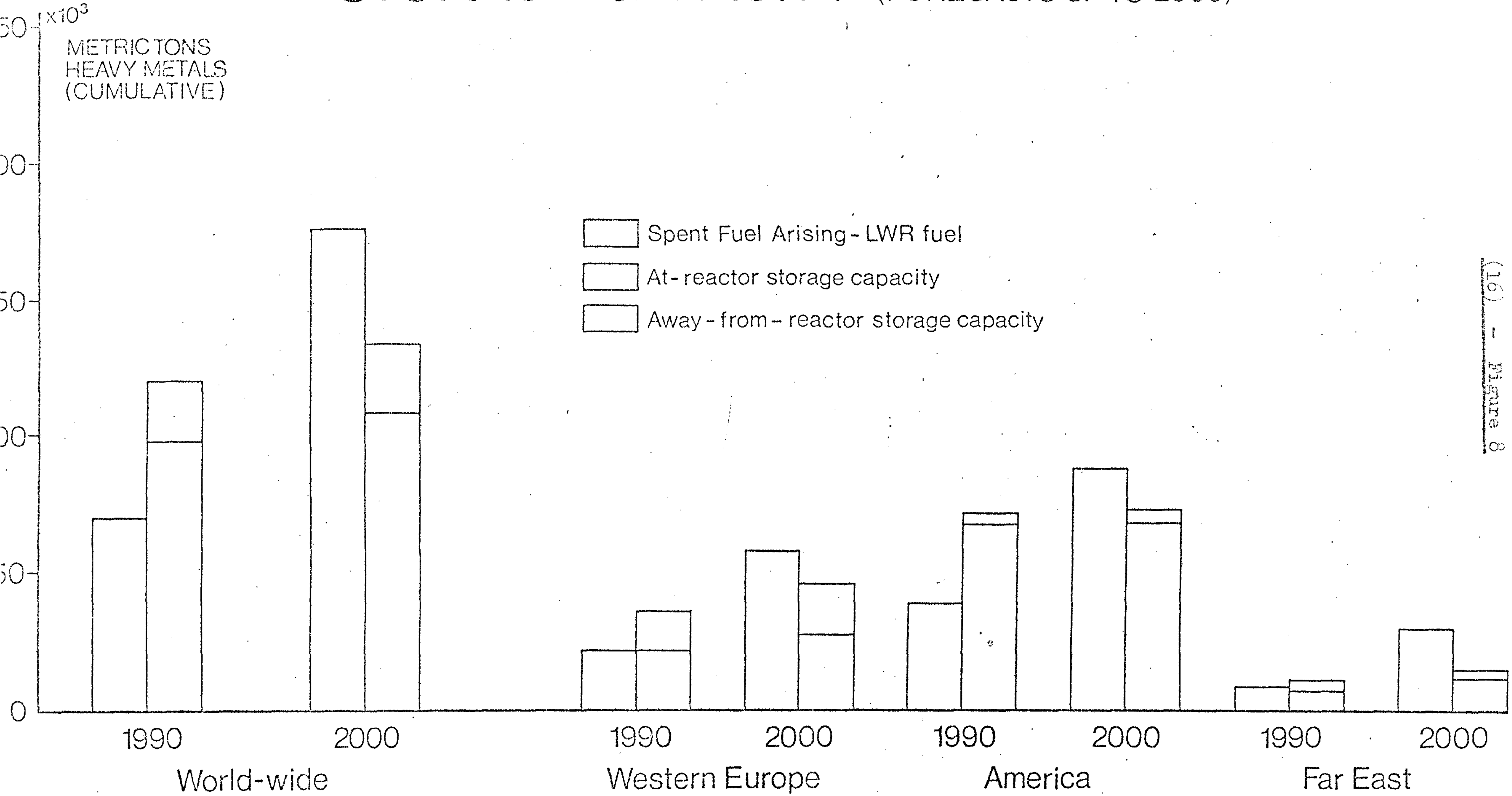
(15) - Table 8

CAPACITIES FUEL FABRICATION PLANTS (FOR LWR ONLY)

	1980			1985		
	NUMBER OF COUNTRIES	NUMBER OF PLANTS	TON U/Y	NUMBER OF COUNTRIES	NUMBER OF PLANTS	TON U/Y
OECD NORTH AMERICA	1	6	2 900	1	7	3 300–3 700
OECD EUROPE	6	13	3 510	7	14	4 860
OECD PACIFIC	1	4	990	1	4	1 050
CPE EUROPE	?	?	?	?	?	?
ASIA	1	1	21	1	1	21
LATIN AMERICA	–	–	–	–	–	–
AFRICA AND MIDDLE EAST	–	–	–	–	–	–
WORLD TOTAL	9	24	7 421	10	26	9 231–9 631

YEARLY AMOUNT OF FUEL LOADED IN 1 GWe–LWR: ≅ 30 TONS/Y

LWR SPENT FUEL ARISING AND STORAGE CAPACITY (FORECASTS UP TO 2000)



(17) - Table 9

CAPACITIES OF REPROCESSING PLANTS (ONLY FOR LWR FUEL)

	1980			1985		
	NUMBER OF COUNTRIES	NUMBER OF PLANTS	TON U/Y	NUMBER OF COUNTRIES	NUMBER OF PLANTS	TON U/Y
OECD NORTH AMERICA	–	–	–	1	3	2 550
OECD EUROPE	4	5	840	5	7	2 115
OECD PACIFIC	1	1	210	1	1	210
CPE EUROPE	?	?	?	?	?	?
ASIA	1	1	100	1	2	200
LATIN AMERICA	–	–	–	–	–	–
AFRICA & MIDDLE EAST	–	–	–	–	–	–
WORLD TOTAL	6	7	1 150	8	13	5 075

YEARLY AMOUNT OF FUEL UNLOADED IN 1 GWe–LWR: ≅ 30 TONS/Y

DR. ABSHIRE'S SPEECH IN TOKYO - MARCH 10, 1981

THE ELECTION OF RONALD REAGAN IN 1980 REFLECTS THE EMERGENCE OF A NEW MOOD IN THE UNITED STATES -- ONE THAT IS DETERMINED TO REVITALIZE AMERICA'S ECONOMIC SYSTEM AND PURSUE AMERICAN GOALS MORE ACTIVELY ABROAD. I WOULD LIKE TO SHARE WITH YOU SOME OF MY OBSERVATIONS ABOUT THIS NEW MOOD IN AMERICA AND ITS IMPLICATIONS FOR THE U.S. APPROACH TO ENERGY AND TO GLOBAL POLITICS. I AM NOT SPEAKING FOR THE REAGAN ADMINISTRATION BUT ONLY FOR MYSELF. BUT I HOPE I CAN USE THIS FORUM TO LAY OUT WHAT I FEEL THE GENERAL THRUST OF THE REAGAN ADMINISTRATION WILL BE.

DOMESTICALLY, THE GUIDING PRINCIPLE OF THE REAGAN ADMINISTRATION IS TO ATTACK INFLATION AND UNEMPLOYMENT BY TAKING STEPS TO INCREASE PRODUCTIVITY, WHICH IS THE BASIS OF ECONOMIC PROSPERITY AND GROWTH. A MAJOR PART OF THE NEW ADMINISTRATION'S PROGRAM IS TO REDUCE THE BURDENS THAT EXCESSIVE GOVERNMENT SPENDING AND REGULATION PLACE ON BUSINESS AND THE CONSUMER. FOR TOO LONG THE FEDERAL

GOVERNMENT IN THE UNITED STATES HAS BEEN CAUGHT IN THE POSITION OF RESISTING THE DECISIONS OF BOTH THE DOMESTIC AND THE INTERNATIONAL MARKETPLACES AND HAS ADOPTED POLICIES DESIGNED TO MINIMIZE THE READJUSTMENTS THE MARKET DEMANDS. THESE POLICIES HAVE BROUGHT SHORT-TERM COMFORT BUT LONG-TERM ILLS. WHILE IT WILL BE IMPOSSIBLE TO CHANGE THEM OVERNIGHT, THE NEW ADMINISTRATION IN THE UNITED STATES IC COMMITTED TO REVERSING THE PATTERN. THIS WILL BE PAINFUL AT FIRST BUT IT IS CLEARLY THE ROAD TO FUTURE ECONOMIC PROSPERITY. THE SIGNALS FROM THE MARKETPLACE CANNOT BE OVERRIDDEN FOR LONG WITHOUT CAUSING LONG-TERM DAMAGE.

AS PERHAPS NO OTHER, THE ENERGY FIELD DEMONSTRATES THE NEW DIRECTIONS THE REAGAN ADMINISTRATION IS COMMITTED TO TAKING. IN ONE OF HIS FIRST ACTS, PRESIDENT REAGAN SIGNED AN EXECUTIVE ORDER IMMEDIATELY DECONTROLLING DOMESTIC OIL PRICES, ENDING A TEN-YEAR EXPERIMENT WITH CONTROLLED PRICES WHICH AGGRAVATED AMERICA'S DEPENDENCE ON FOREIGN SOURCES OF OIL. IT IS EXPECTED THAT THE NEW ECONOMICS OF OIL DECONTROL

WILL MAKE MORE DOMESTIC OIL COMMERCIALLY WORTHWHILE TO EXTRACT.

THERE HAVE BEEN INDICATIONS THE REAGAN ADMINISTRATION WILL SEEK TO DECONTROL NATURAL GAS PRICES AS WELL, ALTHOUGH THIS WILL REQUIRE NEW LEGISLATION AND THE COOPERATION OF CONGRESS. THE NEW SECRETARY OF THE INTERIOR, JAMES WATT, IS KNOWN FOR HIS ADVOCACY OF A POLICY THAT WILL FAVOR MULTIPLE USE OF FEDERAL LANDS TO ENCOURAGE GREATER DEVELOPMENT OF OUR ENERGY RESOURCES.

DESPITE THE BUDGET CUTBACKS PROPOSED BY THE REAGAN ADMINISTRATION, FEDERAL SPENDING FOR NUCLEAR POWER MAY WELL INCREASE. SECRETARY OF ENERGY EDWARDS, HAS DECLARED HIS PERSONAL COMMITMENT TO ITS DEVELOPMENT, SAYING "I AM A STRONG SUPPORTER OF NUCLEAR ENERGY." HE SAID CLEARLY THAT "IN THE NEXT 30 TO 40 YEARS, THERE IS NO REAL PLACE TO TURN OTHER THAN NUCLEAR ENERGY," STRESSING THAT "TO SAY 'NO' TO NUCLEAR ENERGY WOULD BE TURNING OUR BACKS ON THE 33 MILLION AMERICANS WHO WILL COME OF WORKING AGE IN THE NEXT 20

YEARS."

ALTHOUGH THERE WILL BE DIFFICULTIES, THE SECRETARY OF ENERGY HAS ANNOUNCED THAT HE WANTS THE GOVERNMENT:

-- TO MORE FORWARD ON LICENSING THE BACKLOG OF NUCLEAR POWERPLANTS THAT ARE READY FOR OPERATION AND TO EXPEDITE COMPLETION OF THOSE UNDER CONSTRUCTION.

-- TO RESTORE ACTIVE SUPPORT FOR THE CLINCH RIVER BREEDER REACTOR DEMONSTRATION PROJECT,

-- TO RESUME PLANS FOR COMMERCIAL REPROCESSING OF SPENT FUEL, AND,

-- TO MOVE AHEAD AS QUICKLY AS POSSIBLE TO IMPLEMENT PLANS FOR DISPOSAL OF NUCLEAR WASTES.

THIS TURNAROUND OF ATTITUDES IS LONG OVERDUE.

OUR DOMESTIC NUCLEAR PROGRAM HAS BEEN PLAGUED BY INCREASING POLITICAL TENSION OVER THE LAST TEN YEARS, AND IS BELIEVED BY MANY TO BE ON THE VERGE OF PARALYSIS. TO HELP ADDRESS THIS DIFFICULT PROBLEM, THE CENTER FOR STRATEGIC AND

INTERNATIONAL STUDIES IS UNDERTAKING A MAJOR NEW NATIONAL NUCLEAR POLICY PROJECT THAT WILL BRING OPPONENTS FROM THE ENVIRONMENTALIST AND INDUSTRIAL COMMUNITIES TOGETHER IN A DIALOGUE, TO AID THE SEARCH FOR COMMON GROUND UPON WHICH A FIRMER, PUBLICLY ACCEPTABLE NUCLEAR POLICY FRAMEWORK CAN BE CONSTRUCTED. THOUGH IT MAY TAKE TIME TO REACH AGREEMENTS, AND TO DISSEMINATE RESULTS, I AM VERY HOPEFUL THAT THIS MAJOR VENTURE OF OUR CENTER WILL RESOLVE SOME OF OUR COUNTRY'S POLICY DIFFICULTIES, ENHANCE OUR DOMESTIC ENERGY SUPPLIES AND IMPROVE OUR CAPABILITIES FOR COOPERATION OVERSEAS.

ACROSS THE BOARD, THE NEW REAGAN ADMINISTRATION IS MOVING TO GET THE PRODUCTIVE, ENTREPRENURIAL CAPACITIES OF THE AMERICAN ECONOMY GOING AGAIN SO THE UNITED STATES CAN KEEP ITS DEPENDENCE ON FOREIGN SOURCES OF ENERGY TO A MINIMUM AND EASE THE PRESSURE ON WORLD ENERGY MARKETS. IN CONTRAST TO THE LAST ADMINISTRATION, THERE WILL BE LESS EMPHASIS ON REGULATION AND A GREATER RELIANCE ON THE PRICE

MECHANISM FOR ENCOURAGING CONSERVATION. IN GENERAL, THE GOVERNMENT ROLE WITH REGARD TO MORE EXOTIC ENERGY SOURCES WILL BE TO ENCOURAGE HIGH-RISK RESEARCH AND DEVELOPMENT PROJECTS WITH A POTENTIALLY LARGE PROFIT, INSTEAD OF SUBSIDIZING THE COMMERCIALIZATION OF NEW TECHNOLOGIES.

ALTHOUGH THE REAGAN ADMINISTRATION IS MAKING A BOLD NEW BEGINNING, IT IS IMPORTANT TO REMEMBER THAT, SO FAR, IT IS ONLY A BEGINNING. MUCH REMAINS TO BE CONE. LEGISLATIVE CHANGES NEED TO BE FORMULATED AND ENACTED. BUREAUCRATIC AGENCIES NEED TO BE REORGANIZED, TRIMMED OR STREAMLINED. REGULATIONS NEED TO BE PRUNED AND REVISED. IN SHORT, MANY HURDLES MUST BE OVERCOME BEFORE NEW STRUCTURES AND NEW LAWS REFLECTING THE NEW VIEW IN AMERICAN CAN BE PUT FIRMLY IN PLACE. ALSO, THERE ARE LONG LEAD TIMES INVOLVED IN DEVELOPING NEW ENERGY PROJECTS, THE INDUSTRIAL INFRASTRUCTURE NECESSARY TO SUPPORT THEM, AND NEW PATTERNS OF PUBLIC CONSUMPTION. GIVEN THESE REALITIES, IT IS POSSIBLE BUT UNLIKELY THAT THE UNITED STATES WILL REDUCE ITS

CURRENT LEVEL OF CRUDE AND PRODUCT OIL IMPORTS BY A SIGNIFICANT AMOUNT BY THE END OF THE REAGAN ADMINISTRATION'S PRESENT TERM. THE LONGER TERM HOLDS MORE PROMISE AS THE EFFECTS OF THE NEW POLICIES COME MORE FULLY ON LINE.

BUT U.S. ENERGY CONCERNS CANNOT BE LIMITED TO THE NEEDS OF THE AMERICAN ECONOMY ALONE. U.S. ENERGY POLICIES SPILL OVER INTO THE WORLD ECONOMY, OFTEN WITH VERY LARGE RIPPLE EFFECTS. THIS IS ALSO TRUE, FOR EXAMPLE, IN THE NUCLEAR POWER INDUSTRY, WHERE RECENT AMERICAN ACTIONS HAVE NOT BEEN AS SENSITIVE TO JAPANESE CONCERNS AS THEY MIGHT HAVE BEEN

ALTHOUGH THERE ARE SERIOUS CONCERNS EVERYWHERE ABOUT THE DEVELOPMENT OF NUCLEAR ENERGY, IT IS CLEAR THAT JAPAN HAS A PRESSING NEED FOR GREATER SUPPLIES OF NUCLEAR ENERGY TO UNDERPIN ITS CONTINUED ECONOMIC GROWTH, AND EQUALLY CLEAR THAT NUCLEAR ENERGY IS INDISPENSABLE TO JAPAN AS A PARTIAL STEP TOWARDS ENERGY SECURITY FROM UNFORESEEN INTERRUPTIONS IN THE DELIVERY OF INTERNATIONAL OIL. DESPITE THIS IMPERATIVE, COOPERATION BETWEEN THE U.S. AND JAPAN IN THE

DEVELOPMENT OF NUCLEAR ENERGY HAS BEEN REGRETABLY DISTURBED. UNCERTAINTIES ABOUT THE FUTURE U.S. DELIVERY OF ENRICHED URANIUM FUEL AND U.S. QUESTIONING OF JAPANESE PLANS FOR SPENT FUEL REPROCESSING IN EUROPEAN AND JAPANESE FACILITIES HAVE MADE IT MORE DIFFICULT FOR JAPAN TO DEVELOP ITS NUCLEAR ENERGY INDUSTRY. THIS UNFORTUNATE RESULT IS DUE, OF COURSE, NOT TO U.S. CONCERNS ABOUT JAPAN, BUT RATHER TO THE GLOBAL U.S. INTEREST IN NUCLEAR NON-PROLIFERATION. THE REAGAN ADMINISTRATION IS LIKELY TO SEARCH FOR BETTER BALANCE AND CONSISTENCY IN POLICY TOWARDS THESE MATTERS.

POLICY RESEARCH CONDUCTED AT OUR CENTER, I AM HAPPY TO SAY, OUTLINES WAYS IN WHICH OUR RECENT BILATERAL DIFFICULTIES IN NUCLEAR COOPERATION MAY BE EASED. THE THRUST OF THESE RECOMMENDATIONS IS TO ESTABLISH RULES WHICH WILL ENHANCE INTERNATIONAL CONFIDENCE IN SAFEGUARDED NUCLEAR FACILITIES AND TRANSACTIONS SO AS TO PERMIT SMOOTH COOPERATION AND THE ORDERLY DEVELOPMENT OF NATIONAL NUCLEAR ENERGY PROGRAMS.

IT SEEMS CLEAR THAT THE USE OF BREEDER REACTORS AND THE RECOVERY OF PLUTONIUM AND UNUSED URANIUM FROM SPEND FUEL FOR RECYCLING AS FRESH NUCLEAR FUEL WILL BE NEEDED IN THE HEAVILY INDUSTRIALIZED COUNTRIES AFTER THE END OF THIS CENTURY. TO PREPARE FOR THAT TURNING POINT IN A TIMELY WAY REQUIRES DELIBERATE STEPS IN THE PRESENT AND NEAR FUTURE. IT IS MY PERSONAL BELIEF AND HOPE THAT THE UNITED STATES WILL DO ITS PART TO RESTORE FULL CONFIDENCE IN ITS RELIABILITY AS A NUCLEAR SUPPLIES AS A COOPERATIVE PARTNER. THE UNITED STATES HAS A RESPONSIBILITY TO REVITALIZE ITS INTERNATIONAL LEADERSHIP IN THE DEVELOPMENT OF NUCLEAR ENERGY TECHNOLOGY AND RELATED INTERNATIONAL INSTITUTIONS. CARE IS NEEDED TO MAKE SURE THAT THE GOALS OF NUCLEAR NON-PROLIFERATION ARE NOT COMPROMISED. BUT, BASED ON CLOSE BILATERAL DISCUSSION AND GREATER U.S. SENSITIVITY, I AM CONFIDENT THAT WAYS CAN BE FOUND TO PRESERVE THE INTEGRITY OF INTERNATIONAL CONTROLS ON PROLIFERATION WITHOUT INTERFERING WITH THE DEVELOPMENT OF NUCLEAR ENERGY AS A KEY

INGREDIENT IN JAPAN'S ENERGY OUTLOOK FOR THE FUTURE.

IN THE SAME SPIRIT OF COOPERATION AND MUTUAL UNDERSTANDING, I HOPE ARRANGEMENTS CAN BE WORKED OUT THAT WILL ENABLE THE U.S. TO UTILIZE ALASKAN OIL MORE EFFICIENTLY. THERE ARE SUBSTANTIAL TRANSPORTATION SAVINGS TO BE HAD IF ALASKAN OIL IS ALLOWED TO BE SOLE ON THE WORLD MARKET OR EXCHANGED FOR OTHER SUPPLIES OF OIL. HOPEFULLY, THE DOMESTIC POLITICAL ASPECTS OF THIS PROBLEM CAN BE OVERCOME AS THE BENEFITS OF FREER TRADE BECOME MORE OBVIOUS TO THE AMERICAN PEOPLE AND TO CONGRESS.

DESPITE ITS MANY IMPORTANT ECONOMIC IMPACTS, IT WOULD BE WRONG TO VIEW ENERGY JUST AS AN ECONOMIC ISSUE; IT IS A CRUCIAL GEOPOLITICAL ISSUE AS WELL. ENERGY IS A CRUCIAL COMPONENT OF NATIONAL POWER AND WHILE THE DISTANT FUTURE HOLDS PROMISE OF ALTERNATIVE ENERGY SOURCES, IN THE IMMEDIATE FUTURE WE ARE WEDDED TO THE EXISTING SOURCES OF SUPPLY. IN THIS RESPECT, EVENTS IN THE PERSIGN GULF ARE ESPECIALLY IMPORTANT, BOTH TO JAPAN, WHICH RECEIVES 75% OF

ITS OIL FROM THE GULF, TO MOST OTHER OECD COUNTRIES, AND TO THE UNITED STATES. THE U.S. HAS DECLARED ITS INTENTION TO HELP DEFEND THE GULF AGAINST MILITARY THREATS FROM HOSTILE OUTSIDE FORCES, IN RECOGNITION OF THE VITAL INTERESTS WE SHARE IN THAT REGION.

A QUESTION ON EVERYONE'S MIND IS: HOW WELL CAN THE UNITED STATES PROJECT POWER INTO THE GULF REGION TO DEFEND WESTERN INTERESTS? A RECENT CONFERENCE HELD AT OUR CENTER HIGHLIGHTED WAYS IN WHICH THE RAPID DEPLOYMENT FORCE CAN BE IMPROVED SO AS TO BOLSTER AMERICAN ABILITIES TO DEFEAT OUTSIDE AGGRESSION IN THE GULF. THE RECOMMENDATIONS WERE AS FOLLOWS:

- FIRST, THE FOCUS ON GETTING THE RAPID DEPLOYMENT FORCE TO THE GULF QUICKLY HAS TO BE AUGMENTED BY AN EMPHASIS ON IMPROVED FIGHTING ABILITY ONCE THE FORCE ARRIVES AT THE GULF.
- SECOND, SEA-BASED PREPOSITIONED SUPPLIES ARE NEEDED TO GIVE THE RAPID DEPLOYMENT FORCE THE EXTRA LOGISTICAL BACKUP IT NEEDS.

- THIRD, COMMAND STRUCTURES SHOULD BE RATIONALIZED TO CREATE A MORE EFFECTIVE AND COHESIVE FIGHTING FORCE.
- FOURTH, GREATER EMPHASIS SHOULD BE GIVEN TO FORCED ENTRY CAPABILITIES SO THAT THE FORCE CAN INTERVENE IN MORE VARIED CIRCUMSTANCES.
- FIFTH, MORE EMPHASIS SHOULD BE PAID TO CAPABILITIES FOR SUSTAINED CONFLICT.

OF COURSE, U.S. CAPABILITIES TO DEFEND THE GULF DO NOT DEPEND ON THE RESOURCES OF THE RAPID DEPLOYMENT FORCE ALONE. THERE ARE MANY OTHER FACTORS TO TAKE INTO CONSIDERATION. IN RECENT TESTIMONY THE CHAIRMAN OF THE JOINT CHIEFS OF STAFF OF THE UNITED STATES SPOKE OF A NEW GLOBAL APPROACH IN WHICH HE SAID, "WE MUST HAVE THE CAPABILITY TO ACT WHEN, WHERE, AND HOW IT SERVES OUR INTERESTS, NOT SIMPLY REACT TO CRISES AT THE POINT OF ATTACK." IN THIS CONNECTION, HE POINTED OUT THAT A U.S. RESPONSE TO AGGRESSION IN THE GULF NEED NOT BE LIMITED TO

THAT REGION ALONE. THERE ARE MANY PLACES IN THE WORLD WHERE THE SOVIET UNION AND ITS CLIENT STATES ARE OVEREXTENDED AND VULNERABLE AND WHERE THE LOCAL BALANCE OF POWER FAVORS THE UNITED STATES. CUBA FOR EXAMPLE, IS A LONG WAY FROM SOVIET SHORES AND DANGEROUSLY EXTENDED WITH TENS OF THOUSANDS OF TROOPS IN AFRICA. AS THE RECENT FLOODING OF AN EMBASSY IN HAVANA WITH 10,000 CUBANS IN A 24-HOUR PERIOD WHEN THEY WERE GIVEN THE OPPORTUNITY TO FREELY LEAVE THE COUNTRY DEMONSTRATES, THE CASTRO REGIME IS NOT WITHOUT ITS VULNERABILITIES AT HOME. LIKEWISE, THE SOVIET FLEET IS VULNERABLE TO U.S. NAVAL STRENGTH. IN SHORT, HAVING THE CAPABILITIES AND RESERVING THE RIGHT TO RETALIATE AT A TIME AND A PLACE OF OUR CHOOSING RAISES THE POTENTIAL COSTS FOR THE SOVIET UNION OF A MOVE INTO THE GULF, MOREOVER, THE NEXT FEW YEARS WE WILL TAKE MANY STEPS TO REDRESS THE MILITARY DISADVANTAGES WE CURRENTLY FACE IN RESPONDING TO A LARGE-SCALE INVASION OF THE GULF REGION.

IN MAKING MORE FORCES AVAILABLE FOR THIS REGION, THE

UNITED STATES MUST TAKE ACCOUNT OF LOCAL POLITICAL SENSITIVITIES. MANY GULF NATIONS FEAR THAT AN AMERICAN PRESENCE WOULD MAKE THEM PRIME TARGETS FOR DIRECT OR INDIRECT SOVIET ACTIONS. WE HAVE TO DEAL WITH THESE CONCERNS TACTFULLY IN THE SHORT RUN, DEVISING ARRANGEMENTS THAT MEET THE LEGITIMATE SECURITY NEEDS OF THE GULF STATES WIHOUT UNDULY AGGRAVATING THEIR POLITICAL SITUATION. BUT WE MUST RECOGNIZE THAT IN THE LONG RUN THESE CONCERNS CAN BEST BE ALLEVIATED BY RENEWED AMERICAN AND WESTERN STRENGTH AND THE USE OF THIS STRENGTH IN A MORE CONSISTENT AND SUPPORTIVE WAY. THE INHIBITIONS OF MANY GULF NATIONS FEEL IN RESPONDING TO U.S. OFFERS OF HELP AND COOPERATION STEM FROM FEAR OF THE SOVIET POWER AND RADICAL FORCES, AND UNCERTAINTY ABOUT AMERICAN STRENGTH AND STEADFASTNESS. UNTIL THESE BASIC CONCERNS ARE ALLEVIATED, THE MOST SENSITIVE, TACTFUL, AND DIPLOMATIC BEHAVIOR BY THE UNITED STATES WILL NOT SOLVE WESTERN SECURITY PROBLEMS IN THE GULF.

AT THE SAME TIME, THE UNITED STATES REMAINS COMMITTED

TO WORKING TOWARDS A PEACEFUL SOLUTION OF THE ARAB-ISRAELI CONFLICT, ONE THAT SEEKS TO EQUITABLY RESOLVE THE PALESTINIAN PROBLEM AS WELL AS ENSURE THAT THE VITAL SECURITY CONCERNS OF THE STATE OF ISRAEL ARE SAFEGUARDED. WE MUST REMEMBER THAT HELPING FIND POLITICAL AND DIPLOMATIC SOLUTIONS TO THE PROBLEMS OF THE GULF IS JUST AS IMPORTANT AS THE ESTABLISHMENT OF MILITARY FORCES CAPABLE OF REPELLING OUTSIDE AGGRESSION. THE COUNTRIES OF THE GULF ARE UNDERGOING EXTREMELY RAPID CHANGE AS THE MODERN WORLD IMPINGES ON THEIR TRADITIONAL SOCIETIES. WE MUST BE SENSITIVE TO THEIR CONCERNS AS THEY MAKE THIS DIFFICULT TRANSITION AND DO ALL WE CAN TO ENCOURAGE THE POLITICAL STABILIZATION OF THE REGION.

ANOTHER MAJOR ENERGY ISSUE THAT HAS MAJOR GEOPOLITICAL RAMIFICATIONS IS THE ISSUE OF TRADE WITH THE SOVIET UNION, PARTICULARLY WESTERN ATTITUDES TOWARDS THE DEVELOPMENT OF SOVIET ENERGY RESOURCES. THE SOVIET UNION HAS VAST ENERGY RESOURCES BUT LACKS THE TECHNOLOGY OR THE CAPITAL TO DEVELOP

THEM EXPEDITIOUSLY. THE WEST CAN SUPPLY BOTH THESE MISSING INGREDIENTS AND MARKETS FOR SOVIET ENERGY AS WELL. THERE ARE UNDOUBTEDLY ECONOMIC BENEFITS ASSOCIATED WITH HELPING THE SOVIETS DEVELOP THEIR ENERGY RESERVES BUT THERE ARE ALSO VERY GRAVE POLITICAL RISKS.

SOVIET POLICIES OVER THE LAST THREE DECADES HAVE TRIED THAN TO ACHIEVE THE DESTRUCTION OF THE WESTERN ALLIANCE BY SPLITTING EUROPE AND JAPAN AWAY FROM THE UNITED STATES. THE STRENGTH OF U.S. STRATEGIC FORCES AND OUR SECURITY GUARANTEES TO EUROPE AND JAPAN HAVE PREVENTED THE SOVIETS FROM ACHIEVING THIS GOAL MILITARILY. IT IS TRUE THAT OUR CAPABILITIES NEED STRENGTHENING SO THAT OUR SECURITY GUARANTEE WILL REMAIN FULLY CREDIBLE, BUT THE IMMEDIATE THREAT TO THE WESTERN ALLIANCE DERIVES FROM OUR ECONOMIC INSTEAD OF OUR MILITARY VULNERABILITIES.

IT IS APPARENT THAT THE SOVIETS ARE MOVING INTO A POSITION IN WHICH THEY COULD APPLY ENORMOUS POLITICAL AND MILITARY PRESSURE ON THE WEST, PARTICULARLY IF THE SITUATION

IN THE GULF SHOULD DETERIORATE. BUT THESE DANGERS OF RESOURCE DENIAL IN THE GULF ARE PARALLEL BY THE DANGER OF INORDINATE RESOURCE DEPENDENCE ON SOVIET UNION. IF THE SOVIET UNION EVER BECAME AN INDISPENSABLE SUPPLIER OF VITAL RAW MATERIALS TO THE WEST, THE SOVIETS WOULD BE IN A POSITION TO EXTRACT POLITICAL CONCESSIONS FROM THE WEST IN A SUBTLE, INCREMENTAL WAY THAT WOULD BE DIFFICULT TO RESIST OR EVEN IDENTIFY. THE POSSIBILITIES FOR POLITICAL PRESSURE WOULD BE INFINITE IF THE WEST BECAME SUFFICIENTLY DEPENDENT ON THE SOVIET UNION; AND THE ABILITY TO RESIST THESE PRESSURES WOULD BE VERY DIFFICULT TO COORDINATE.

FOR THESE REASONS I THINK THE WEST MUST BE VERY WARY OF INCREASING ITS RESOURCE DEPENDENCE ON THE SOVIET UNION OR BUILDING UP THE SOVIETS' TECHNOLOGICAL CAPABILITY. THE COMMUNIST PARTY LEADERSHIP OF THE SOVIET UNION HAD BEEN RUNNING THAT COUNTRY'S ECONOMY ON WHAT CAN ONLY BE DESCRIBED AS A WAR FOOTING FOR AT LEAST THE LAST 15 YEARS.

ESTIMATES OF SOVIET MILITARY SPENDING RANGE FROM 12 TO

18% OF THEIR GNP, COMPARED TO 5-6% FOR THE UNITED STATES AND LESS THAN 1% FOR JAPAN. IN ABSOLUTE TERMS, THE SOVIETS HAVE OUTSPENT US BY AT LEAST 50% -- WHICH IS 100 BILLION DOLLARS -- PER YEAR. AND THEY SHOW NO SIGNS OF REDUCING THEIR LEVELS OF MILITARY SPENDING. ON THE CONTRARY, THEY ARE CLEARLY INCREASING MILITARY EXPENDITURES, IN ABSOLUTE TERMS AND THERE IS EVIDENCE IT MAY BE INCREASING AS A PERCENTAGE OF GROSS NATIONAL PRODUCT.

SUCH A MASSIVE EFFORT OVER AN EXTENDED PERIOD OF TIME NATURALLY CAUSES EXTREME ECONOMIC DISLOCATIONS IN THE CIVILIAN AND INDUSTRIAL SECTORS. IF THE SOVIETS HAVE THE LATEST MILITARY TECHNOLOGY BUT ARE UNABLE TO DEVELOP THEIR ENERGY RESOURCES ON ACCOUNT OF A SHORTAGE OF THE NECESSARY TECHNOLOGY AND CAPITAL, THEN THEY SHOULD BE MADE TO FEEL THE CONSEQUENCES OF THEIR DECISIONS ON MILITARY PROCUREMENT. IF THE WEST, HELPS THEM AVOID THEIR PREDICAMENT THEY WILL HAVE LITTLE INCENTIVE TO CHANGE THEIR SPENDING PATTERNS. THEY WILL DIVERT RESOURCES AWAY FROM THE MILITARY INTO THE

CIVILIAN SECTOR ONLY IF THEY HAVE NO CHOICE. IT IS IN THE WEST'S INTEREST TO ENCOURAGE SUCH A SHIFT; IT IS NOT IN OUR INTEREST TO HELP THE SOVIETS AVOID MAKING SUCH A SHIFT.

BUT WHAT IS DESIRABLE IS EASY. THE DIFFICULTIES ARISE WHEN WE HAVE TO TAKE THE CONCRETE STEPS TO PUT OUR IDEAS INTO PRACTICE.

AS WE SURVEY THE WORLD, WE FIND THAT THE THREAT TO THE INDUSTRIAL DEMOCRACIES IS GREATER THAN IT HAS BEEN IN A GENERATION. OUR PROBLEMS CANNOT BE REMEDIED EASILY OR CHEAPLY. SOLUTIONS WILL NOT BE ACHIEVED WITHOUT AN EXTRAORDINARY AMOUNT OF COOPERATION AMONG THE NATIONS OF THE WEST.

IT WILL BE DANGEROUS TO UNDERESTIMATE THE DIFFICULTIES WE WILL FACE IN TRYING TO RESOLVE OUR PROBLEMS. BUT IT WILL BE FAR MORE DANGEROUS IF WE DO NOT TRY TO SOLVE THEM BECAUSE THE PROBLEMS SEEM SO OVERWHELMING. THERE IS A NEW MOOD IN AMERICA THAT OUR PROBLEMS ARE SOLVABLE; THAT THE CHALLENGES MUST BE MET; THAT AMERICAN AND WESTERN INTERESTS AROUND THE

WORLD MUST BE MORE VIGOROUSLY DEFENDED; AND THAT EFFORTS BY OTHERS TO CAUSE DIFFICULTIES FOR US MUST BE MET WITH FIRM RESISTANCE.

AS WE ENTER THIS NEW ERA, WITH WESTERN STRENGTH DANGEROUSLY REDUCED, THE UNITED STATES MUST TAKE SPECIAL ACCOUNT OF THE REQUIREMENTS OF PARTNERSHIP WITH ITS ALLIES AS WE TRY TO ELIMINATE OUR VULNERABILITIES. THE UNITED STATES CANNOT TURN THE CLOCK BACK TO AN EARLIER ERA WHERE IT WAS POSSIBLE TO IMPOSE OUR PREFERENCES ON OUR FRIENDS AND FOES ALIKE. THE SHIFTS IN THE DISTRIBUTION OF WORLD POWER MEAN THAT IT IS NECESSARY TO DISPLAY MORE ACUMEN, SKILL, AND SENSITIVITY IN OUR RELATIONS WITH OUR ALLIES AND OUR ADVERSARIES.

THE WEST WILL NOT BE EQUAL TO THE CHALLENGES IT FACES UNLESS IT MEETS THEM TOGETHER. IN ENERGY AFFAIRS, IN NATIONAL SECURITY AFFAIRS, IN TRADE POLICY VIS-A-VIS THE COMMUNITY COUNTRIES, AND IN A HUNDRED DIFFERENT AREAS OF COMMON WESTERN CONCERN, WE MUST WORK CLOSELY WITH EACH OTHER

TO PROTECT OUR COMMON INTERESTS.

PARTNERSHIP MEANS POWER SHARING AND WILL REQUIRE GREATER MUTUAL UNDERSTANDING ON BOTH SIDES AS WELL AS MORE EQUITABLE DIVISION OF RESPONSIBILITY. A CLOSE RELATIONSHIP WITH JAPAN REMAINS ESSENTIAL TO THE ACHIEVEMENT OF THE FUNDAMENTAL INTERESTS AND ASPIRATIONS OF BOTH OUR NATIONS. WE CAN BEST MEET THE CHALLENGES AND OPPORTUNITIES OF PARTNERSHIP IF WE PROCEED TOGETHER IN THE SPIRIT OF COOPERATION.

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JAPAN ATOMIC INDUSTRIAL FORUM

TOKYO, 10 MARCH 1981

SESSION 1

PROSPECTS OF THE NUCLEAR INDUSTRY IN FRANCE

presented by G. Vendryes, Director, Industrial Nuclear Applications

C.E.A., FRANCE

To talk about the prospects of the nuclear industry in France means first and foremost discussing the energy situation of the country, and the reasons that explain and justify its policy of massive and immediate recourse to nuclear power.

The energy shortage is a matter of concern that a Japanese audience, more than any other, can understand and fully perceive. Because in this respect Japan and France both have the same anxieties, and share with a few other countries the dubious distinction of being one of the industrial nations that are practically devoid of their own fossile energy resources.

Despite major exploration programs, especially in offshore zones bordering our territory, France has very little oil, and its natural gas reserves are nearing exhaustion. Its coal reserves are modest, deposits are deep, thin and therefore expensive to work. Its hydroelectric potential has largely been harnessed and utilized.

The consequences of this are as clear as they are disquieting :

- to satisfy its energy needs, which amounted in 1980 to some 200 Mtoe, or about 3% of world energy consumption,
- France only has :
  - . 0.7% of world energy production,
  - . 0.1% of world energy reserves,
- hence it is forced to import a growing share of its energy procurements :
  - . 38% in 1960,
  - . about 75% today.

This extreme dependence is intolerable both economically and politically :

- economically, because the burden of energy imports is growing from year to year, essentially due to rising oil prices,
- politically, because this situation makes our country extremely vulnerable to the decisions of a small number of producing States and to the convulsions of the international market.

Faced with this dramatic foreign exchange, and to the international risks incurred, the French Government many years ago established a firm, consistent policy, aimed in three major directions :

- a program of energy economies in all branches of activity,
- the discovery and upgrading of all possible national energy sources, both conventional and new ones,
- finally and above all - because we are already aware that the two foregoing solutions cannot cope with the problem - the massive growth of nuclear energy, the only form of energy currently capable of redressing our energy balance in the short and medium term.

It is this nuclear policy that I want to discuss here, first as a whole, and then broken down into its different industrial aspects.

1 - THE PENETRATION OF NUCLEAR ENERGY IN THE FRENCH ENERGY BALANCE.

An analysis made in France prior to the oil crisis demonstrated the advantages of nuclear power on three levels :

- it is a technology available now, one that has already proved its safety and reliability;
- in view of France's uranium reserves, both on its own territory and through its mining participations abroad, nuclear energy guarantees our security of supply at least for several decades, not to mention the incomparable prospects offered in the longer term by the development of fast breeder reactors;
- finally, economically, it serves to produce electricity at a price far lower than that offered by coal or fuel oil fired power plants.

Hence nuclear energy is a must, and has been selected by the French Government as the chief alternative energy source to oil imports, in order to reduce the energy dependence of the country. An initial program of 8000 MWe of PWR reactors was launched in 1970, added to the natural uranium power plants built previously. Since 1974, this program has been accelerated steadily. By the end of 1980 :

- 20 units were in service, representing power capacity of 13 GWe,
- 32 reactors, with a total capacity of 33 GWe, were in various stages of construction, some of them close to commissioning.

Added to these figures are the power plants on the drawing-boards or planned for the 1980/1983 period, 19 reactors representing 23 GWe, some of which are already in the preparatory stage. All these reactors should be commissioned before 1990. By this date - and in view of the final shutdown of some old reactors - total nuclear power capacity in France will amount to about 65GWe.

This program's impact on the French energy balance is already and will mainly be reflected, in terms of electricity, and in terms of energy.

In terms of electricity

- In 1980, nuclear power plants in service had already produced 58 billions of KWh, or 23% of French electricity consumption.
- This share of nuclear power should continue to grow substantially to reach :

  55% in 1985 (193 billions of KWh)

  70% in 1990 (315 billions of KWh)

  and to level off at about 80% in the longer term.

In terms of energy

- In 1980, nuclear power production accounted for no more than 6% of the French total energy consumption, half of which was covered by oil alone.
- This share of nuclear power should increase significantly at the expense of oil, and the 1990 target is for France to have a balanced energy pattern including approximately :
  - 30% nuclear,
  - 30% oil,
  - 30% coal and gas,
  - 10% hydropower and other renewable energies.

These figures call for two series of remarks.

(1) In relation to the size and economic power of our country, the French nuclear program is undoubtedly the world's biggest. It implies considerable financial and industrial effort, at the limits of our capacity. And yet, if everything goes along smoothly as planned, by 1990 it will only allow France to :

- stabilize its oil imports, in absolute figures, at the 1978 level (about 100 Mtoe),
- reduce its rate of energy dependence to around 55%, from the current level of about 75%.

(2) A program of this scale will also cause a significant change in methods of energy utilization in the various consumption sectors. As it aims to replace oil by nuclear power, of which the only currently feasible vector is electricity, it necessarily implies a significant growth in the share of electricity in the national energy balance. In 1980 this share only amounted to 28 % in France - a low figure, below the level prevailing in most industrialized countries. The penetration of nuclear power should raise this share to 40% at least by 1990, and to around 50% by the end of the century. This pattern in no way appears unrealistic if one considers the example followed abroad.

Enhanced by the relatively low nuclear KWh cost, this penetration of electricity should occur chiefly in two areas in which a large potential market still exists in France : in the domestic sector especially for electric heating and in the industrial one, where electricity offers undeniable advantages of flexibility and convenience, which can be even further improved by expected developments in certain advanced technologies.

These reflexions help us to gauge the scope of the French nuclear effort, and also the extent of the changes implied in national economic structures.

What stage has been reached by the practical implementation of this program, and how is it reflected industrially ? I shall now try to answer this question by drawing a distinction between its three technical aspects : pressurized water power plants, their fuel cycle, and the fast breeder reactors.

2. - PRESSURIZED WATER POWER PLANTS.

After trying several types of reactors, the French Government came in 1970 to the conclusion that the PWR system was the right one for the implementation of the national nuclear power program. This decision was confirmed when nuclear growth was accelerated in the aftermath of the oil crisis. Hence the current program is based nearly exclusively on this technique, the only exception being the SuperPhénix fast breeder power plant that I shall discuss later.

Faced with the effort required, it was necessary to set up a multilevel and cohesive industrial organization to avoid the dispersion of national capacity. There is only one utility, Electricité de France, the exclusive owner and operator. The construction of PWR power plants was entrusted to a limited number of French companies, each combining all the resources of the country in its own special field. Hence the design and construction of the NSS systems is carried out by Framatome and the turbogenerators units are manufactured by Alsthom-Atlantique.

With respect to the NSS systems, licence agreements concluded in 1972 between Framatome and Westinghouse initially offered advantages to EDF because they made available to Framatome the experience acquired by Westinghouse in designing and building a large number of PWR's. But, due to the extensive French program backed by a major national R and D effort, and to the interruption of orders in the United States, the respective weights of Framatome and Westinghouse changed drastically over the years. It was made clear long ago on the French side that the existing licence agreements would not be renewed and that, if the relations between the two companies had to continue, they could only proceed on an equal footing, each partner being fully master of its own technology. An agreement along these lines has already been reached between the two companies and it will replace the ones of 1972 as soon as a final approval will be given by the two Governments, which is expected to take place shortly.

The scale of the program to be implemented also required the setting up of a specific industrial infrastructure and the use of special procedures. Thus four "multi-annual" contracts, covering the entire sequence of a series of 900 or 1300 MWe units, were concluded by EDF with the two main suppliers mentioned above. Subject to minor local factors, all the plants of each series are similar. This offers many advantages.

. It has allowed the industrial firms to improve their fabrication and quality insurance procedures, and to set up large-scale workshops, equipped with the latest machinery. This is the case, for example, of the plants built by Framatome at Chalon and at Creusot, capable of building eight pressure vessels and some twenty PWR steam generators annually.

. Duplicate construction is also a decisive factor in safety and reliability, because it makes possible to focus all resources available on a limited number of projects and ensures that each unit will benefit from progress achieved in previous ones, throughout the development of a series.

. Finally, standardization has largely minimized the effect of the hazards encountered, by allowing the replacement of any faulty part by an identical component taken from another unit currently being manufactured.

All these advantages have their financial counterparts, and partly explain the low KWh cost of electricity produced by French nuclear power plants.

A major problem raised by the implementation of this program relates to nuclear sites. While most of the power plants have been accepted without objection by neighboring populations, limited but sometimes violent anti-nuclear oppositions have taken place in certain regions afflicted by local problems of an economic, political or social nature - as recently at Plogoff in Brittany. At all events, the seventeen sites currently selected and authorized, most of them already possessing up to four units in operation or under construction, can accommodate 53 GWe. Procedures are under way for another seven sites. This total potential of 24 sites will be able to accommodate 90GWe, in other words, henceforth the location of French nuclear power plants is guaranteed up to the end of the century.

It may be seen that an exceptional industrial, technical, administrative and financial effort has been mounted. France is beginning today to gather the benefit from it.

Naturally, some delays occurred in the initial phases of the program. These delays were gradually reduced, as the organization progressed and the similarity of the units made it possible to take advantage from past experience. In this respect, the results obtained for Dampierre 1 are quite outstanding : this unit, which went critical on March 15, 1980, was coupled to grid on March 23. It reached full power on May 29, and had produced its first billion of kWh by June 15, 1980.

During the year 1980, a total of six 900 MWe plants have been coupled to grid, an average of one every two months, and this rate is expected to continue in forthcoming years. The availability of these nuclear stations is comparable to that of the best conventional thermal power plants and at the same time the advantages of nuclear power from the economic standpoint become more and more clear. Since the oil crisis, the KWh cost of electricity produced by PWR power plants has fallen sharply below that of fossil power plants.

I would like to terminate this summary by mentioning that Technicatome, a subsidiary of the Commissariat à l'Energie, has also developed a modular range of medium sized PWR NSS systems (up to 300 MWe) designed to generate heat or electricity or propulsion power for merchant ships.

3 - THE NUCLEAR FUEL CYCLE

The growth of installed nuclear power capacity, as planned in France in forthcoming decades, implies the simultaneous development of an extensive nuclear fuel cycle industry. In this area, we have pursued our efforts with the same vigor as for the power plants. The leading role is performed by Compagnie Générale des Matières Nucléaires (COGEMA), a wholly-owned subsidiary of the Commissariat à l'Energie Atomique, which now covers all the activities of the nuclear fuel cycle and is the world's foremost company in this field.

Prospecting for natural uranium in Metropolitan France and abroad is a subject that focuses considerable attention, with the principal aim of diversifying our resources. Known or economically workable French resources exceed 120,000 tons, enough to satisfy the needs of a large share of the French program. Supplementary supplies are secured abroad, thanks to mining participations acquired by French companies in many countries ; for instance, in Niger, Cogema and the Japanese entity OURD are both shareholders of the Cominak firm and partners for further uranium exploration projects. However, the amount of uranium to be imported in France will regularly increase and will represent at the end of the century about 70 % of our total needs. This is why - as we shall see later - France is so strongly committed to developing fast breeder reactors, the only ones capable of providing a definitive answer to this problem of uranium supplies in the long term.

Let me recall that URANEX, a subsidiary of the CEA-Cogema group, is in charge of selling natural uranium abroad and is working particularly close with Japanese utilities. Conversion to uranium hexafluoride is carried out in France by COMURHEX, a subsidiary of the Pechiney-Ugine-Kuhlman group (PUK) ; its present annual capacity above French needs is allotted to foreign customers.

For the light water power plants, which currently make up the bulk of our program, isotopic enrichment of uranium is the next indispensable step in the nuclear fuel cycle. In this area, scientific and technical know-how gained in construction of the Pierrelatte facility helped to undertake the building of a large-scale gaseous diffusion enrichment plant for civil purposes. Built within the framework of EURODIF, a French company with the participation of several foreign countries, the TRICASTIN plant started operation at low level in 1979, in accordance with the initial schedule. At the present time, its capacity is 6 millions SWU/year ; from now onwards, significant amounts of enriched uranium are available for export, and the first deliveries have been made in 1980 to Japanese utilities. The Tricastin plant will reach its full capacity of about 11 millions SWU/year in 1982 - a quarter of worldwide enrichment capacity by this date. In the longer term, a second multinational gaseous diffusion facility, of which the size, site and commissioning date will be determined in accordance with market requirements, will be built by the shareholders of Eurodif associated within Coredif.

Simultaneously, the CEA continues to conduct a major research and development program on various techniques of isotopic separation, including gaseous diffusion - which is still open to significant technical and economical improvements - and the unique chemical exchange process discovered in France 13 years ago. The progresses achieved on this Chemex process during the recent years are remarkable. The process system is founded upon well-known engineering principles, and no new technologies are required to implement it ; it represents a consistent, workable process, sufficiently well developed to allow plant operation ; it lends itself to a modular construction, allowing a regular adjustment of the size of the plant to the market requirements. From the standpoint of economics, the results obtained to date are very promising : even for medium-size installations (1 million SWU/year) the estimated cost of Chemex SWU is expected to be fully competitive with existing gaseous diffusion and gas centrifuge processes, as they are presently or will be implemented in large-size plants. The next step in the development of our Chemex process is the construction in France of a pilot unit, fully representative of an actual industrial plant ; the design of this pilot is now underway, and the building operations are expected to start in the near future.

Fuels for French PWR power plants are currently fabricated in the Dessel (Belgium) and Romans (France) plants of Société Franco-Belge de Fabrication de Combustible (FBFC), a subsidiary of the Pechiney-Ugine-Kuhlmann Group (PUK) and Framatome. The total capacity of the Romans plant. is now being expanded. Simultaneously, COGEMA and Framatome recently agreed to build and operate jointly a new fabrication plant within the Tricastin industrial complex. Namely, this plant will fabricate fuel of French design, developed jointly by the CEA and Framatome in liaison with EDF. These various decisions will enable us to meet, with a good safety margin, the quick-growing requirements of the French program.

The reprocessing of spent fuels constitutes an imperative need for the immediate future. By avoiding the long term storage of irradiated fuels it allows safer management of nuclear materials and radioactive wastes. Reprocessing is also a must when one considers efficient use of energy resources : valuable fissile material is thus recovered, in particular plutonium which is needed for start-up of fast breeders. And without breeders nuclear energy would bring only a very temporary contribution to the energy needs.

France's position is therefore clear and has often been stated officially : for us reprocessing is a sine qua non of our energy independence and an irreversible choice.

I shall now say a few words on feasibility of reprocessing : technical demonstration on industrial scale has been achieved. In this area, France has facilities at Marcoule and La Hague, which are operating satisfactorily : the cumulative amount of light water fuels reprocessed at La Hague now exceeds 250 tons (including 150 tons for the last 1979/1980 run). Of course, as every incipient industrial activity, our reprocessing facilities met with some troubles ; on several occasions, their importance have been magnified beyond measure, and I would like to stress out here that, in no case, these incidents had the slightest consequence upon the people or the environment.

As for the new reprocessing facilities, which are necessary to guarantee optimum management of the irradiated fuels, Cogema is starting to extend considerably the size of the La Hague plant, the major engineering rôle being assumed by the SGN company (Société Générale pour les Techniques Nouvelles) . I would like to stress that the technology involved in the design of this large extension is the most modern one worldwide, as it makes use of a long and unique operating experience. The capacity of the La Hague plant will be raised, by steps, up to 1600 tons per year before the end of the current decade. I need not recall here that this plant will reprocess spent fuel elements for a number of foreign utilities, and that a fair share of these elements will come from Japan.

We attach a great importance to improve the present methods for conditioning radioactive waste disposal, for high activity as well as for low and medium activity waste. To illustrate what can be done, I shall point out the vitrification process, that was designed and experimented in France. The Marcoule Vitrification Unit (AVM) continues to operate with sustained high performance results. As this experiment is especially satisfactory, units based on the same principle as AVM, but larger, are planned at La Hague.

On the whole, thanks to these intensive developments, French industry is currently present at all levels of the fuel cycle. It is today capable of guaranteeing the safe supply of nuclear materials for the country, and of covering the specific requirements of the national nuclear program at least until the turn of the century - while reserving a reasonable margin for exports.

4. - FAST BREEDER REACTORS (LMFBR)

While the French light water nuclear power plant program, as described earlier, serves to alleviate the oil yoke and to cope with the energy demand of the country for the years to come, it is not a final solution to the problem of its energy supplies.

In fact, PWR power plants - like all slow neutron power plants - are very wasteful users of uranium, and only burn a very small proportion of the energy potential contained in this precious material. The growth rate of our indispensable nuclear power program will thus mean fast rising uranium needs : nearly 10,000 tons per year by 1990. Since a priority objective of our energy policy is national self-sufficiency, it is essential to stabilize these uranium needs, and then to reduce them to a level compatible with national resources, which as we have stated are limited.

Fast breeder reactors offer the only means of attaining this objective. Their fundamental asset is their very low consumption of natural uranium and even, in the initial period, zero consumption. They can operate on depleted uranium, a material that cannot be used elsewhere, and will be available abundantly for many decades. Fast breeder reactors are thus released of any dependence on raw material resources, and will thus serve to cut natural uranium requirements in proportion to their share of nuclear power production. With a progressive introduction of breeder reactors, only limited by the plutonium availability in the short term, our natural uranium needs, peaking at nearly 10,000 tons per year at the end of the century, will then rapidly decrease to reach in 2015 the 1985 level.

The fast breeder program has been developed in France since 25 years with an uninterrupted effort. The experimental reactor RAPSODIE, which was commissioned in 1967, has constituted a full-scale test bench for components and for technology, and also an irradiation tool for fuels and materials of the system. This facility is expected to keep on doing so for many years.

The development of the LMFBR system in France entered the industrial phase with the Phénix (250 MWe) demonstration reactor. Built in five and a half years, within the planned deadlines and costs, this plant started full power operation in 1974. Since then it has unceasingly proved that it is possible to build an electric power plant of this type and to operate it in comparable conditions to those of conventional installations.

The electricity production since commissioning till now exceeds 8.5 billions of kWh. The availability of the plant reached 93.5 % in 1979 and was limited to 70.7 % in 1980 only as a consequence of a three months planned shutdown for routine maintenance and inspection.

Hence the operation of Phénix is extremely satisfactory on the whole, and in particular from the standpoint of environmental protection. During seven years operation, there has been practically no release of gaseous and liquid effluents, and radiation monitoring of operating personnel has shown an exposure level onehundredth of the authorized threshold. Phénix accumulates irreplaceable experience in the technological area and especially on fuel behaviour. Work carried out in 1977 on the intermediate heat exchangers demonstrated that the pool concept does not set any problem from the repair and maintenance point of view.

As this essential step has been taken, the problem at hand is to demonstrate progressively the commercial character of the system. This is the goal of SuperPhénix, a 1200 MWe power plant on which construction began in 1977, in a European setting, on the Creys-Malville site in France. This project is currently at mid-point. The civil work on the reactor building is practically finished. All the NSS system contracts have been awarded. The internal structures of the reactor, fabricated and assembled on site by a method already tried successfully on Phénix, have been already positioned, starting with the safety vessel and the main vessel which were placed in the reactor in May and August 1980 respectively. The other main components like sodium pumps, heat exchangers and steam generators are being fabricated by various industrial firms, while the corresponding tests are being performed at CEA and EDF facilities.

The Creys-Malville power plant is expected to achieve first criticality by the end of 1983. Capital costs for SuperPhénix - about 8 billions of 1980 French francs, without fuel and without interests during construction - will be approximately twice those of a PWR with the same generating capacity. It will generate electricity at a cost comparable to that of modern coal-fired plants in France ; this is not an economic heresy, taking into account that SuperPhénix is the first one of its kind, built within a multinational framework as only one plant on a site. While acceptable for a prototype, this result is not considered good enough for the commercialization phase and our main concern with fast breeders at present is to lower their cost. Our objective in the years to come is to gradually narrow the gap between the production costs of the breeder and the PWR, the breeder's temporary higher cost being justified as an insurance for the future. This is unquestionably an ambitious goal, but we have good reason to believe that it will be reached in a not too distant future.

In parallel with our work on the fast neutron reactors themselves, a major effort has been undertaken on the associated fuel cycle. The construction of TOR, a facility specifically devoted to the reprocessing of fast breeder fuel with a capacity of 5 tons per year, is going on at Marcoule. TOR will be operational in 1983. Design and engineering work currently being done is not only aimed at the fabrication and reprocessing of fuel assemblies irradiated in Phénix and SuperPhénix, but is also intended to prepare for the construction of large plant to match the needs of future fast breeder power plants.

The preliminary design of the next breeder reactors is well under way. A special effort is focused on the safety aspects. As an exemple great care is taken to ensure that the reactor will withstand satisfactorily earthquakes.

In the months to come, Electricité de France working in close connection with the CEA, will conclude with Novatome a contract for the detailed design of the NSS system of the reactors to follow SuperPhénix.

After this design has been finalized and the safety procedure has been completed, it is expected that Electricité de France will order, in principle in 1984, a small series of identical breeder power plants of about 1500 MWe each, launched at 18 months interval. At the same time, the decision will be taken to build two large plants, one for manufacturing (FOR) and the other one for reprocessing (PURR) fast breeder fuel elements. This time schedule will enable us to draw maximum benefit from the operation of SuperPhénix and TOR.

The current studies assume that the next breeder power plants and the corresponding fuel cycle FOR and PURR plants will be located side by side, on an extension of the Marcoule site in the Rhône Valley. If the investigations under way confirm that such an integrated scheme is feasible, it will obviously offer considerable advantages from the economic standpoint and also in order to avoid long distance transport of plutonium.

Looking at our long-term strategy, twenty years will elapse between the date at which our first large industrial prototype SuperPhénix was launched and the time, by the end of the century, when fast breeders will account for a significant share of our whole nuclear electricity production. The implementation of the program will proceed in accordance with the growth in electricity needs and plutonium availability, in continuity with the prudent spirit that has always prevailed hitherto in France in the development of the fast breeder reactor system.

CONCLUSIONS

French energy policy is based on a lucid examination of the situation of our country and of constraints related to the international context: the energy crisis is a worldwide matter affecting all countries. But among the leading industrial nations, few are as vulnerable as France on account of its poor fossil energy material resources.

But if geography makes us dependent, it cannot lead us into resignation or inaction. And the brief description that I have just given of our nuclear power policy shows, I believe, that in this respect the French have got a good grasp of their future . . .

As it happens, this analysis could be transposed to Japan word for word. It is impossible to avoid being struck by the similarity of the energy situations of our two countries, and by the similarity of their reactions: faced with the identical shortage of fossil energy, the same massive recourse to light water nuclear power plants, the same efforts to master the different stages of the fuel cycle, and finally, the same awareness of the need for fast breeder reactors.

In this respect, both our Governments have made consistent, logical decisions, in harmony with the recommendations of the Western Heads of State, made during their meeting in Venice in June 1980. One can only hope that identity of views will induce them to collaborate even further, as they have already done in the past, for the best interests of our two nations.

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SESSION-I "ENERGY SECURITY AND NUCLEAR POWER"

THE ROLE OF NUCLEAR POWER IN KOREA

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urrent Energy Situation

Korea does not have adequate indigenous energy resources nd hence must rely heavily upon imported oil. ntil now, coal has been its most important domestic energy ource but the reserve recoverable on an economical basis anges between 500 million and 1,000 million tons depending pon oil prices. Coal production has recently been limited o about 20 million metric tons annually.

Potential hydro capacity is estimated at 3,000MW of which 57MW has been developed. The remaining hydro potential ill be developed to maximize the efficient use this domestic nergy resource. Tidal power potential capability is estimated o be about 1,700MW, and a site with among the best prospects s under study, but there has been no other development work n this area to date. (Table 1 and Figure 1)

There are most promising prospects for offshore oil for hich prospecting is under way but an early supply is not nticipated even when any is discovered. There are also liited amounts of low grade thorium and uranium resources. he thorium is estimated at one million tons of monazite hich can yield up to 45,000 tons of ThO_2. The uranium is, owever, extensive, but mostly in the form of low grade, ranium-bearing black slate. Its uranium content is about .04% for uranium mining. The proven reserves of minable lack slate are about 30 million tons from which about 12,000 ons of U_3O_8 which is well below the current cut-off grade f 0.08% for uranium mining. The proven reserves of minable lack slate are about 30 million tons from which about 12,000 ons of U_3O_8 could ultimately be extracted.

Even with the expeditious development of domestic energy esources, imported energy will play an even more important ole in the future because indigenous energy resources will ot support ever increasing energy requirements.

Excessive dependence on a single form of imported energy nd on a single source is thought highly risky from the view oint of a reliable supply of energy. Interruption of Korea's nergy supply could prove catastrophic to economic developent and even to national security. Thus diversification of imported energy in terms of both source and form has become an underlying issue of energy policy. In an effort to diversify nuclear power will assume top importance in Korea's energy program. There is no question about the relative economics of nuclear power, (Table 2) our firm policy will be to develop nuclear power plants expeditiously to the extent that such constraints (as the availability of financing, required manpower, usable sites, and reliable supplies of nuclear fuel will allow.

Nuclear Power Program

A. Nuclear Power Projections

For the period from 1961 through 1976, the average annual GNP growth rate was 9.7% but for the period from 1977 through 1980, it went down to 5.5% per annum mainly due to high energy cost.

The Republic of Korea's economic growth has, however, been one of the fastest in the world for the last two decades.

As is generally the case in developing countries, power demand growth in Korea has been nearly double the growth of GNP. The annual power growth rate over the period 1961 through 1976 averaged 18.3% and over the period 1977 through 1980, 9.4% (Table 3).

Assuming that the GNP growth rate slows gradually to 7% during the 1980s and 6% in the 1990s, Korean energy demand in 2,000 is expected to reach over 160 million metric tons of oil equivalent. The share of electricity in total demand will increase from 23.5% in 1979 to over 35% in 2,000.

Nuclear power's share of total electrical power supply may be determined via systems analysis considering not only a direct economic comparison of construction costs, operation and maintenance costs, or generation costs, but also such indirect factors as safety, manpower and site availability and reliability. Based on such an approach various combinations of fossil, nuclear, hydro and pumped storage units have been analyzed for both low and high energy growth paths using the Wien Automatic System Planning Package (WASP) program at Korea Advanced Energy Research Institute(KAERI).

The WASP analysis shows that the nuclear share in total installed power capacity will grow steadily from the current 7% to around 36% by 1991 while the share of oil fired power plants will decrease to around 28% from the current 72% level.

Table 4 shows the current share of respective energy forms for power generation and the expected result of diversification.

To achieve these goals a detailed nuclear power development program has been established as shown in Table 5. This program has remained virtually unchanged since it was first established after the serious oil crisis of late 1973. By the end of 1991 Korea will have 12 operating nuclear units. Currently one unit with an installed capacity of 587MW is in operation. Eights units are under construction and three nits in the planning stage.

Even though there is no official plan beyond 1991, more han 30,000MWe of nuclear power will have been introduced n to Korea by 2000, and it is assumed that the Koren nuclear ower program beyond 2000 will continue to be carried out s rapidly as double that of the world average nuclear growth ate as reported by INFCE. Nuclear power projections are ummarized in Table 6.

. Nuclear Fuel Cycle

None of elements of the fuel cycle is currently available using domestic capabilities and is none expected to be vailable in the foreseeable future. (Table 7)

To support the successful implementation of the nuclear ower program best the need for uranium concentrates and nrichment services must be met in advance with reasonable ssurance. Table 8 depicts the annual uranium concentrate equirement through 1995. In 1990 it will be around 2,500 T U_3O_8 and will range from 3,700MT U_3O_8 minimum through ,400MT U_3O_8 maximum in 1995 depending upon such assumptions s fuel cycle options, plant capacity factor and the content f tails assay.

The mass flow data for the lower projection is based on an advanced or optimized fuel cycle scheme as proposed by one of our reactor suppliers while a currently available standard fuel cycle scheme is the basis for the higher projection. Two years lead time is assumed for both projections. The cumulative requirements by 1990 will range from 17,500 through 18,500 MT of U_3O_8 and by 1995 range from 33,500 through 44,000 MT U_3O_8. As shown in Table 4 requirements to 1986 have already been committe(

Short term ore requirements have been currently purchased on the spot market, but it is our policy to reduce such purchasing. Long-term requirements will be secured through long-term purchasing contracts and joint exploration.

As seen in Table 9, about 14,000 MT U_3O_8 have already been secured by spot purchase and long-term contracts: about 40% from Canada, 20% from the U.S.A., 20% from Australia and the remaining 20% from other countries. The diversification policy has been established.

Two joint exploration programs are currently underway. One program in Paraguay started in 1978. The partners are Taiwan Power Company and American Anschutz Corporation which is in charge of the projects. The other joint exploration program started in mid 1980 in Gabon, Africa with COGEMA, a French company and Gabonese Government as the partners. COGEMA is the operator of this project. A Korean drilling company is performing drilling services a subcontractor to COGEMA.

The basic policy for enrichment services includes long-term fixed commitment contracts and diversification of enrichment service sources. Enrichment service contracts are signed for all light water reactors either in operation or under construction. Contracts for enrichment services for Korean Nuclear Units through No. 8, except No. 3 which is a CANDU reactor plant, have been made with the US DOE in the form of adjustable fixed commitment(AFC) contracts. The enrichment services for Korean Nuclear Units Nos. 9 and 10 have been secured by contract made with COGEMA, France. AFC contracts with US DOE are under discussion for KNU Nos. 11 and 12 (Table 10).

conversion, the fabrication of nuclear fuel and processing services are not available from domestic urces. No significant problem is forseen in the area conversion and fabrication. Fabrication would be e first element of the fuel cycle to be localized. ch nuclear unit has its own on-site spent fuel storage cility covering at least ten years of normal operation accordance with prevailing non-proliferation policy.

Others

Siting Principles

- Multiple (4-6) units at one sites (Table 11)
- Preliminary site survey; 11 tears ahead of plant completion
- Detailed survey; 10 years in advance of plant completion
- About 10 sites are needed to support the nuclear program up to the year 2,000

Build-Up of Local Engineering Capability (Table 12)

Basic Policy For Localization Plan

- Localization plan for each unit to be established in accordance with government policy(Table 13)
- KECO sets contractual requirements for the suppliers of major equipment to promote localization.
- Local suppliers' cooperation is required to assure quality and timely delivery.
- It is hoped that safety related components will have test periods in conventional plants.
- The Korea Heavy Industry & Construction Co. Ltd. will be the major equipment supplier.

ng-term Nuclear Reactor Strategies

For economic comparisons and fuel cycle analysis, four fferent reactor mix scenarios have been postulated as own in table 14. The reactor types considered here are sumed for the sake of simplicity to be PWR, HWR and

LMFBR, even though many other reactor types will become available in the future. The capital costs for PWRs are estimated at 827 and 734 \$/KW for 900 and 1,200 MWe units, respectively, while those for HWRs are predicted at 1,061 and 947 \$/KW.

These costs are calculated by using the CONCEPT-5 computer code, based on the 1978 value of the dollar, assuming 4 identical units are constructed at the same site. The unit capital costs have a tendency to go down if unit size increases, or if identical units are constructed at adequate time intervals, say one year, at the same site.

It is assumed that the capacity factor of the HWR is great than that of the PWR by 5%, based on past records. The capital costs of the LMFBRs are assumed to be 1.4 times higher than for the PWRs in this study while the life-time average fuel cycle costs for the former are predicted as being as low as a quarter of the latter. The economic comparison for 4 different reactor mixes has been made using the WASP[1] program at KAERI.

It will require about 30 to 32 billion dollars to have 31 nuclear power plants in operation in Korea by 2,000. According to the results, total costs do not in the long run depend much on reactor strategies.

It is quite important to find out whether or not Korea would be able to obtain enough uranium for its planned nuclear power program, since it has little in the way of domestic resources as already mentioned.

The world natural uranium reserves recoverable in \$130/Kg U are limited to not more than 5 million metric tons of U_3O_8, while about 18 million tons of U_3O_8 including speculative resources may ultimately be minable at a higher cost, according to a INFCE study.

Korea now shares 0.3% of the world GNP, 0.3% of world energy consumption, and 0.9% of world population. It has been assumed that its future GNP growth rate will be as high as doubled the future world average predicted by INFCE.

We may expect to share 45,000 tons (0.9% of 5 million tons of U_3O_8) or 108,000 tons of U_3O_8 (0.6% of 18 million tons) for Korea's nuclear program. If we can get more, how much more?

Even though we figure conservatively that Korea's nuclear program will be twice the world average, as predicted in the previous section, the upper limit of natural uranium obtainable from abroad will not be more than about 200,000 tons of U_3O_8. Figure 2 illustrates cumulative U_3O_8 requirements by 2040 for 4 different reactor strategies as shown in Table 14. Figure 3 shows annual U_3O_8 requirements for these four.

It is assumed in this calculation that only a once-through option is available for both the PWRs and HWRs by 2,000 and that the plutonium recovered from spent fuel of LWRs is stored for certain periods and then fed to the LMFBR's initial core material.

The life-time uranium ore requirements for these reactors are assumed to be the same as those reported by INFCE. Although the evidence from this strategic analysis is hardly decisive, the following points are suggested:

1. Early introduction of fast breeder reactors into Korea is most desirable so far as uranium ore consumption in concerned.
2. If a once-through cycle is only permissable in the near future, storing spent fuel until reprocessing is feasible.
3. If the recycling of plutonium and/or the reprocessing of spent fuel is not possible soon, the HWR fuel cycle should be concentrated upon.

It is also important to reduce the transport distance for spent fuel and to shorten the resident time for plutonium in a separated form when the recycling of the spent fuel is possible.

In addition, to carry out Korea's nuclear power program more effectively, it is necessary to assure reactor safety as well as to improve the reliability of nuclear power plants.

Japan is Korea's closest neighbor and is carrying out a nuclear power program so it is more imperative than ever to maintain a close cooperative and collaborative relationship between Korea and Japan.

AVAILABLE ENERGY RESOURCES

1. DOMESTIC RESOURCE

* ANTHRACITE

  - PROVED RESERVES: 640 MILLION TON
  - ESTIMATED PRODUCTION PERIOD: 30 YEARS

* HYDRO POWER

  - POTENTIAL RESOURCES: 3,000 MW
  - AVAILABLE RESOURCES: 1,760 MW

* TIDAL POWER

  - POTENTIAL RESOURCES: 1,740 MW
  - AVAILABLE RESOURCES: ONLY ONE TO TWO SITES

* NUCLEAR POWER

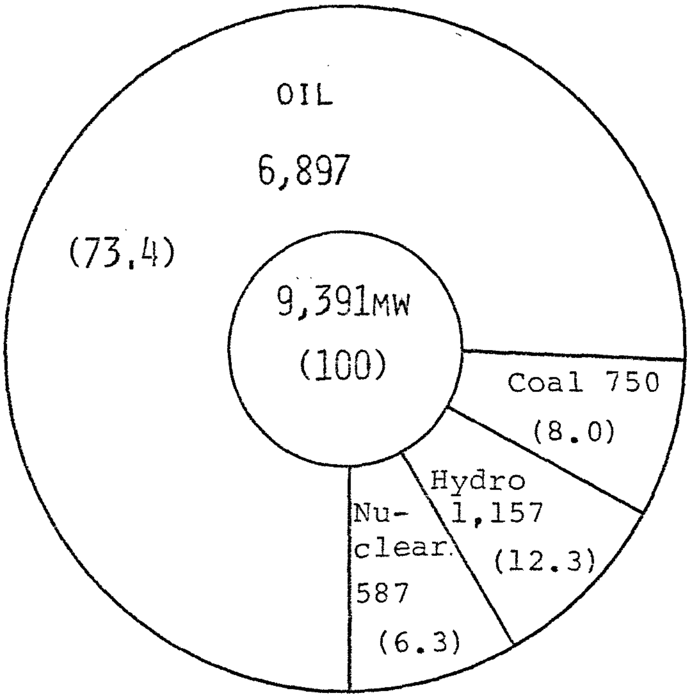
  - THORIUM RESOURCES: 45,000 TONS OF ThO_2
  - URANIUM RESOURCES: 12,000 TONS OF U_3O_8

* ALTERNATIVE ENERGY RESOURCES: R & D IS IN PROGRESS

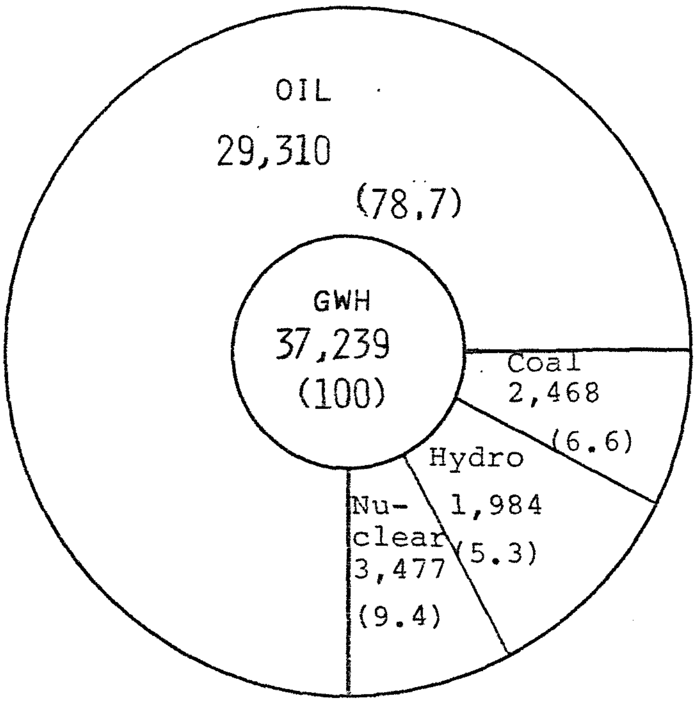
-Table 1-

THE ROLE OF IMPORTED PETROLEUM IN ELECTRIC POWER PRODUCTION.

1) INSTALLED CAPACITY('80)



2) POWER PRODUCTION('80)



gure 1

PRODUCTION COST COMPARISON IN 1980

Cost \ Unit		Ko-Ri #1	Thermal (Oil + Coal)
Unit Capacity (MW)	Gross	587	System Total
	Net	539	
Capacity Factor (%)		67.4	N/A
Fixed Charge (Mills/KWH)		11.82	6.53
Fuel (Mills/KWH)		2.43	63.35
Total Generation Cost (Mills/KWH)		14.25	69.88

ıble 2

GROWTH OF POWER DEMAND AND INSTALLED CAPACITY

YEAR / ITEM	1961	1976	1980
ENERGY SALES(GWH)	1,213	19,620	32,739
T & D LOSS(%)	29.4	10.8	6.7
AUX. USE(%)	5.04	5.2	5.55
POWER GENERATED(GWH)	1,773	23,117	37,240
SYSTEM AVE. OUTPUT(MW)	202	2,632	4,240
PEAK DEMAND(MW)	306	3,807	5,457
INSTALLED CAPACITY(MW)	367	4,810	9,391
HYDRO	143	711	1,157
THERMAL	223	3,854	6,412
INTERNAL COMBUSTION	1	245	1,235
NUCLEAR	-	-	587
PER CAPITA INCOME(US $/P)	83	765	1,058

Table 3

COMPOSITION OF GENERATING FACILITIES

UNIT : MW

ITEM \ YEAR	1980	1986	1991
HYDRO POWER :			
HYDRO	757	1362	1812
PUMPED STORAGE	400	1000	2100
TIDAL	-	-	400
SUB-TOTAL	1,157(12.4%)	2,362(13.1%)	4,312(15.3%)
COAL FIRED	887(9.4 %)	3,170(17.6%)	4,970(17.6%)
OIL FIRED	6,760(71.9%)	7,765(43.1%)	7,765(27.6%)
LNG FIRED	-	-	1,000(3.6 %)
NUCLEAR	587(6.3 %)	4,716(26.2%)	10,116(35.9%)
T O T A L	9,391(100 %)	18,013(100 %)	28,163(100 %)

Plant Name	Site	Capacity (MWe Gross)	Reactor Type	Scheduled Operation	Status	Suppliers & A/E
Ko-Ri Unit No.1	Ko-Ri	587	PWR	Apr. 78	In Operation	NSSS, Fuel : W T/G : GEC A/E : GAI
Ko-Ri Unit No.2	Ko-Ri	650	PWR	Dec. 83	Under Construc-tion	NSSS, Fule : W T/G : GEC A/E : GAI
Wolsung Unit No.1	Wolsung	678	PHWR	Apr. 83	Under Construc-tion	NSSS, Fuel : AECL T/G : HPL/CAP A/E : CANATOM CO.
Nuclear Units No.5& 6	Ko-Ri	950	PWR	Sep. 84 Sep. 85	Under Construc-tion	NSSS, Fuel : W T/G : GEC A/E : BECHTEL
Nuclear Units No.7& 8	Yeong-gwang	900	PWR	Mar. 86 Mar. 87	Under Construc-tion	NSSS, Fuel : W T/G : W A/E : BECHTEL
Nuclear Units No.9& 10	Uljin	900	PWR	Mar. 88 Mar. 89	Partially Awarded	NSSS, Fuel : FRAMATOME, T/G : In review A/E : In review
Nuclear Units No.11&12	In Planning	900 Class	To be Determined	Dec. 89 Dec. 90	In Planning	Not Decided
Nuclear Units No.13	In Planning	900 Calss	To be Determined	Dec. 91	In Planning	Not Decided

-Table 5-

NUCLEAR POWER PROJECTIONS.

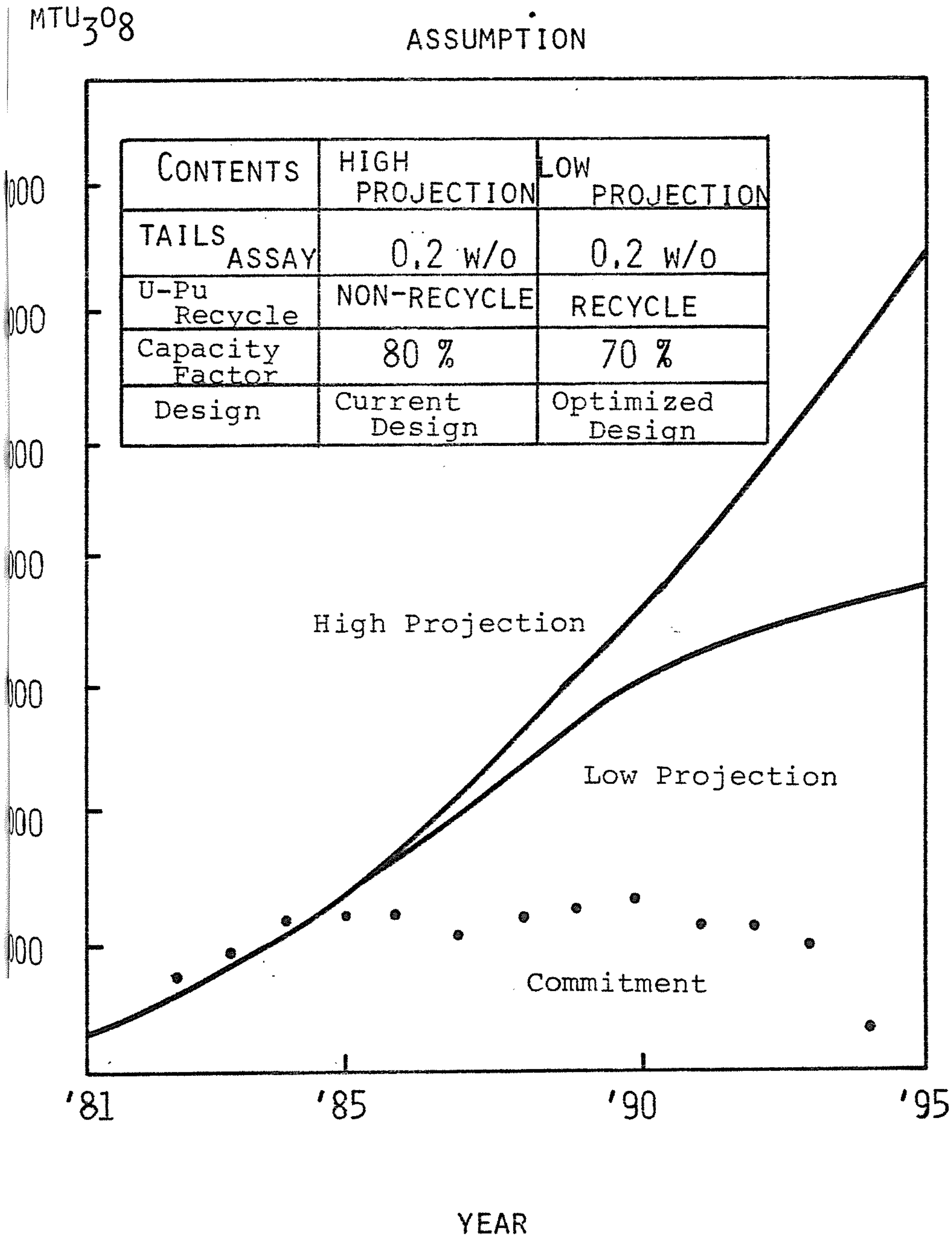
Year	Nuclear Growth Rate (% / Yr)	Installed Nuclear Capacity (net GWe)
1990	22	10
2000	11.6	30
2010	8.7	69
2020	4.8	110
2030	3.6	157
2040	2.4	199

-Table 6-

NUCLEAR FUEL CYCLE

ELEMENT	KOREAN SITUATION
A. URANIUM CONCENTRATE	INADEQUATE
B. CONVERSION TO UF_6	NOT AVAILABLE IN DOMESTIC SOURCE
C. ENRICHMENT	NOT AVAILABLE IN DOMESTIC SOURCE
D. FABRICATION	NOT AVAILABLE IN DOMESTIC SOURCE
E. REPROCESSING	NOT AVAILABLE IN DOMESTIC SOURCE

ANNUAL URANIUM REQUIREMENT



CONTENTS	HIGH PROJECTION	LOW PROJECTION
TAILS ASSAY	0.2 w/o	0.2 w/o
U-Pu Recycle	NON-RECYCLE	RECYCLE
Capacity Factor	80 %	70 %
Design	Current Design	Optimized Design

(9)

DIVERSIFICATION OF U SOURCES

CANADA	40 %
U S A	20 %
AUSTRALIA	20 %
OTHER	20 %

- - - - - - - - - - - - - - - - -

TOTAL OF 14,000 MT U_3O_8

Table 9

ENRICHMENT SERVICES

: LONG-TERM FIXED COMMITMENT CONTRACTS

: DIVERSIFICATION OF ENRICHMENT SERVICE SOURCES

UNIT # 1 - 8	UNIT # 9 & 10	UNIT # 11 & 12
U.S. DOE	COGEMA, FRANCE	U.S. DOE

Current Status of Siting

assification	Location	Status
	Ko-Ri	1 Unit in operation 3 Units under construction
	Wolsung	1 Unit under construction
quired	Yeonggwang	2 Units under construction Site for 6 Units
	Uljin	2 Units under construction Site for 4 Units
der Detailed rvey	Buan, Sanpo	Sept. 1980 - Nov. 1981
eliminary rvey Completed	9 locations	

e 11

KNE Participation Program

nit No.	KNE Participation	Remarks
Ri #2 sung #1	• Design for site facilities • Participation in construction management	
lear & 6	• Participation in off-shore engineering : 8.5% • Participation in on-shore services : as much as KNE can do	28 KNE engineers are resident in Norwalk, Ca. as of Dec. 1980
lear & 8	• Participation in off-shore engineering : 15% • Participation in on-shore services : Preliminary estimation is 37.8%	39 KNE engineers are resident in Norwalk, Ca. as of Dec. 1980
lear & 10	• Participation in off-shore engineering : 17.3% • Participation in on-shore services : Under discussion	29 KNE engineers are to reside in Paris, France

LOCALIZATION RATIO

UNIT NO.	LOCALIZATION RATIO	REMARKS
KO-RI UNIT #1	ABOUT 8%	ACTUAL
KO-RI UNIT #2	12.8%	PLANNED
WOLSUNG UNIT #1	10%	"
NUCLEAR UNIT #5 & 6	23.7%	"
NUCLEAR UNIT #7 & 8	35.8%	"
NUCLEAR UNIT #9 & 10	ABOVE THE RATIO FOR NUCLEAR UNIT #7 & 8	"

Table 13

REACTOR MIX SCENARIOS.

Scenario	Reactor mix Strategy
I	**PWR only :** o Only PWRs introduced.
II	**Both PWR and CANDU :** o 1/3 of market available to CANDU ; and o The rests are PWRs.
III	**PWR , CANDU & LMFBR :** o 2/3 PWR and 1/3 CANDU by 1998 ; o LMFBR from 1999 ; and o Neither PWR nor CANDU beyond 2010 ;
IV	**PWR , CANDU & LMFBR :** o 2/3 PWR and 1/3 CANDU by 1996 ; o LMFBR from 1997 ; and o Neither PWR nor CANDU beyond 2005.

Table 14

CUMULATIVE URANIUM REQUIREMENTS.

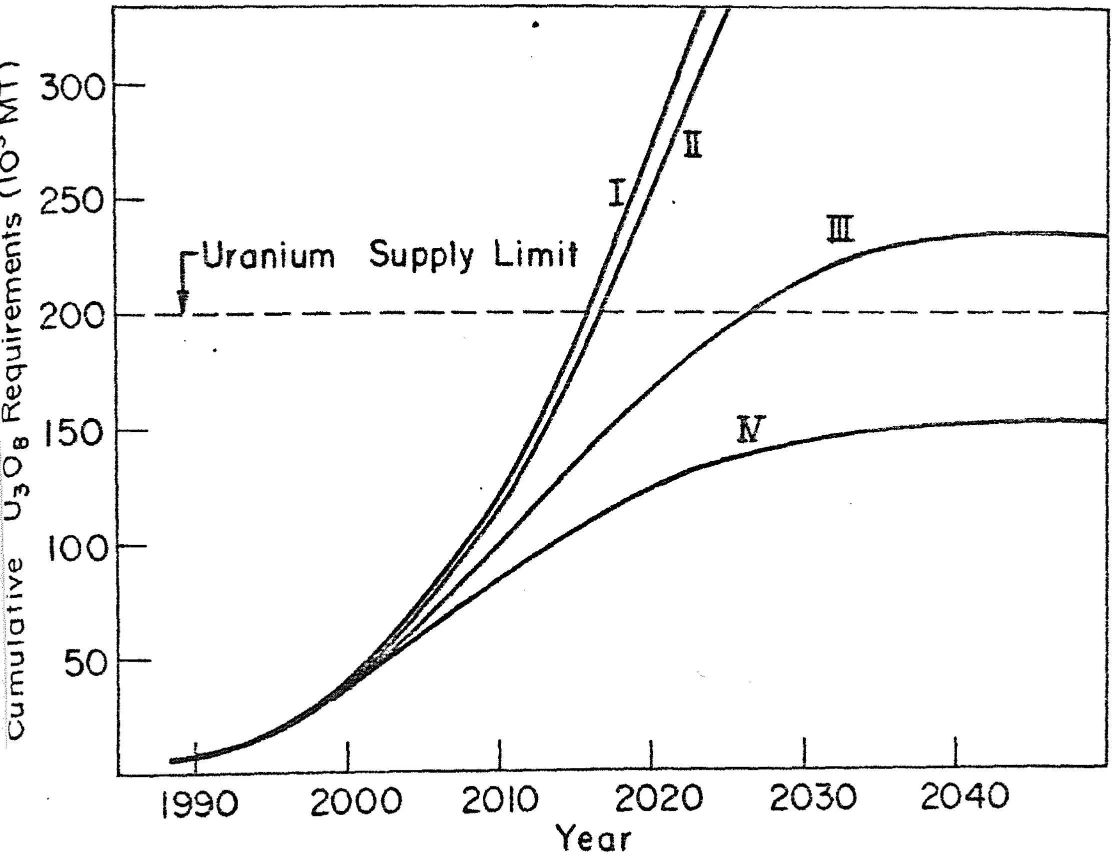


Figure 2

ANNUAL URANIUM REQUIREMENTS.

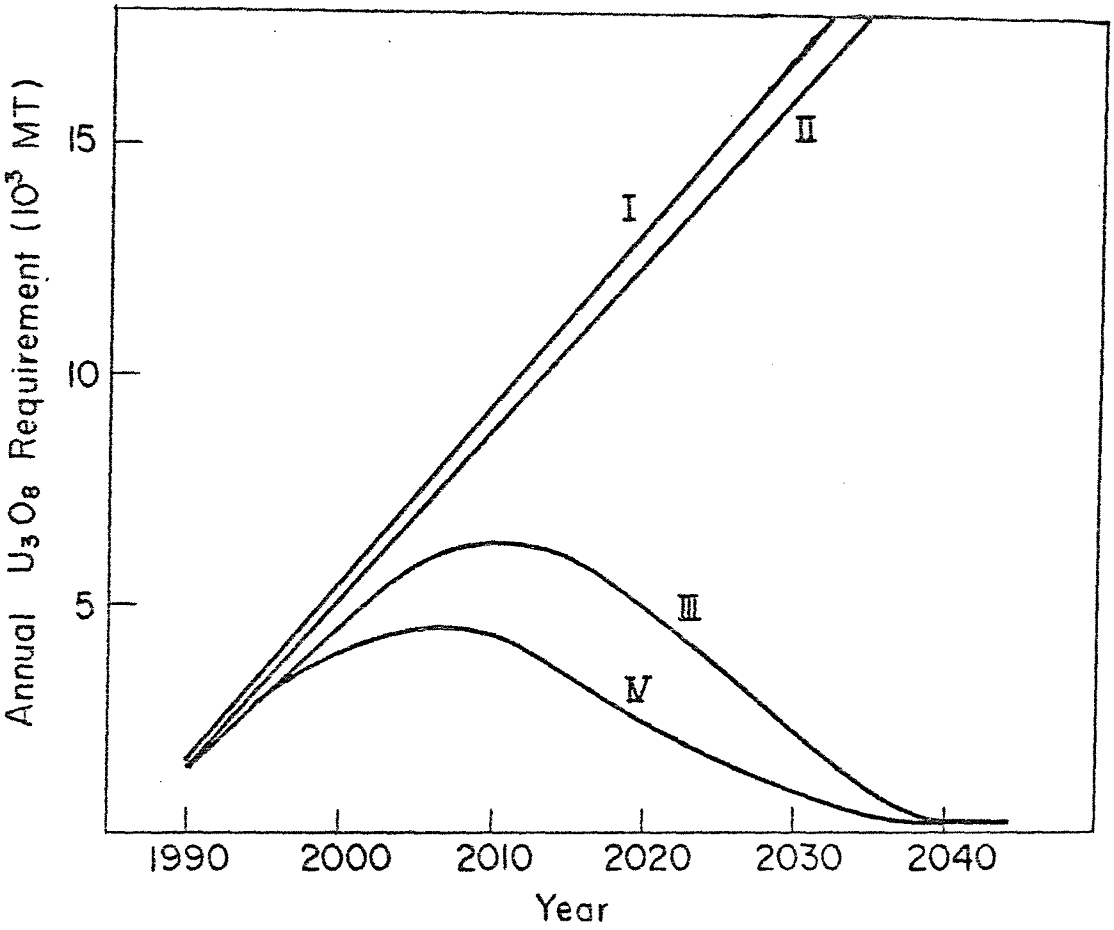


Figure 3

発表は 3 月10 日 ~~午前 時~~ 午後6 時
以降に願います。

EMBARGO UNTIL
10, March p.m. 18:00

(6)

ENERGY POLICY AND NUCLEAR POWER DEVELOPMENT IN THE UNITED STATES

SOL ROSEN
DIRECTOR, INTERNATIONAL NUCLEAR PROGRAMS DIVISION
OFFICE OF NUCLEAR REACTOR PROGRAMS
U.S. DEPARTMENT OF ENERGY

REMARKS AT THE FOURTEENTH ANNUAL MEETING
OF THE JAPAN ATOMIC INDUSTRIAL FORUM
MARCH 10, 1981, TOKYO, JAPAN

THANK YOU MR. CHAIRMAN. IT IS AN HONOR AND PLEASURE FOR ME TO ADDRESS THIS DISTINGUISHED INTERNATIONAL AUDIENCE ON THE OCCASION OF THE FOURTEENTH ANNUAL MEETING OF THE JAPAN ATOMIC INDUSTRIAL FORUM. I HAVE BEEN PERSONALLY INVOLVED FOR THE PAST SEVERAL YEARS IN MANY OF THE AREAS OF COLLABORATION BETWEEN OUR GOVERNMENTS IN NUCLEAR ENERGY RESEARCH AND DEVELOPMENT AND SO FOR ME IT IS A PERSONAL PRIVILEGE TO BE AMONGST SO MANY OF MY PROFESSIONAL COLLEAGUES AND CO-WORKERS.

NUCLEAR ENERGY SITUATION IN THE UNITED STATES

IN THE UNITED STATES, TODAY, OUR ENERGY POLICY IS AIMED AT SHIFTING, AS RAPIDLY AS PRACTICABLE, FROM AN OIL DEPENDENT ECONOMY TO ONE THAT RELIES HEAVILY ON OTHER FUELS AND ENERGY SOURCES. DECISIONS ARE STILL BEING MADE REGARDING THE SPECIFICS OF THE NEW ADMINISTRATION'S ENERGY POLICY BUT ONE THING IS CLEAR, NUCLEAR POWER IS NOW AND IS EXPECTED TO CONTINUE TO BE AN INTEGRAL PART OF THE ENERGY MIX IN THE UNITED STATES. AS ONE LOOKS ACROSS THE HORIZON TO FIND THE ANSWERS TO OUR ENERGY PROBLEMS, THERE APPEARS TO BE NO REAL PLACE TO TURN, AT LEAST IN THE NEXT SEVERAL DECADES, THAT DOES NOT INCLUDE NUCLEAR ENERGY, PARTICULARLY AS AN ESSENTIAL COMPONENT OF ELECTRICITY GENERATION. AUTHORITATIVE ENERGY STUDIES PERFORMED IN THE UNITED STATES AND ABROAD HAVE REPEATEDLY TOLD US THAT NUCLEAR ENERGY MUST MAKE AN ESSENTIAL CONTRIBUTION TO ENERGY SUPPLY. THIS MEANS THAT NUCLEAR'S CONTRIBUTION MUST EXPAND CONSIDERABLY FROM ITS CURRENT LEVEL IF IT IS TO FULFILL ITS ENVISIONED ROLE AS ONE OF THE PRINCIPAL FUEL SOURCES CAPABLE OF REDUCING DEPENDENCE ON OIL.

As I have indicated, decisions are still being made regarding the details of the United States Department of Energy's nuclear energy program. However, in order to provide a frame of reference for the Department's strategy, I would like to reflect briefly on the paradoxical situation that exists today with regard to nuclear power development.

As shown in Figure 1, seven years after the end of the oil embargo of 1973-1974, somewhat less than half of U.S. energy consumption is still supplied by oil, our least abundant domestic resource. Approximately 40 percent of that oil is imported at continuously rising prices. Coal and natural gas, reasonably available but exhaustible resources, also supply somewhat less than half our needs. An abundant resource, uranium, with a potential energy content many times that of all domestic fossil fuels combined, however, accounts for less than 4 percent of current U.S. energy usage.

About 70 commercial nuclear power plants (with a capacity of over 50,000 electrical megawatts) are providing 11 percent of U.S. electric power requirements. More than 25 percent of the energy generated in each of 13 states is from nuclear power and in 2 of those states more than 50 percent is from nuclear. This electricity, if produced by oil-fired plants, would require the annual consumption of about half a billion barrels of oil. This amounts to 1.4 million barrels of oil per day, which is roughly equivalent

TO THE CAPACITY OF THE ALASKAN PIPELINE. CURRENT PROJECTIONS ARE THAT THIS FIGURE WILL BE INCREASED BY AN ADDITIONAL ONE MILLION OR SO BARRELS OF OIL PER DAY BY 1985. ALTHOUGH NUCLEAR ENERGY HAS ALREADY BECOME AN ESSENTIAL ELEMENT OF U.S. ENERGY SUPPLY, WE NOW HAVE A SITUATION IN THE NUCLEAR MARKET WHEREBY WE HAVE HAD NO NEW PLANT ORDERS IN THE LAST 3 YEARS AND A NUMBER OF PLANTS THAT ARE BEING CANCELLED. THE SITUATION IS SUMMARIZED IN FIGURE 2 WHICH DEPICTS THE NUCLEAR ENERGY CAPACITY SCHEDULED FOR COMMERCIAL OPERATION BY U.S. ELECTRICAL UTILITIES. THE FIGURE CONSISTS OF SIX CURVES, WHICH PROCEEDING FROM LEFT TO RIGHT SHOW A CONSISTENT DECREASE IN SCHEDULED CAPACITY IN THE U.S. FROM 1975 TO 1980. SINCE 1976, THE NATION'S UTILITIES HAVE CANCELLED OVER 50 NUCLEAR PLANTS PREVIOUSLY ORDERED. SOME OF THESE CANCELLATIONS CAN BE ATTRIBUTED TO DECLINING GROWTH RATES, BUT MANY CAN BE ASSOCIATED WITH PROBLEMS UNIQUE TO NUCLEAR ENERGY.

THE NUCLEAR INDUSTRY, WHICH WAS THRIVING AND EXPANDING IN THE EARLY 1970'S, AND WHICH SHOWED PROMISE OF MEETING THE PROJECTED ELECTRICAL ENERGY NEEDS IN THE UNITED STATES, HAS BEEN THREATENED. I BELIEVE, HOWEVER, THAT THE IMMEDIATE PROMISE AND FUTURE POTENTIAL OF THIS ABUNDANT ENERGY SOURCE WILL BE ACHIEVED BY THE ACTIONS THAT THE NEW ADMINISTRATION IN THE U.S. IS PROPOSING.

THE REASONS FOR THE DETERIORATING SITUATION ARE INSTITUTIONAL RATHER THAN TECHNICAL. DESPITE THE FACT THAT UTILITIES IN MANY AREAS HAVE CONSISTENTLY REPORTED LOWER GENERATING COSTS FOR THEIR

NUCLEAR UNITS THAN FOR THEIR FOSSIL UNITS, NUCLEAR INVESTMENT HAS NOT BEEN AN INVITING PROSPECT FOR UTILITY EXECUTIVES OVER THE LAST SEVERAL YEARS. THE LICENSING PROCESS HAS HELPED EXAGGERATE NORMAL MARKET UNCERTAINTIES BY CONTINUOUSLY LENGTHENING THE TIME REQUIRED TO BRING A PLANT ON LINE. THOUGH THE LICENSING PROCESS IS NOT THE SOLE REASON, NUCLEAR PLANTS IN THE U.S. NOW TAKE 10-14 YEARS TO SITE, DESIGN, LICENSE AND CONSTRUCT. A DECADE AGO SUCH ACTIONS COULD BE ACCOMPLISHED IN 5 TO 6 YEARS. WHILE FOSSIL PLANTS HAVE ALSO BEEN SUBJECT TO DELAYS AND COST ESCALATION, IN ABSOLUTE TERMS THE SITUATION HAS NOT BEEN AS SEVERE. THE HESITATION OF UTILITIES TO PUT MONEY INTO A NUCLEAR PLANT THAT HAS A LEADTIME OF 10 TO 14 YEARS IS UNDERSTANDABLE. THIS IS BY NO MEANS A SITUATION UNIQUE TO THE UNITED STATES. WITH FEW EXCEPTIONS, LEADTIMES WORLDWIDE HAVE INCREASED BEYOND THOSE WHICH CAN BE CONSIDERED REASONABLY NECESSARY. IT IS CERTAIN THAT A REDUCTION IN LICENSING AND CONSTRUCTION TIME WILL LEAD TO CONSIDERABLE COST SAVINGS IN NUCLEAR POWER TOTAL CAPITAL COSTS. AN EXAMPLE TO HIGHLIGHT THIS POTENTIAL SAVINGS IS THE COMPARISON BETWEEN TWO COMPARABLE SIZED NUCLEAR POWER PLANTS IN THE U.S. CONSTRUCTION PERMIT APPLICATIONS FOR BOTH UNITS WERE FILED IN 1969. ORIGINAL CONSTRUCTION SCHEDULES AND COSTS ESTIMATES WERE COMPARABLE FOR BOTH UNITS, YET ONE WENT ON LINE IN 1975 AT A COST UNDER $0.5 BILLION WHILE THE OTHER, FOR A VARIETY OF REASONS, IS NOW SCHEDULED FOR COMMERCIAL OPERATION IN 1982 AT AN ESTIMATED COST OF OVER $1.5 BILLION.

HIGHLY VISIBLE ACTION AT THE GOVERNMENT LEVEL WILL CONSTITUTE A POSITIVE CONTRIBUTION TO NUCLEAR DEVELOPMENT IN THE U.S. MANY VIEWED PAST GOVERNMENT POLICIES AS AMBIVALENT IF NOT ACTUALLY HOSTILE TOWARD NUCLER ENERGY. THE DEFERRAL OF A BREEDER DEMONSTRATION AND REPROCESSING HAD BEEN INTERPRETED AS AN ATTEMPT TO CURTAIL FUTURE NUCLEAR IMPACT. ALL OF THESE FACTORS HAVE CONTRIBUTED TO THE DIMINISHED EXPECTATIONS OF NUCLEAR ENERGY TO HELP SOLVE OUR ENERGY PROBLEMS. THIS MUST BE CORRECTED IF THE U.S. IS TO AVOID CONTINUED RELIANCE ON UNCERTAIN SUPPLIES OF FOREIGN OIL, INCLUDING THE POSSIBLE CONSEQUENCES OF INADEQUATE ELECTRICAL ENERGY, WIDESPREAD ECONOMIC HARDSHIP, AND INCREASED PERIL TO OUR NATIONAL SECURITY.

THE REVITALIZATION OF THE NUCLEAR OPTION WILL NOT BE AUTOMATIC NOR WILL IT COME OVERNIGHT. NEW GOVERNMENT POLICIES AND PROGRAMS, HOWEVER, ARE EXPECTED TO TURN THE SITUATION AROUND, AND RETURN CONFIDENCE TO INDUSTRY, TO THE PUBLIC, AND TO INVESTORS. CLEAR STATEMENTS OF AFFIRMATIVE POLICY, AS ARE NOW FORTHCOMING FROM THE PRESENT ADMINISTRATION IN THE UNITED STATES, ARE THE FIRST STEPS FOR INITIATING ACTION. THE REVITALIZATION OF THE NUCLEAR ENERGY PROGRAM HAS IMPLICATIONS FOR BOTH OUR ENERGY SECURITY AND INTERNATIONAL SOLIDARITY WITH OUR ENERGY ALLIES.

THE PROBLEMS TO BE ADDRESSED ARE BOTH NEAR-TERM AND LONG-RANGE. SOLUTIONS TO THE NEAR TERM PROBLEMS WHICH ARE MAINLY CONCERNED WITH THE LIGHT WATER REACTOR MUST BE ACCOMPANIED BY RESPONSIBLE

AND TIMELY PLANNING FOR THE BREEDER AS THE NEXT GENERATION OF NUCLEAR TECHNOLOGY.

LIGHT WATER REACTORS

I WOULD LIKE TO HIGHLIGHT SOME OF THE OPTIONS AVAILABLE FOR A REBIRTH OF THE LIGHT WATER REACTOR INDUSTRY. IN THE AREA OF SAFETY, THERE IS A TWO-FOLD RESPONSIBILITY. WE MUST, OF COURSE, CONTINUE TO ENSURE THE AVAILABILITY OF TECHNOLOGY WHICH WILL ASSURE THE SAFE CONSTRUCTION AND OPERATION OF NUCLEAR PLANTS. NUCLEAR POWER ALREADY HAS A SAFETY RECORD UNPARALLELED IN ANY OTHER ENERGY INDUSTRY, BUT DESPITE THAT RECORD AN APPRECIABLE SEGMENT OF THE POPULATION CONTINUES TO HAVE SIGNIFICANT CONCERNS. ANOTHER RESPONSIBILITY IS TO ENSURE PUBLIC UNDERSTANDING. AS A CASE IN POINT, THE ACCIDENT AT THREE MILE ISLAND, UNFORTUNATE THOUGH IT WAS, TAUGHT US LESSONS WHICH, WHEN INCORPORATED IN PLANT DESIGN AND OPERATION, WILL REDUCE EVEN FURTHER THE ALREADY LOW PROBABILITY OF NUCLEAR ACCIDENTS. THE LESSONS LEARNED AND THE CONTINUED OUTPUT OF OUR SAFETY RESEARCH AND DEVELOPMENT ACTIVITIES WILL ASSURE THAT NUCLEAR ENERGY WILL REMAIN AMONG OUR SAFEST ENERGY SUPPLY OPTIONS. A COROLLARY EFFORT IS NEEDED TO INFORM THE PUBLIC OF THE SAFETY IMPROVEMENTS THAT HAVE BEEN ACHIEVED. THE WHOLE AREA OF COMMUNICATING ACCURATE INFORMATION ABOUT NUCLEAR ENERGY TO THE PUBLIC IS ONE WHICH DEMANDS GREATER ATTENTION.

TO ENHANCE THE SAFE AND EFFICIENT USE OF DOMESTIC NUCLEAR ENERGY RESOURCES, THE U.S. DEPARTMENT OF ENERGY SUPPORTS A LIGHT WATER

Reactor systems development program. This program involves the development and demonstration of technology to 1) improve the utilization of uranium in Light Water Reactors, 2) reduce occupational radiation exposures, 3) improve plant productivity, and 4) lower the probability and consequences of nuclear accidents.

The benefits of improving uranium utilization in Light Water Reactors include better utilization of our uranium resources, reduction in the storage requirements for spent fuel, and better fuel cycle economics. A demonstration of technology that will permit a 15 percent reduction in uranium requirements is targeted for 1988. The most straightforward near-term means for achieving this target is to develop higher burnup fuel for use in existing and future reactors.

The goals of the occupational dose reduction/productivity improvement efforts program are: 1) minimizing radiation exposure to nuclear power plant operating personnel and 2) to help reduce dependency on foreign oil for the generation of electricity by increasing the reliability and availability of nuclear power plants. A large Light Water Reactor at 60-65 percent plant factor displaces about 25,000 barrels of oil equivalent per day. The oil savings from a 10 percent increase in availability applied to currently existing plants would be in the range of 130,000 barrles per day or nearly 50 million barrels per year, an oil savings well worth considerable investment. Programs aimed at improving system

AND COMPONENT RELIABILITY AND IMPROVED DESIGN AND OPERATION TO DECREASE SCHEDULED DOWNTIME ARE UNDERWAY. STUDIES IN THE AREAS OF DOSE REDUCTION INCLUDES WORK ON IMPROVED RELIABILITY, REMOTE INSPECTION AND HANDLING TECHNOLOGY AND IMPROVED SYSTEM DECONTAMINATION TECHNIQUES.

THE LIGHT WATER REACTOR SAFETY TECHNOLOGY PROGRAM IS DIRECTED IN PART AT DEVELOPING TECHNOLOGY THAT CAN BE USED BY INDUSTRY AND THE U.S. NUCLEAR REGULATORY COMMISSION TO SIMPLIFY THE RULES AND METHODS USED IN NUCLEAR PLANT DESIGN AND OPERATIONS, WHILE MAINTAINING A HIGH LEVEL OF SAFETY. THIS INVOLVES ACQUIRING DATA AND TECHNOLOGY NECESSARY TO IMPROVE THE PERFORMANCE OF COMPONENTS AND SYSTEMS, TO DEVELOP CRITERIA FOR CONTAINMENT DESIGN, SITING, AND EMERGENCY PREPARATIONS, TO DETERMINE STAFFING AND TRAINING REQUIREMENTS FOR NUCLEAR FACILITIES, AND TO PROVIDE ADDITIONAL INFORMATION FOR USE BY OPERATORS IN RUNNING THE PLANT.

ANOTHER MAJOR OPTION FOR REINFORCING THE LIGHT WATER REACTOR INDUSTRY IS, AS PREVIOUSLY CITED, IN THE AREA OF REGULATORY REFORM. THE U.S. NUCLEAR REGULATORY COMMISSION IS WORKING ON INITIATIVES TO IMPROVE THE LICENSING SYSTEM. THE CURRENT LICENSING PROCESS COULD MOST PROBABLY BE APPRECIABLY SHORTENED WITHOUT ANY SACRIFICE TO SAFETY CONSIDERATIONS. UNLESS WE SEE EFFECTIVE REFORM, IT IS MOST UNLIKELY THAT WE WILL BE ABLE TO ATTRACT A RENEWAL OF UTILITY INVESTMENT. THE UNPREDICTABILITY OF THE LICENSING PROCESS IS CAUSING UTILITIES TO AVOID ORDERING

NUCLEAR PLANTS DUE TO THE INABILITY TO RELY ON THE AVAILABILITY OF NUCLEAR PLANTS TO MEET LOAD GROWTH AND DUE TO THE INCREASED COST CREATED BY ESCALATION AND INTEREST DURING CONSTRUCTION ON NON-PRODUCTIVE CAPITAL. ANOTHER OBSTACLE TO NUCLEAR COMMITMENTS IS THE DIFFICULTY FACING UTILITY FINANCIAL OFFICERS IN OBTAINING THE NECESSARY INVESTMENT CAPITAL TO PLAN FOR NEW CAPACITY ADDITIONS.

WASTE MANAGEMENT

A THIRD AND EXCEEDINGLY IMPORTANT AREA REQUIRING ADDITIONAL FOCUS AND ATTENTION IS WASTE MANAGEMENT. INDICATIONS ARE THAT THIS IS THE GREATEST SINGLE CONCERN OF THE AMERICAN PUBLIC REGARDING NUCLEAR ENERGY. THE COMMERCIAL WASTE PROGRAM IS UNDER REVIEW AS PART OF A BROADER PROGRAM TO DETERMINE WHAT IS NEEDED TO STRENGTHEN OUR NUCLEAR PROGRAMS. ALTHOUGH WE ALREADY HAVE THE TECHNOLOGY IN HAND OR UNDER DEVELOPMENT FOR SAFE DISPOSAL OF NUCLEAR WASTES, IT IS MY OPINION THAT WE ARE LOSING CREDIBILITY WITH THE AMERICAN PUBLIC. A TECHNICAL DEMONSTRATION WOULD GO A LONG WAY IN RESOLVING THIS ISSUE. EFFORTS IN THE U.S. WILL CONTINUE IN SUPPORT OF REPOSITORY DESIGN, DEVELOPMENT, AND SITING. SITE INVESTIGATION EFFORTS INCLUDE STUDIES OF SALT FORMATIONS, BASALT, TUFF, SHALES, GRANITE, AND OTHER POTENTIALLY SUITABLE ROCK FORMATIONS. RESEARCH AND DEVELOPMENT WILL CONTINUE IN MANY AREAS OF TECHNOLOGY DEVELOPMENT SUCH AS SOLIDIFICATION TECHNOLOGY FOR IMMOBILIZING WASTE, IN-SITU TESTS USING THERMAL HEATERS, AND TRANSPORTATION STUDIES.

The actions that I previously described are designed to reaffirm the current generation of nuclear energy, since a prerequisite to a successful advanced nuclear program for tomorrow is a strong and effective nuclear industry today. We have a viable means of contributing to the solution to our future energy needs in the form of the breeder reactor. Moreover, unlike some other inexhaustible sources of energy supply, breeder technology does not await a scientific breakthrough. The technology is in hand and now requires implementation. The time to act in the U.S. is now, while we still have the capability, the expertise, and the facilities to do it.

As you know, although a large research and development effort has been maintained, the Liquid Metal Fast Breeder Reactor Demonstration program, has been effectively stalled in the U.S. since 1977. A research and development program must be focused and scheduled by a central line of advance. That is, it must be relevant to and driven by a sequence of plant projects which determine the scalability of the technology up to sizes of commercial applicability. Such was the intention when project planning for CRBR, the 375 MWe Clinch River Breeder Reactor, began around 1969. The obstacles that have confronted the Clinch River Project over the last 10 years, however, have been continuous and severe--numerous interventions, schedule slippages, and inflationary costs to name a few. Since 1977, the licensing process for the project has been suspended. The Administration is proposing to fully reactivate the Clinch River Breeder Reactor Project and with the concurrence of the U.S. Congress we expect this vital project to proceed towards construction and successful operation. The project is well underway in the design and hardware procurement areas. The overall plant design is more than 80 percent complete. Contracts for over $500 million of hardware have been placed. The project is in a position to begin site clearing and construction upon receipt of the necessary approvals from the appropriate authorities. On this score, it would be helpful if some methodology could be found to make sure that earlier efforts with the U.S. Nuclear Regulatory Commission on breeder licensing will not have been in vain.

As many of you are aware, the Department of Energy is in the final stages of its Conceptual Design Study for a breeder that is one step beyond the Clinch River Breeder Reactor. The results of this study will be presented to the U.S. Congress next month.

What we gain from a breeder demonstration is the benefit that derives from the availability of a proven concept. We now have an opportunity to work toward the development of a strong industrial base in the United States for fast breeder technology. We know our allies welcome our movement in this direction.

Remarks dealing with the U.S. breeder program are not complete without mention of the FFTF, the Fast Flux Test Facility, and the existing Breeder Reactor base program. The U.S. breeder

DEVELOPMENT PROGRAM ACHIEVED A SIGNIFICANT MILESTONE AT THE END OF LAST YEAR WITH INITIAL FULL POWER OPERATION OF THE FFTF. FIGURE 3 IS A PHOTOGRAPH OF THE FACILITY, WHICH IS LOCATED AT THE U.S. GOVERNMENTS HANFORD RESERVATION, NEAR THE CITY OF RICHLAND, WASHINGTON. THE FFTF IS A 400 MWTH SODIUM COOLED FAST REACTOR DESIGNED SPECIFICALLY FOR IRRADIATION TESTING OF NUCLEAR FUELS AND MATERIAL FOR FAST REACTORS.

ALTHOUGH FFTF, AS A TESTING REACTOR, IS NOT DESIGNED TO BREED FUEL OR TO PRODUCE ELECTRICITY, IT PROVIDES VITAL INFORMATION FOR PLANT DESIGN AND BASE-TECHNOLOGY PROGRAMS IN THE AREAS OF: PLANT SYSTEM AND COMPONENT DESIGN, COMPONENT FABRICATION, PROTOTYPE TESTING, AND LARGE PLANT CONSTRUCTION, TESTING, AND STARTUP. IN ADDITION, FFTF PROVIDES EXPERIENCE IN THE OPERATION OF A LARGE REACTOR PLANT HAVING COOLANT LOOPS AND COMPONENTS AT TEMPERATURES AND COOLANT VELOCITIES NEARLY TYPICAL OF LARGE POWER PLANTS. THIS EXPERIENCE COMBINED WITH THE OPERATING AND MAINTENANCE EXPERIENCE FROM OTHER TEST FACILITIES IN THE U.S. PROVIDES A PROVEN BASELINE FOR SCALING UP SYSTEMS AND COMPONENTS. FFTF WILL BE USED TO TEST FUEL ELEMENTS UP TO AND INCLUDING FAILURE UNDER DYNAMIC SODIUM-FUEL CONDITIONS TO ESTABLISH ULTIMATE CAPABILITY AND FAILURE MODES. UNDERSTANDING OF FAILURE MODES IS ESSENTIAL TO ESTABLISH REACTOR CORE RELIABILITY, PERFORMANCE, SAFETY, AND LIFETIME. IT IS USED IN TESTS TO DEVELOP THE ADVANCED FUELS AND THE ADVANCED CLADDING AND DUCT MATERIALS ESSENTIAL TO OPTIMIZING FUEL PERFORMANCE.

The breeder base technology development which is funded at an annual level greater than $300 million solves long lead-time technical problems on the critical path of reactor demonstration and eventual commercial acceptance. Five program elements are emphasized. They are: engineered systems and components, fuels and core design, materials and structures, physics, and safety. These programs are supported by an extensive array of test facilities such as the Experimental Breeder Reactor, Transient Reactor Test Facility and Zero Power Reactors at the Argonne National Laboratory and the component test rigs at the Energy Technology Engineering Center. We in the United States believe that the breadth and depth of our breeder development program will enable expeditious progress to be made in the U.S. towards breeder demonstration and eventual deployment.

Consistent with resumption of the breeder development program is the requisite fuel cycle development. Reprocessing is seen as an integral and necessary part of the fuel cycle. The Government's presence in this activity is currently under intensive review within the Administration.

THREE MILE ISLAND

Finally, the immediacy of the problem of cleanup and remedial actions to be taken at Three Mile Island cannot be overstated. Technical problems associated with the cleanup appear to be solvable. The U.S. Department of Energy is involved in certain technical aspects of TMI recovery based on a memorandum of understanding signed by the Department of Energy, the Nuclear Regulatory Commission, the Electric Power Research Institute and the General Public Utilities, the owner/operator of the plant. General Public Utilities' efforts are directed primarily at plant cleanup and recovery. The Department of Energy's strategy has been to develop a program work scope that will obtain information that would not be obtained from the utility's efforts and at the same time would not delay the schedule. The information will be of generic value to the entire nuclear electric utility and supply industry. The overall matter of Government assistance is unresolved and is part of a larger review to determine, among other things, the disposition of the radioactive waste produced by the cleanup and the damaged reactor core. Firm and stable regulatory criteria, along with a commitment to solve this problem, must be established so the cleanup can proceed.

I have tried to share with you this afternoon some of the major thrusts and priorities that are being weighed by the new Administration in the United States which affect the nuclear option. Decisions are still to be made regarding many of the areas that will impact nuclear development and which will define the U.S. nuclear energy program. However, the underlying intent is clear. The U.S. Government has a critical role in ensuring the availability of nuclear energy as an essential element in the generation of electricity. By addressing forthrightly those

ISSUES THAT ARE SERIOUSLY LIMITING THE NUCLEAR OPTION, BOTH THE CURRENT PROMISE AND THE FUTURE POTENTIAL OF NUCLEAR POWER AS A SAFE, CLEAN, ABUNDANT, AND RELIABLE SOURCE OF ENERGY FOR THIS COUNTRY AND THE WORLD CAN BE ACHIEVED.

THE SUCCESS OF ONE NATION CONTRIBUTES TO THE SUCCESS OF ALL. WITH THIS IN MIND I WISH YOU ALL SUCCESS IN MEETING THIS MOST IMPORTANT CHALLENGE OF OUR TIMES.

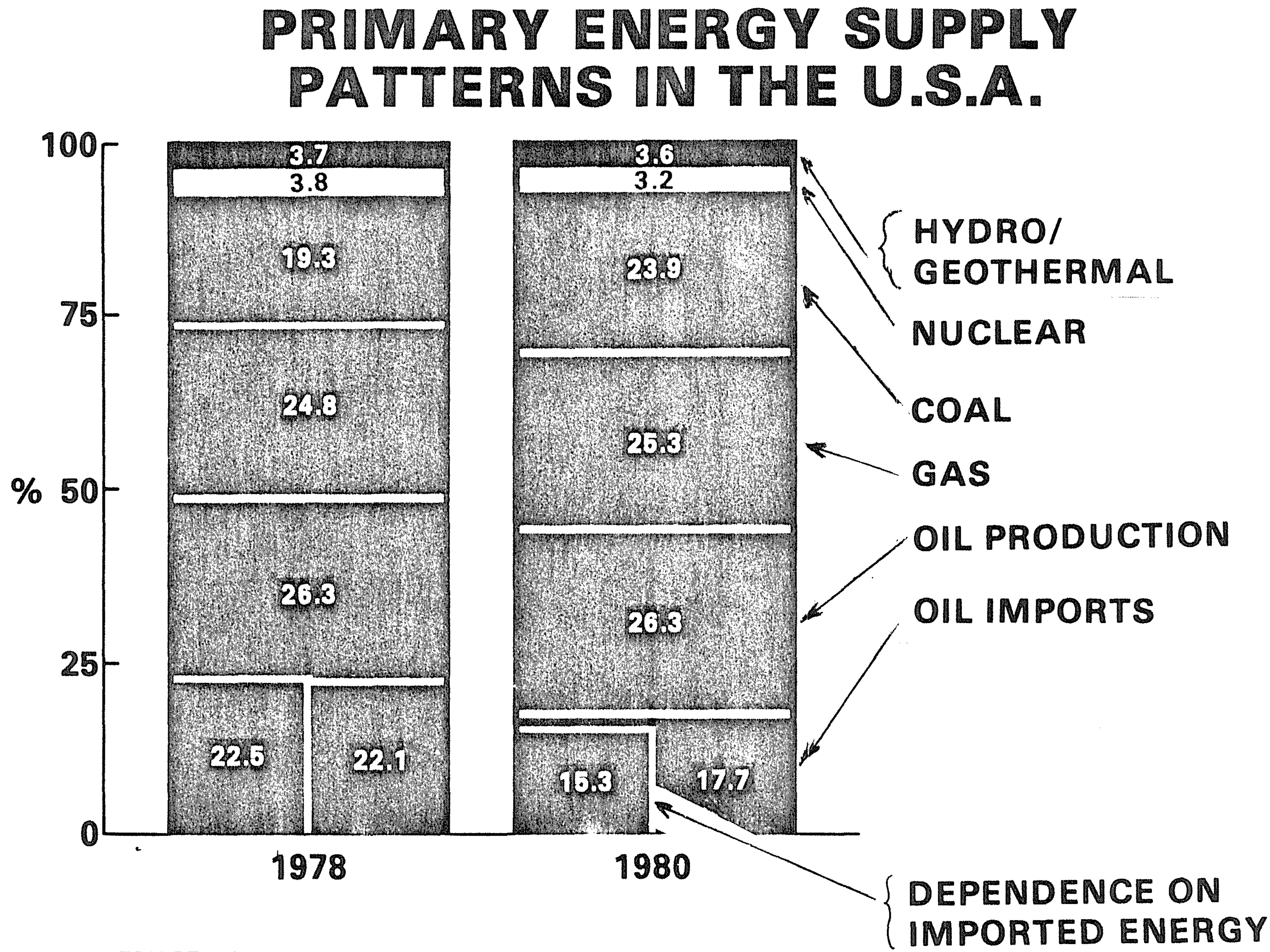

PRIMARY ENERGY SUPPLY PATTERNS IN THE U.S.A.
100
75
% 50
25
0
3.7
3.8
19.3
24.8
26.3
22.5
22.1
3.6
3.2
23.9
25.3
26.3
15.3
17.7
1978
1980
HYDRO/ GEOTHERMAL
NUCLEAR
COAL
GAS
OIL PRODUCTION
OIL IMPORTS
DEPENDENCE ON IMPORTED ENERGY

FIGURE 1

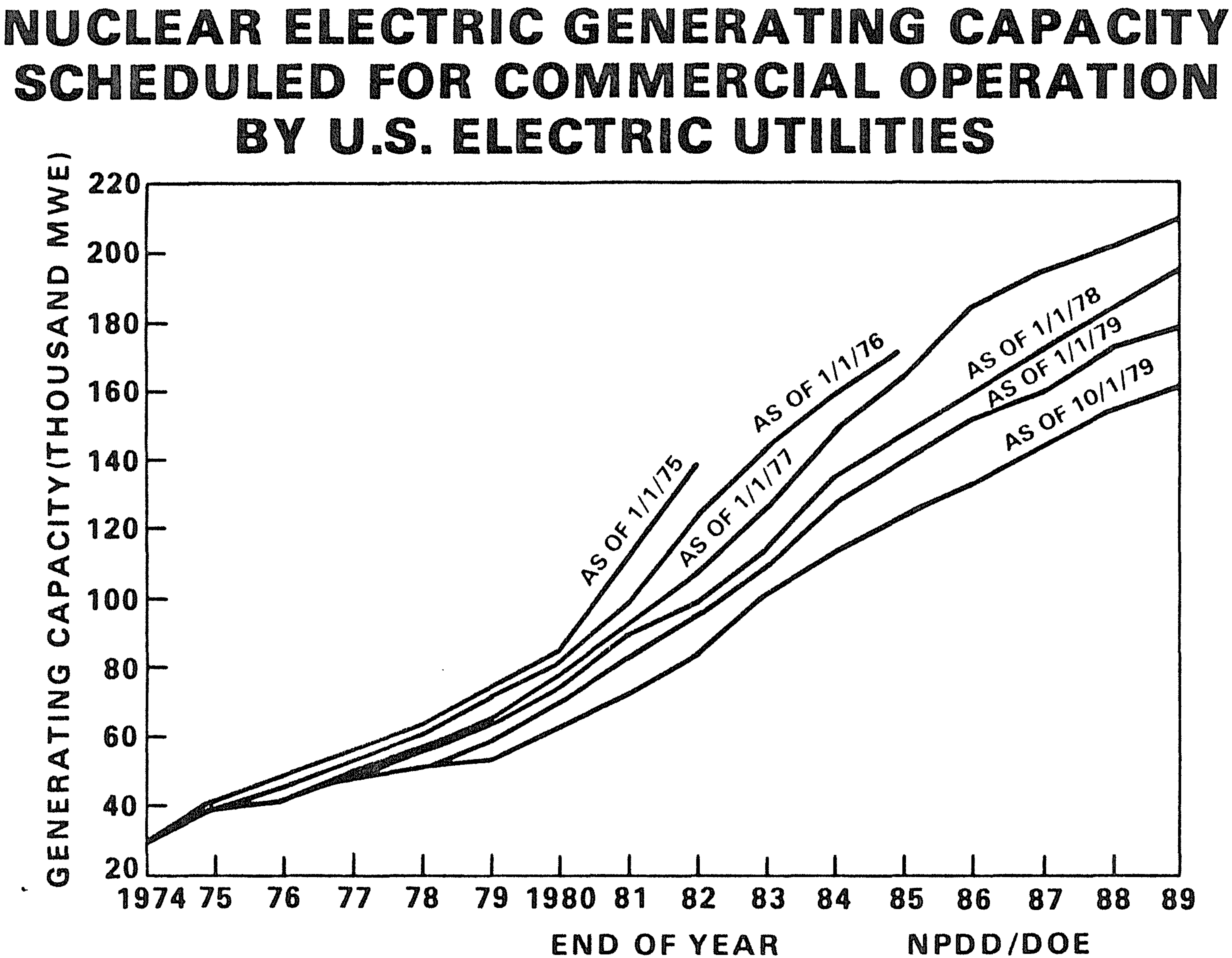
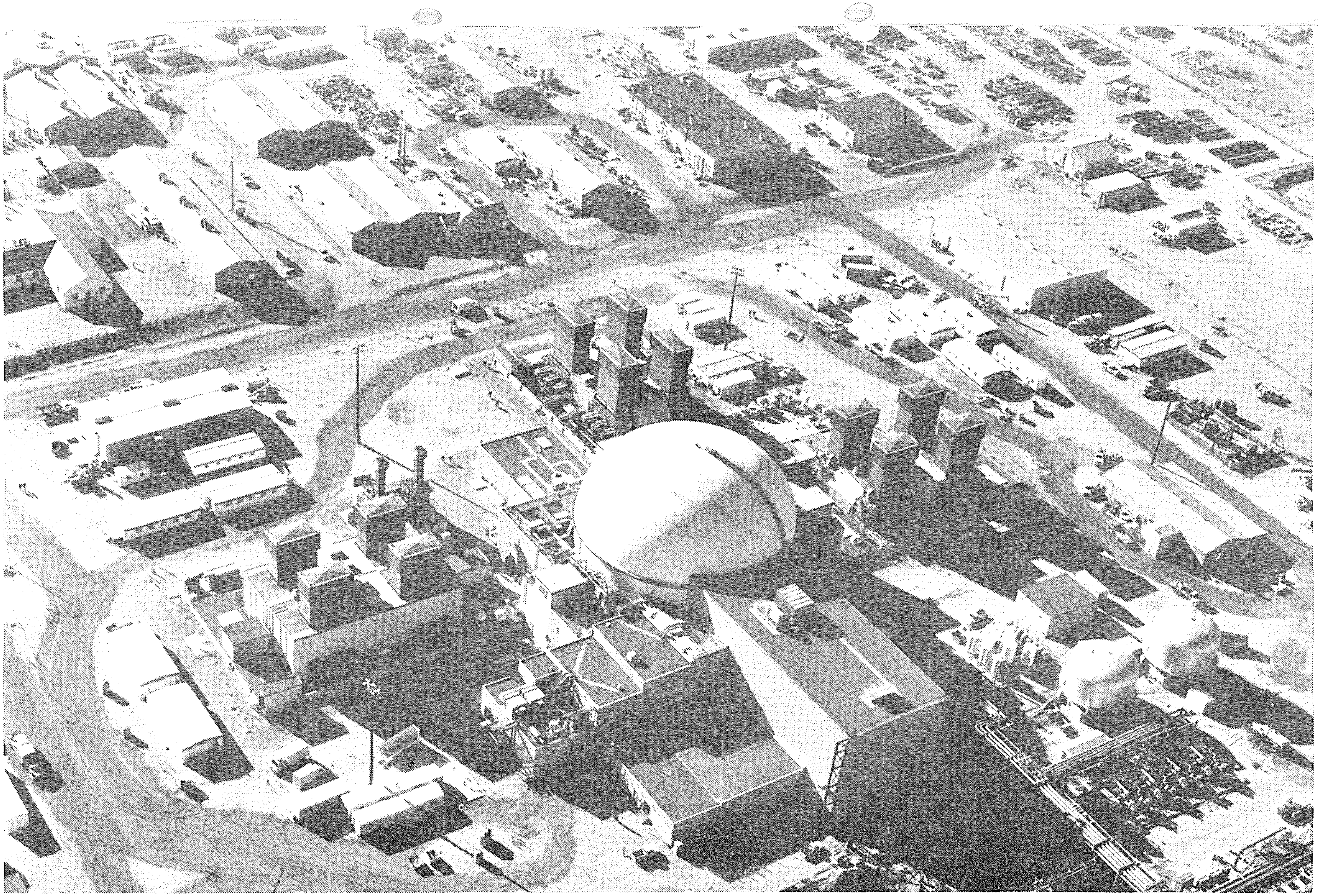

NUCLEAR ELECTRIC GENERATING CAPACITY
SCHEDULED FOR COMMERCIAL OPERATION
BY U.S. ELECTRIC UTILITIES
GENERATING CAPACITY (THOUSAND MWE)
220
200
180
160
140
120
100
80
60
40
20
1974 75 76 77 78 79 1980 81 82 83 84 85 86 87 88 89
END OF YEAR
NPDD/DOE
AS OF 1/1/75
AS OF 1/1/76
AS OF 1/1/77
AS OF 1/1/78
AS OF 1/1/79
AS OF 10/1/79

FIGURE 2



FAST FLUX TEST FACILITY

FIGURE 3

発表は3月12日午前10時以降に願います

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THE INTERNATIONAL PERSPECTIVE ON NUCLEAR ENERGY DEVELOPMENT

IT IS A PLEASURE FOR ME TO APPEAR BEFORE THIS DISTINGUISHED GROUP WHICH INCLUDES SO MANY REPRESENTATIVES FROM THE INTERNATIONAL NUCLEAR AFFAIRS AREA. WE HAD HOPED THAT AN APPROPRIATE OFFICIAL OF THE NEW ADMINISTRATION COULD BE HERE TODAY, BUT AS I AM SURE YOU WILL UNDERSTAND, THE PRESS OF BUSINESS IN WASHINGTON IS PARTICULARLY DEMANDING AT THIS TIME.

IT IS ALSO A PLEASURE TO SEE THIS GATHERING HERE IN JAPAN. AS YOU KNOW, THE UNITED STATES PLACES GREAT EMPHASIS ON CLOSE AND COOPERATIVE RELATIONS WITH SUCH KEY NATIONS AS OUR HOST. THE REAGAN ADMINISTRATION IS COMMITTED TO IMPROVING THE TRADITIONALLY CLOSE TIES BETWEEN JAPAN AND THE UNITED STATES IN THE PEACEFUL USES OF NUCLEAR ENERGY AS IN OTHER AREAS.

THE TOPIC TODAY IS THE INTERNATIONAL PERSPECTIVE ON NUCLEAR ENERGY DEVELOPMENT. I AM SURE THAT MANY OF YOU WOULD LIKE ME TO SPELL OUT IN DETAIL HOW THE NEW ADMINISTRATION WILL APPROACH SOME SPECIFIC NUCLEAR ENERGY ISSUES. THE REVIEW PROCESS ON A NUMBER OF THOSE POLICY ISSUES IS WELL UNDERWAY IN WASHINGTON, BUT IS NOT YET COMPLETE. I CANNOT, OF COURSE, FORECAST FOR YOU A PRECISE DESCRIPTION OF THE NEW ADMINISTRATION'S APPROACH. HOWEVER, I CAN GIVE YOU A SENSE OF SOME OF THE BASIC DIRECTIONS OF U.S. POLICY AND THE CONSIDERATIONS WHICH I KNOW WILL WEIGH HEAVILY IN U.S. POLICY DELIBERATIONS.

NUCLEAR POWER ALREADY PLAYS AN IMPORTANT ROLE IN MEETING THE ENERGY NEEDS OF MANY COUNTRIES, INCLUDING CLOSE ALLIES OF THE UNITED STATES, AND THIS ROLE MUST GROW IN THE FUTURE. DOMESTICALLY, THE REAGAN ADMINISTRATION IS ACTIVELY COMMITTED TO REALIZING EXPANDED BENEFITS OF NUCLEAR POWER IN AMERICA'S ENERGY PROGRAM, AND TO DEALING EFFECTIVELY AND EXPEDITIOUSLY WITH THE PROBLEMS WHICH HAVE BEEN ENCOUNTERED IN NUCLEAR POWER PROGRAMS. WE RECOGNIZE THE IMPORTANT ROLE THAT NUCLEAR POWER WILL PLAY IN MEETING THE GROWING ENERGY NEEDS IN THE WORLD. NATIONS CANNOT AND WILL NOT TURN THEIR BACKS ON SUCH A SIGNIFICANT RESOURCE AS NUCLEAR POWER.

THE NEW ADMINISTRATION IS ALSO VERY MUCH AWARE OF THE SENSITIVITIES OF THE NUCLEAR CONSUMER NATIONS, INCLUDING DEVELOPING COUNTRIES. THESE NATIONS EXPECT PREDICTABILITY, RELIABILITY, AND TIMELINESS IN THEIR NUCLEAR SUPPLY RELATIONSHIPS. WE ARE STRONGLY COMMITTED TO RESTORING TRUST AND CONFIDENCE IN THESE RELATIONSHIPS. THE UNITED STATES BELIEVES THAT THESE ARE CRITICAL INGREDIENTS IN BOTH PEACEFUL NUCLEAR COMMERCE AND EFFECTIVE PURSUIT OF OUR NON-PROLIFERATION OBJECTIVES. IN THE COMING MONTHS, THE UNITED STATES WILL BE REVIEWING ITS CURRENT PRACTICES WITH A VIEW TO ENHANCING THE RELIABILITY AND PREDICTABILITY OF UNITED STATES SUPPLY. WE WILL SEEK TO DEVELOP MORE PREDICTABLE AND EXPEDITIOUS METHODS AND CRITERIA FOR EXPORT LICENSING AND FOR MEETING SPENT FUEL MANAGEMENT CONCERNS.

THE NEW ADMINISTRATION IS ALSO FIRMLY COMMITTED TO CURBING NUCLEAR PROLIFERATION WHERE THE THREAT EXISTS. THE IMPLICATIONS OF THE SPREAD OF NUCLEAR EXPLOSIVES ARE SIMPLY TOO SERIOUS FOR THE UNITED STATES AND OTHER COUNTRIES NOT ACTIVELY TO SEEK TO LESSEN THE LIKELIHOOD AND RISKS OF PROLIFERATION. NUCLEAR PROLIFERATION WOULD ENDANGER THE SECURITY NOT ONLY OF THE UNITED STATES BUT OF OTHER COUNTRIES AS WELL, INDEED, OF THE ENTIRE INTERNATIONAL COMMUNITY. NON-PROLIFERATION WILL THUS REMAIN A CORNERSTONE OF UNITED STATES POLICY. THE NEW ADMINISTRATION RECOGNIZES, HOWEVER, THAT NON-PROLIFERATION POLICY CANNOT BE EFFECTIVELY FORMULATED OR PURSUED IN A VACUUM, DISSOCIATED FROM OUR OTHER INTERESTS AND OBJECTIVES.

WE LOOK FORWARD TO CONSULTING CLOSELY WITH OTHER INTERESTED STATES, IN A VARIETY OF FORA, AS WE DEVELOP OUR POLICIES ON THE INTERRELATED AREAS OF NUCLEAR COOPERATION AND THE NON-PROLIFERATION REGIME. WE LOOK FORWARD TO A GRADUALLY BROADENING CONSENSUS IN THE INTERNATIONAL COMMUNITY ON AN APPROPRIATE FRAMEWORK FOR NUCLEAR COOPERATION WHICH WILL BE ACCEPTABLE TO SUPPLIERS AND RECIPIENTS.

IN THIS REGARD, SEVERAL INTERNATIONAL EFFORTS ARE UNDERWAY IN THE IAEA THAT ARE AIMED AT IMPROVING THE EXISTING FRAMEWORK FOR INTERNATIONAL COOPERATION AND COMMERCE IN THE NUCLEAR AREA. THE NEWEST OF THESE IS THE IAEA COMMITTEE ON ASSURANCE OF SUPPLY, WHICH WAS ESTABLISHED LESS THAN A YEAR AGO TO CONSIDER WAYS TO ASSURE NUCLEAR SUPPLY ON A MORE PREDICTABLE AND LONG-TERM BASIS

IN ACCORDANCE WITH MUTUALLY ACCEPTABLE CONSIDERATION OF NON-PROLIFERATION FACTORS. DEVELOPED AND DEVELOPING COUNTRIES, CONSUMERS AND SUPPLIERS, AND NUCLEAR-WEAPON AND NON-NUCLEAR-WEAPON COUNTRIES ARE PARTICIPATING IN THIS EFFORT. GIVEN THIS DIVERSITY, WE WOULD ANTICIPATE A FULL AND FRANK EXCHANGE OF VIEWS REFLECTING A NUMBER OF DIFFERENT, AND OFTEN COMPETING, INTERESTS.

THE UNITED STATES BELIEVES THAT THE WORK OF THIS COMMITTEE CAN MAKE A SIGNIFICANT CONTRIBUTION TO PROMOTING INCREASED NUCLEAR COOPERATION WITHIN BROADLY ACCEPTED GUIDELINES. WE INTEND TO PARTICIPATE ACTIVELY IN THE WORK OF THE COMMITTEE WITH THIS IN MIND. WE ARE INTERESTED IN HEARING THE VIEWS AND IDEAS OF OTHERS AS WE WORK TOGETHER TO DEVELOP A MORE REALISTIC AND WORKABLE CONSENSUS ON NUCLEAR FUEL CYCLE AND NUCLEAR CO-OPERATION MATTERS.

ANOTHER AREA THAT WILL RECEIVE AND DESERVES INCREASING INTERNATIONAL CONSIDERATION RELATES TO CERTAIN ASPECTS OF THE NUCLEAR FUEL CYCLE, PARTICULARLY THE QUESTIONS OF HOW TO MAIN-TAIN ADEQUATE CONTROLS OVER SENSITIVE MATERIALS AND HOW TO ADEQUATELY MANAGE SPENT FUEL. TWO IAEA-SPONSORED STUDIES ARE CURRENTLY EXAMINING THESE QUESTIONS -- ONE ON INTERNATIONAL PLUTONIUM STORAGE, THE OTHER ON SPENT FUEL MANAGEMENT. THE FULL ACHIEVEMENT OF THE PROMISE OF NUCLEAR POWER REQUIRES THAT WE WORK TOGETHER IN SEEKING SOLUTIONS TO THE PLUTONIUM AND NUCLEAR WASTE PROBLEMS.

REALIZING THE BENEFITS OF AN INCREASINGLY IMPORTANT ROLE FOR NUCLEAR ENERGY WILL ALSO DEPEND ON AN EFFECTIVE AND CREDIBLE IAEA SAFEGUARDS REGIME. OF COURSE, THE GREAT MAJORITY OF COUNTRIES TODAY ARE PARTIES TO THE NON-PROLIFERATION TREATY AND ACCEPT SAFEGUARDS ON ALL THEIR NUCLEAR ACTIVITIES. THIS TREATY AND THE IAEA SAFEGUARDS SYSTEM ARE CRITICAL CORNERSTONES FOR ADVANCING INTERNATIONAL NUCLEAR COOPERATION. NATIONS WILL NEED TO WORK TOGETHER TO ENSURE THAT THE SAFEGUARDS SYSTEMS AND CAPABILITIES KEEP PACE WITH GROWING NEEDS AND CONTINUE TO PROMOTE PUBLIC AND NATIONAL CONFIDENCE IN INTERNATIONAL NUCLEAR COOPERATION. THIS CONFIDENCE IS ESSENTIAL TO OUR SHARED OBJECTIVES. IT IS ALSO INCUMBENT ON US TO WORK TOGETHER FOR THE BROADEST POSSIBLE ACCEPTANCE OF THE NPT, THE TREATY OF TLATELOLCO AND OF IAEA SAFEGUARDS ON ALL PEACEFUL NUCLEAR ACTIVITIES.

THE UNITED STATES RECOGNIZES THAT IT HAS A VERY IMPORTANT ROLE TO PLAY IN THE EFFORT TO DEVELOP A BETTER INTERNATIONAL UNDERSTANDING ON NUCLEAR ISSUES. WE INTEND TO KEEP THIS FULLY IN MIND AS WE REVIEW OUR POLICIES, PROCEDURES, AND PROGRAMS. WE LOOK FORWARD TO COOPERATION WITH OTHER COUNTRIES IN ADDRESSING THE KEY ISSUES THAT ARE NOW BEING ADDRESSED IN THE INTERNATIONAL NUCLEAR ARENA. WE ARE CONFIDENT THAT THROUGH GIVE-AND-TAKE AND CONSTRUCTIVE COMPROMISE THE INTERNATIONAL COMMUNITY SHOULD BE ABLE TO REACH BROADLY SHARED COMMON POSITIONS THUS PROVIDING A SOUND BASIS FOR INCREASED USE OF NUCLEAR POWER.

THANK YOU.

C.サランダー

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Policy and Development of Reprocessing of Spent Nuclear Fuel and High Level Radioactive Waste Management in the Federal Republic of Germany

by

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Hanover, Federal Republic of Germany

To be presented by Carsten Salander
at the 14th JAIF Annual Conference,
March 10-12, 1981, Tokyo, Japan

0. Summary

The following paper describes the present activities in the Federal Republic of Germany in closing the nuclear fuel cycle. As a cosequence to recent political decisions this is to be done in the frame of an integrated "Entsorgungs"-concept, which differs from the formerly planed integrated "Entsorgungs"-centre in so far, that the various facilities need not to be located on one site.

Thus, the concept concists of temporary storage facilities for spent fuel elements at Gorleben and Ahaus, a reprocessing plant in the State of Hesse, the Plutonium-factory of ALKEM at Hanau, various facilities for conditioning of radioactive wastes, and the repository for their final disposal. Following the "regulations for a proper "Entsorgung" of nuclear power plants" the progress in realisation of all these facilities has to be shown to those authorities, which are responsible for licensing the power plants.

1. Introduction

The need for closing the nuclear fuel cycle was identified in the Federal Republic of Germany already shortly after German scientists and engineers had started to work within the research establishments as well as in the electricity utility industry about the generation of electricity by nuclear power plants in the year 1955.

Reprocessing, as the main step of the back end of the nuclear fuel cycle, fabrication of plutonium containing fuel elements, and a proper disposal of all radioactive wastes were the main topics to be handled by the relevant industrial companies with financial support by the Ministry for Research and Technology. Like usual, the development started with research work and small facilities of laboratory-size, before prototype plants were designed and built like the small reprocessing plant at Karlsruhe (WAK), the ALKEM plutonium-factory, or the ASSE salt mine for the disposal of radioactive waste.

As a consequence of an increased consciousness about enviromental effects of industrial production in general the Federal Government introduced the so called "polluter pays-principle" in its legislation in the late 1960's. Within the German nuclear law this "polluter pays-principle", too, was included in an amendment in 1976. Thus, the German electricity utilities had to take over the responsibility for closing the nuclear fuel cycle, and they founded DWK to coordinate all steps in a proper way.

In a close cooperation between Federal Government, State Authorities and DWK a concept for closing the nuclear fuel cycle, in Germany called "Entsorgung", was developed, and the relevant licensing procedures were started. In the meantime the political development has shown, that the original idea of an integrated "Entsorgungs"-centre, in which all facilities are placed on the same site, does not seem to be realisable at present, so that instead, within the frame of an integrated "Entsorgungs"-concept, the individual facilities have to be designed and built in smaller scale at different sites in the Federal Republic, before possibly later on it can be shown to the public, that such nuclear installations are operable without impact to the environment or the population and may therefore be better accepted.

2. Temporary Storage Facilities

Since it could be foreseen since some time, that the long-term storage of spent fuel elements would become more important, if plans for construction of reprocessing plants were delayed, it was tried in the Federal Republic of Germany to develop a concept for this temperary storage, which should be safe, practicable and flexible. Moreover, the necessary facilities should easily to be decommissioned, when later on enough reprocessing capacity was available.

Those conditions could best be fulfilled by a transport container storage system, which reduces the radiation of the personnel, as it avoids reloading. Also the building, in which the containers will be stored, is a rather simple industrial building, which later on can either be used for other purposes, since there is practically no release of radioactivity within the building, or, if there is no need for such a building, it can be decommissioned much easier as for example a wet storage facility.

In this context it has to be mentioned, that the transport container storage facility has not to be air-crash proof like all other nuclear installations in the Federal Republic of Germany, as the containers themselves are enough protection against such impacts.

The first such facility is to be constructed at the village of Gorleben close to the site of the formerly planed "Entsorgungs"-centre. We still hope to receive the construction permit in May 1981. A second one will be built at Ahaus in Northrhine-Westphalia, and two more will be necessary, following our calculations, until the end of this century.

3. The Reprocessing Plant

In May 1979 the Lower Saxony Ministerpresident announced in the parliament at Hanover, that an integrated "Entsorgungs"-centre would be realisable from a safety-technical point of view, but not from a political one. Therefore, a new concept had to be found, which was agreed upon by all German heads of state and the Federal Chancellor. Main part of this concept is a "small" reprocessing plant, for which DWK applied for at the licencing authorities of the state of Hesse on February, 25th, 1980.

This plant, which is to reprocess 350 t of spent fuel per year, should be placed in the area of North-Hesse, where there is traditionally a lack of employment possibilities. Therefore, together with a Hesse company for siting of industrial facilities, suitable sites were investigated and compared to each other.

Meanwhile the Federal Ministry for Internal Affairs has issued nuclearspecific site criteria, and the Hesse Government published non-nuclearspecific site criteria, which had been investigated. About in May 1981 we hope to be able to present our results to the Hesse Government and to the public. Only then the license application can be completed by the relevant site chapters.

In the political discussion it is - following the results of the Enquete Commission of the last German parliament - obviously necessary to prove, that the Hesse reprocessing plant (WAH) has demonstration character only, since the ultimate decision about whether to reprocess or directly to dispose spent fuel elements is to be taken only by 1985. Therefore, the main task of the plant is to prove and keep up the know how of the reprocessing technology, and moreover to demonstrate the possibility of the operation of such a plant in context with the nuclear power plants.
The basis for this knowledge ist the pilot reprocessing plant WAK at Karlsruhe, which is owned by the Federal Republic and operated by the DWK daughter company GWK. This plant is at present in a repair phase, as the dissolver became leak in May 1980 after nearly 10 years of successful operation. During this time about 115 tons of spent LWR fuel has been reprocessed by WAK.

In addition the large components for the WAH like the bundle shear the pulse columns, the electrolytic mixer-settler, pumps, valves etc. are being tested in an technical component test facility (TEKO), also operated by GWK at Karlsruhe. Most of these components are based on the results of the research work, which ist done at the Karlsruhe research establishment (KfK) under a cooperation agreement between KfK and DWK.

4. Plutonium Refabrication

Present activities for Plutonium fuel fabrication in Federal Republic are concentrated in ALKEM, a 60/40 % daughter company of KWU and NUKEM.

ALKEM's capacity of either 25 tons per year of recycle fuel or about 3 tons per year of fast breeder fuel is at present used for fabricating fuel for the fast breeder reactors SNR 300 and KNK II. Two dual purpose fabrication lines, one of which is highly mechanized, during the last years have produced more than 25 tons of MOX fuel, utilizing about 1.500 kg of fossile Plutonium, supplied both as PuO_2 and Plutonium nitrate. More than 20.000 fuel rods and patelets fabricated there have shown excellent irradiation behaviour with failure rates below comparable U-fuel. Recent requests for co-reprocessing led to development of co-precipitated fuel, which has a solubility in nitric acid of better than 99,5 % in the unirradiated state.

Within the next years increasing amounts of this kind of fuel will be loaded into PWR's as recycle fuel, so that some of the Plutonium, coming as nitrate from the WAK (about 100 kg per year) and from COGEMA (about 19 tons as oxide within one decade) will be recycled into a limited number of German light water reactors.

Current licensing criteria including plane crash considerations may require a new production building on ALKEM's site at Hanau. Fabrication facilities in connection with this building are now in the planning stage. They are designed to fully utilize Plutonium coming from the planed WAH (about 3,8 tons per year) and to transform this either into about 75 tons of MOX fuel for recycle or a corresponding amount for eventual fast breeder fuel requirements in the early nineties.

In the Federal Republic of Germany we agree, that an existing and workable Plutonium fabrication facility contributes substantially to the credibility of reprocessing as the first choice against permanent spent fuel storage alternatives due to its economic and ecologic benefits.

5. Waste Conditioning

The facilities for the conditioning of the radioactive waste resulting from reprocessing will be placed on the site of the planed reprocessing plant in Hesse. Proven techniques like cementation of low- and intermediate-level wastes as well es vitrification of high-level waste will be used.

Although today the french AVM*-process, adapted to German licensing conditions, is foreseen for the vitrification of high-level wastes we are developing and improving the PAMELA**-vitrification process together with Belgium, also using Boronsilicate glass. At present we are going to demonstrate this process on a technical-industrial scale at the site of the Eurochemic reprocessing plant at Mol/Belgium, to vitrify the liquid high-level waste from the former operation of this plant. The construction license for the PAMELA-facility has recently been granted by the Belgian authorities and construction work will start early summer this year.

*) AVM = Atelier Vitrification Marcoule

**) PAMELA = Phosphatglasverfestigung mit anschließender Metalleinbettung zur sicheren Endlagerung

6. Waste Disposal

Since the early 1960's Germany is doing a lot of work in the field of radioactive waste disposal in salt domes. In 1964 the Federal Government purchased the former salt mine ASSE II near Brunswick in order to start an extensive test programme about the disposal of radioactive waste. In 1967 the first drums of low-level waste were disposed of. Since then, until the end of 1978 about 124.000 drums of low-level waste were disposed of without any difficulties. Parallel to this action the disposal of intermediate level waste was begun in 1972, and until the end of 1977 about 1.300 drums of cemented or bituminized wastes were disposed of.

Thus, proven techniques for the disposal of low- and intermediate-level wates exist in the Federal Republic of Germany. The disposal of high-level wastes has also been tested at the ASSE salt mine and it could be shown that salt is an excellent material to contain these heat generating wastes.

Due to the 4. amendment of the atomic law in 1976, which required among other subjects a specific licensing procedure for disposal facilities, the licenses for the disposal of low- and intermediate-level wastes at ASSE could not be renewed at the end of 1978 and 1977 respectively, since it was forgotten, to introduce an exemption for this test facility.

In the meantime, ASSE salt mine, however, has been used to perform an extensive R+D-programme, which will last for several years to come. Also the basic decision about the use of ASSE as a repository and not only as a test site has now been made and thus the corresponding licensing procedure will soon be initiated. It is expected though, that ASSE can restart operation not earlier than 1985.

Basing on the experience gained from the operation of the ASSE salt mine a large central repository was planed within the already mentioned integrated "Entsorgungs"-centre in the salt dome at the site of Gorleben in Lower Saxony. The Federal Physical-Technical Institution (PTB) as the authority responsible for disposal of radioactive waste in Germany has applied for a license for this repository on July 28, 1977. As already mentioned the Ministerpresident of Lower Saxony in May 1979 announced the realisability of an "Entsorgungs"-centre from a safety and technical point of view but because of political reasons denied to continue the project. On the other hand, however, he asked the PTB to start investigation of the Gorleben salt dome and declared that his State Government would grant a license for the disposal of radioactive wastes if the Gorleben salt dome proves to be suitable. Therefore, PTB started an extensive investigation programme including about 100 hydrogeologic borings in an area of about 300 km² and five deep drillings in order to investigate the structure of the salt dome itself.

All hydrogeologic boreholes have already been drilled and results are evaluated. Also four of the deep boreholes which go down to a depth of 2.000 m have been completed and have up to now shown no fact, which might exclude the Gorleben salt dome from the use as a repository. Because of demonstrations of nuclear opponents at the drilling sites measures for physical protection had to be taken in order to assure a drilling operation without disturbance.

Thus, as the results of the salt dome investigation are rather encouraging the next steps will be to find a place to sink a shaft, apply for a license for this action and after shaft sinking investigate the internal composition of the salt dome in more detail in order to have the repository available in the early 1990's.

7. Conclusion

In summing up, we want to state that "Entsorgung" of nuclear power plants in the Federal Republic of Germany is a well and carefully handled subject, in which a total of at least 3.000 specificly trained experts are working to solve the remaining problems, which are a consequence of scaling up. In addition we are working hard to reduce the impact of the necessary facilities on the public and on the environment, so that the acceptibility may increase again in the near future.

AGENCE NATIONALE
POUR LA GESTION DES DECHETS RADIOACTIFS
3 RUE DE LA FEDERATION - 75752 PARIS CEDEX 15 TEL: 273 60 00

(9)

発表は 3月12日 ~~午前~~ 午後 3 時
以降に願います。

EMBARGO UNTIL
12 March ~~a.m.~~ p.m. 15:00

INDUSTRIAL LONG TERM MANAGEMENT OF RADIOACTIVE WASTE IN FRANCE

[ラビ氏]

I - SCOPE OF THE PROBLEM

ANY HUMAN ACTIVITY AND EVERY PRODUCTION OF ENERGY INVOLVE THE PRODUCTION OF WASTE. THIS RULE ALSO APPLIES TO THE NUCLEAR GENERATION OF ELECTRIC POWER. HENCE A TIME ARISES WHEN THIS WASTE MUST BE MANAGED INDUSTRIABLY.

THE VIGOR AND THE SCOPE OF THE FRENCH NUCLEAR PROGRAM, WITH THE COMMISSIONING OF ONE POWER PLANT EVERY TWO MONTHS AND THE SUBSEQUENT FUEL REPROCESSING, THE FIRST EFFECTIVE LINK ON WASTE MANAGEMENT, HAVE INDUCED THE FRENCH AUTHORITIES TO INTENSIFY THE EFFORT REGARDING THE WASTE AND TO SET UP A SUITABLE INDUSTRIAL STRUCTURE FOR THE WASTE DISPOSAL.

THIS IS THE ROLE OF THE NATIONAL RADIOACTIVE WASTE MANAGEMENT AGENCY, ANDRA, ESTABLISHED WITHIN THE CEA BY AN INTERMINISTERIAL DECISION IN NOVEMBRE 1979.

II - THE NATIONAL RADIOACTIVE WASTE MANAGEMENT AGENCY (ANDRA)

ANDRA'S GOALS ARE MAINLY

- THE DESIGN, SITING AND CONSTRUCTION OF WASTE DISPOSAL CENTERS,
- THE MANAGEMENT OF THE WASTE DISPOSAL CENTERS,
- THE ESTABLISHEMENT OF RADIOACTIVE WASTE CONDITIONING AND STORAGE SPECIFICATIONS,
- THE CONTRIBUTION TO THE RESEARCH AND DEVELOPMENT WORK.

THE CREATION OF ANDRA ALSO REFLECTS THE DECISION OF THE AUTHORITIES TO MAKE A CLEAR SEPARATION BETWEEN THE BODIES IN CHARGE OF REGULATION AND MONITORING ACTIVITIES AND THOSE IN CHARGE OF INDUSTRIAL OPERATIONS. IT MARKS THE INDUSTRIAL MATURITY OF THE LONG TERM WASTE MANAGEMENT. ANDRA TAKES IN CHARGE OF DEVELOPING AND RECOMMANDING POLICIES AND INDUSTRIAL ALTERNATIVES. THE SAFETY AUTHORITIES ARE RESPONSIBLE FOR GIVING THEIR OPINION TO THE SUPERVISORY AUTHORITY THAT DECIDES ON THE MATTER.

.../...

ANDRA ITSELF IS A VERY LIGHT ORGANIZATION WHOSE ACTIVITY CENTERS ON A HIGHT LEVEL MANAGEMENT ROLE FOR THE ACHIEVEMENT OF OPTIMIZATION ON THE ECONOMIC AND SAFETY LEVELS. ANDRA EMPLOYED ABOUT 20 PEOPLE, INCLUDING 15 MANAGEMENT STAFF. ANDRA'S HEADQUARTER IS IN PARIS.

III - THE NEED FOR AN OVERALL INDUSTRIAL APPROACH

IT APPEARED VERY EARLY, AS SOON AS THE NUCLEAR PROGRAM WAS LAUNCHED THAT THE COST OF WASTE DISPOSAL IN THE STRICT SENSE OF THE TERM WAS ONLY 10% TO 20% OF THE TOTAL COST OF THE WASTE MANAGEMENT AS A WHOLE (TREATMENT + CONDITIONING + TRANSPORTATION + DISPOSAL) AND THAT THIS COST WAS DIRECTLY CONNECTED TO THE DISPOSAL CONCEPT IMPLEMENTED. HENCE THE NEED TO DETERMINE THE DISPOSAL CONCEPT IN ADVANCE, IN ORDER TO DESIGN UPSTREAM MANAGEMENT (TREATMENT + CONDITIONING) MORE OFFICIENTLY AND ECONOMICALLY, ESPECIALLY IN THE REPROCESSING FACILITIES AND NUCLEAR POWER PLANTS.

ANDRA'S INDUSTRIAL APPROACH IS PART OF A CONSISTENT POLICY OF OPTIMIZED INTEGRATION OF ALL THE DIFFERENT FACTORS INVOLVED IN WASTE MANAGEMENT IN THE BROAD SENSE OF THE TERM, FROM THEIR INITIAL SOURCE, ALL THE WAY TO THE FINAL STORAGE CENTER. THIS IS ACHIEVED BY COOPERATION BETWEEN PRODUCERS AND ANDRA, AS DESIRED BY THE AUTHORITIES.

IV - INDUSTRIAL MANAGEMENT CONCEPTS

THE PROBLEMS RAISED BY LONG TERM RADIOACTIVE WASTE MANAGEMENT ARE ESSENTIALLY NO DIFFERENT FROM THOSE RAISED BY THE MANAGEMENT OF ALL OTHER WASTES.

AS FOR ANY KIND OF WASTE, OR ANY OTHER INDUSTRIAL OPERATION, IT IS IMPORTANT :

- TO IDENTIFY AND INVENTORY THE NEEDS, NAMELY THE WASTE PRODUCTION AND DELIVERY FORECASTS,

- TO DEFINE THE DISPOSAL CONCEPT WHICH MUST BE

  . ACCESSIBLE TECHNOLOGICALLY,

  . RESONABLE FROM THE ECONOMIC STANDPOINT,

  . SATISFACTORY FROM THE SAFETY STANDPOINT,

  . SUFFICIENTLY SIMPLE AND CLEAR TO BE ACCEPTED BY PUBLIC OPINION.

- TO SELECT SITES, OR AT LEAST POSSIBLE TYPES OF SITES. THIS CHOICE IS THE BOTTLENECK IN THE DISPOSAL OF RADIOACTIVE WASTE.

ONCE THIS PROSPECTIVE APPROACH HAS BEEN MADE AND ACCEPTED, IT BECOMES POSSIBLE TO DEFINE THE FOLLOWING IN A CONSISTENT OPTIMIZED MANNER :

- THE TECHNICAL SPECIFICATIONS THAT MUST BE MET BY THE CONDITIONING OF THE DIFFERENT WASTE CATEGORIES,

- THE QUALITY ASSURANCE CONTROLS THAT ANDRA HAS OR WILL HAVE PERFORMED TO GUARANTEE THE COMPLIANCE OF THE PACKAGE TO THE AUTHORIZATION FILE,

- THE RESEARCH AND DEVELOPMENT PLAN APPLIED TO LONG TERM WASTE MANAGEMENT.

V - ANDRA'S WORK PLAN

FORECASTS OF WASTE DELIVERIES TO ANDRA FOR DISPOSAL CONSTITUTE THE VERY SENSE OF ANY CONSISTENT STORAGE POLICY. SO, AN OUTSTANDING EFFORT HAS BEEN MADE AT ALL LEVELS TO IMPROVE THE RELIABILITY AND ACCURACY OF MEDIUM AND LONG TERM FORECASTS.

THE VIEW FILM 7 GIVES THE ANNUAL AND CUMULATIVE DELIVERY FORECASTS CORRESPONDING TO A FEW KEY DATES FOR EACH OF THE THREE USUAL WASTE CATEGORIES.

THE VIEW FILM 8 SHOWS THE BREAKDOWN OF DELIVERIES ACCORDING TO SOURCE ORGANIZATIONS.

THE VIEW FILM 9 DETAILS THE DELIVERY FORECASTS FOR THIS YEAR 1981.

IT SHOULD BE NOTED THAT THESE FORECASTS DO NOT ACCOUNT FOR THE VERY CONSIDERABLE SOURCE OF WASTES ARISING FROM THE DISMANTLING OF NUCLEAR INSTALLATIONS.

FROM THE CLIENTELE STANDPOINT, APART FROM SOME 10 LARGE CLIENTS, ANDRA HAS ABOUT MORE THAN 3 000 SMALL CLIENTS DESIGNATED BY OTHERS INCLUDING HOSPITAL, UNIVERSITIES, RESEARCH LABORATORIES AND INDUSTRY.

VI - FRENCH INDUSTRIAL WASTE DISPOSAL POLICY.

. THE FRENCH DISPOSAL POLICY AS THE POLICY OF MANY OTHERS COUNTRIES, IS BASED ON THE CONSIDERATION OF FOUR PRINCIPAL FACTORS :

- THE ADVANTAGE OF RADIOACTIVE DECAY,

- THE RISK OF HUMAN INTERVENTION OR THE ACTION OF WATER,

- THE DURATION OF THE EFFECTIVENESS OF ARTIFICIAL BARRIERS,

- THE TOTAL COST OF THE WASTE MANAGEMENT AND DISPOSAL.

.../...

THE OPTIMIZATION OF THESE FOUR FACTORS LEADS TO :

- SUB-SURFACE STORAGE OF SHORT LIVED WASTE OR NON-ALPHA WASTES BECAUSE WE HAVE BARRIERS WITH AN EFFECTIVENESS OF AT LEAST 300 YEARS AND SURVEILLANCE OF THE SITE THROUGHOUT THIS PERIOD,

- DEEP STORAGE OF ALPHA WASTES AT A SUITABLE DEPTH TO SHIELD THEM FROM UNFORESEEN HUMAN INTERVENTION. HENCE ONLY THE ACTION OF WATER NEEDS TO BE CONSIDERED,

- DEEP STORAGE OF VITRIFIED WASTES AFTER A PRIOR COOLING PERIOD ON THE SURFACE OR IN SITU.

. THE DISPOSAL OF BETA-GAMMA WASTE IS CARRIED OUT IN FRANCE BY SPECIAL SUB-SURFACE STORAGE (CONCRETE MONOPOLITH, SEALED COVER, WATER DRAINAGE ...) WHICH GUARANTEE THEIR ISOLATION FROM THE PRESENT AN FUTURE HUMAN ENVIRONNEMENT FOR MORE THAN 300 YEARS.

FOR THE DISPOSAL OF BETA-GAMMA WASTES, ANDRA DISPOSE OF ONE CENTER IN OPERATION IN THE NORTH WESTERN FRANCE AND PLANS TO BUILD ANOTHER IN THE SOUTHEASTERN.

.. THE NORTHWESTERN CENTER, CALLED CENTRE DE STOCKAGE DE LA MANCHE, CSM, WITH AN AREA OF 30 ACRES, HAS A SUB-SURFACE STORAGE CAPACITY OF 300 000 M3 OF WICH ABOUT 120 000 M3 ARE ALREADY OCCUPIED SINCE ITS CREATION IN 1969.

THESE FOLLOWINGS SLIDES PRESENT :

- THE GENERAL STRUCTURE OF THE CSM,

- THE TEMPORARY STORAGE FACILITY OF THE CSM FOR ALPHA BEARING WASTES,

- THE PRINCIPLE OF SUB-SURFACE DISPOSAL IN OPERATION AT THE CSM,

- THE SURFACE STORAGE OF DRUMS AND BLOCKS,

- THE SUB-SURFACE STORAGE OF DRUMS,

- THE COVER BY CLAY AND FARMING SOILS,

- THE GROWTH OF VEGETATION SOME YEARS AFTER.

.. THE SOUTHEASTERN CENTER, CALLED CENTRE DE STOCKAGE DU FOREZ (CSF) IS PLANNED TO BE BUILD IN THE FOREZ REGION. THE PLAN WAS MADE PUBLIC IN AUTUMN 1979. THE LICENSING REQUEST FOR THE CREATION OF THIS CENTER WAS FILED ON MARCH 30 1980. SUBJECT TO THE GRANTING OF THIS AUTHORIZATION, COMMISSIONING IS PLANNED FOR EARLY 1983. THE LOCAL INQUIRY, OPENED ON MAY 19, 1980, WAS CLOSED ON JUNE 13 WITHOUT ANY SIGNIFICANT INCIDENT. THIS CENTER WILL ACCOMODATE FOR DISPOSAL ONLY BETA GAMMA WASTES;

.../...

. THE ALPHA WASTES WILL BE STORED AT MEDIUM DEPTH IN FRANCE. THE OBJECTIVES OF ANDRA'S INDUSTRIAL POLICY GOVERNING ALPHA WASTE MANAGEMENT ARE :

.. TO ATTEMPT TO BUILD AN UNDERGROUND DISPOSAL FACILITY EITHER ON THE CSF OR AN ANOTHER SITE (CS3). ANDRA WILL IMPLEMENT THE INVESTIGATIVE MEANS FOR AN INDUSTRIAL COMMISSIONNING OF THIS ALPHA CENTER IN 1986.

.. TO ORGANIZE TEMPORARY STORAGE FACILITIES IN THE CSM AND CSF TO MEET THE MOST PRESSING NEEDS.

. THE VITRIFIED WASTES SOLIDIFICATION, SOLUTION SELECTED IN FRANCE, ARE TEMPORARILY STORED ON THE SURFACE ON THE PRODUCTION SITE. ANDRA IS ACTIVELY INVESTIGATING THE MOST SUITABLE METHOD OF DISPOSAL, BOTH FROM THE SAFETY AND ECONOMIC STAND POINT, ON A LAND SITE.

DIFFERENT SOLUTIONS HAVE BEEN PROPOSED TO SOLVE THIS PROBLEM :

.. COOL THE PACKAGE COMPLETELY ON SURFACE FOR ABOUT 150 YEARS, AND THEN BURY THEM, MAKING POSSIBLE TO HAVE A COMPACT STORAGE UNIT,

.. COOL THEM PARTLY ON THE SURFACE, FOR EXAMPLE FOR 30 YEARS, AND THEN BURY THEM. BUT THE RESIDUAL HEAT REMAINING LEADS TO THE BUILDING OF A LARGE UNDERGROUND FACILITY,

.. BUILD A COMPACT GEOLOGICAL STORAGE FACILITY, STORE AND COOL THE GLASSES IN THIS FACILITY A FEW YEARS AFTER THE VITRIFICATION, AND AFTER A SUFFICIENT MEMBER OF YEARS, TRANSFORM THIS STORAGE FACILITY INTO A DISPOSAL BY SEALING IT SUITABLY.

THESE THREE SOLUTIONS ARE CURRENTLY BEING INVESTIGATED BY ANDRA, PARTICULARLY THE THIRD. IF THIS STUDY IS CONCLUSIVE, A DEMONSTRATION GLASS STORAGE FACILITY (SDV) WOULD BE DESIGNED TO MAKE A FULL SCALE DEMONSTRATION OF A VERY LONG TERM STORAGE FACILITY.

THIS SDV, OR A SURFACE STORAGE CENTER FOR VITRIFIED WASTES, SHOULD ENTER INTO SERVICE IN 1992, WHEN COGEMA WILL DELIVER THE FIRST GLASSES TO ANDRA (ABOUT 400 M3).

VII - THE FINANCING OF ANDRA'S ACTIVITIES

LIKE FOR THE DISPOSAL OF OTHER WASTES, THE "POLLUTERS PAY" PRINCIPLE APPLYES ENTIRELY TO THE FINANCING OF DISPOSAL OF RADIOACTIVE WASTES. THE FINANCING OF THE ACTIVITIES OF ANDRA IS SECURED AS FOLLOWS BY THE WASTE PRODUCERS.

- ANNUAL OPERATING COSTS ARE DIRECTLY BILLED TO THE PRODUCERS ON A THREE MONTHS BASE,

- CAPITAL COSTS, OR COSTS INVESTMENTS ARE FINANCED BY LOANS, FOR WHICH THE SERVICE IS COVERED ANNUALLY BY THE PRODUCERS UNDER HAND CONTRACTS BASED ON DELIVERY FORECASTS.

As for the very long term burdens, the distribution principle has been selected, similar to the retirement system, in which the young wastes pay for the old wastes, in preference to capitalization. However, a provision to cope with immediate expenditures in case of accident is gradually being installed.

The view film 16 presents the first Andra's five years plan. It provides for expenditure of the order of $ 150 millions including about $ 85 millions of capital expenditures over the 1980 - 1984 period.

The view film 17 details some 1981's disposal costs at the CSM for the beta gamma wastes.

VIII - The policy of operating, engineering and R and D assistance

The andra's creation act clearly states that andra can not deligate or transfer its liabilities in other words, andra must remain the owner and prime contractor. But, for reasons of flexibility, a lightweight organization was adopted for andra which therefore relies on operating, engineering and research and development assistance.

Andra, the owner and prime operator of CSM untrusts under its supervision, the management of the CSM to an operator.

For engineering, andra calls on the services of different industrial consulting engineers.

Furthermore, for the R and D stand points, Andra relies on the operational units of the CEA and on the services of different organizations engaged in this field.

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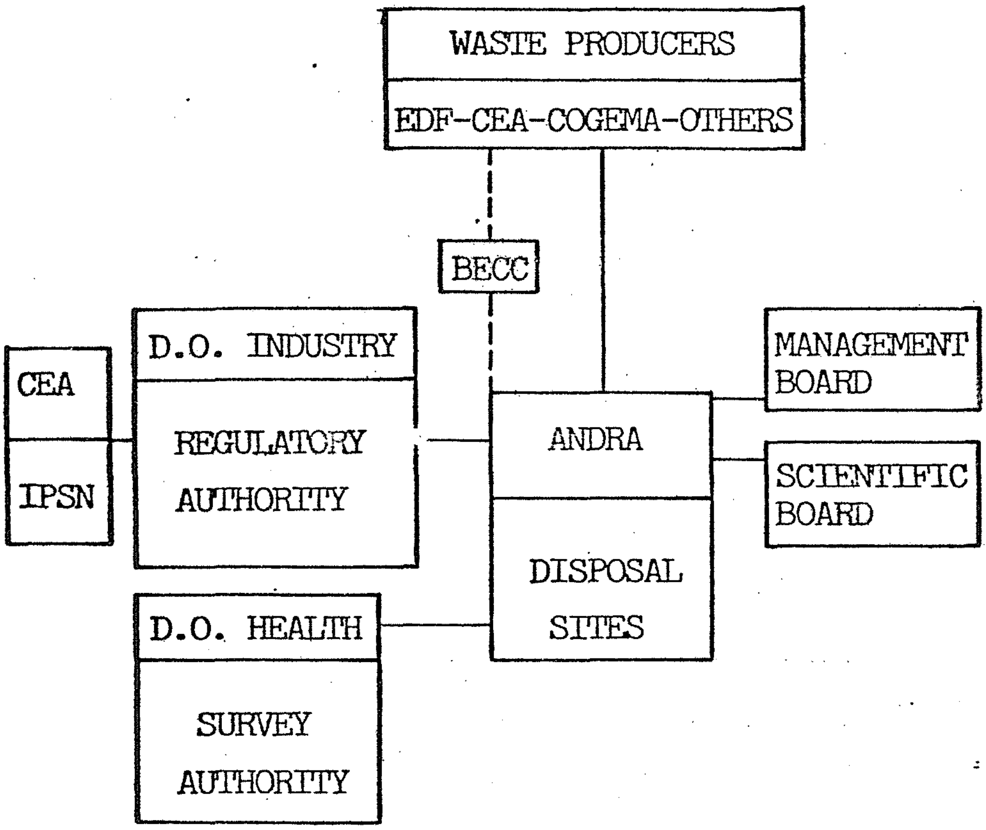
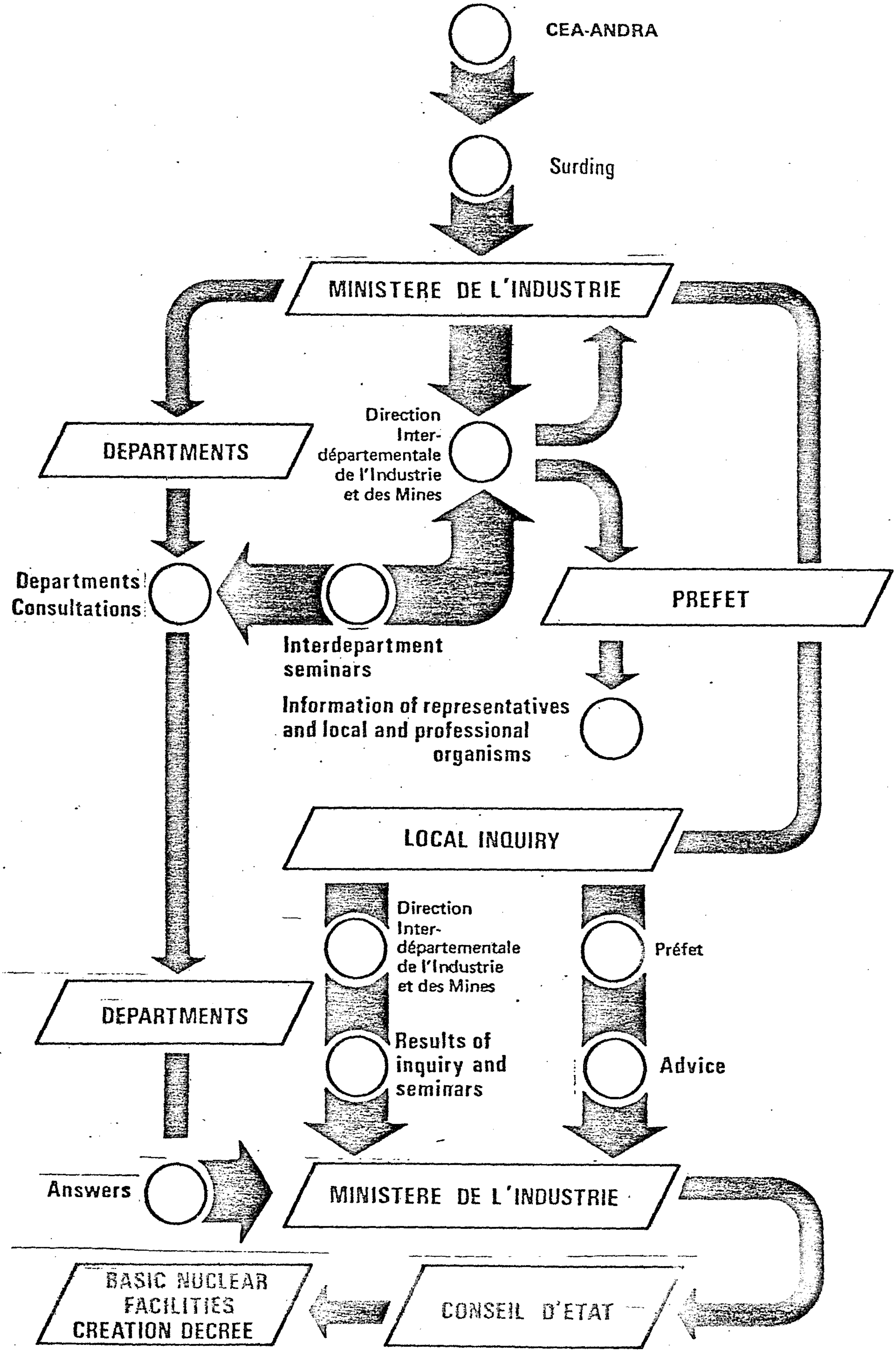
In conclusion : I would like to emphasize, after this outline of the frame work of industrial waste management policy in France, that the most important problem met by andra remains the political and social problem. Andra is trying to convince the public that the establishement of these industrial facilities serves and will serve to solve the problem of radioactive waste disposal in condition of safety sustancially equivalent to those governing the disposal of all other waste.

Thank you for your attention

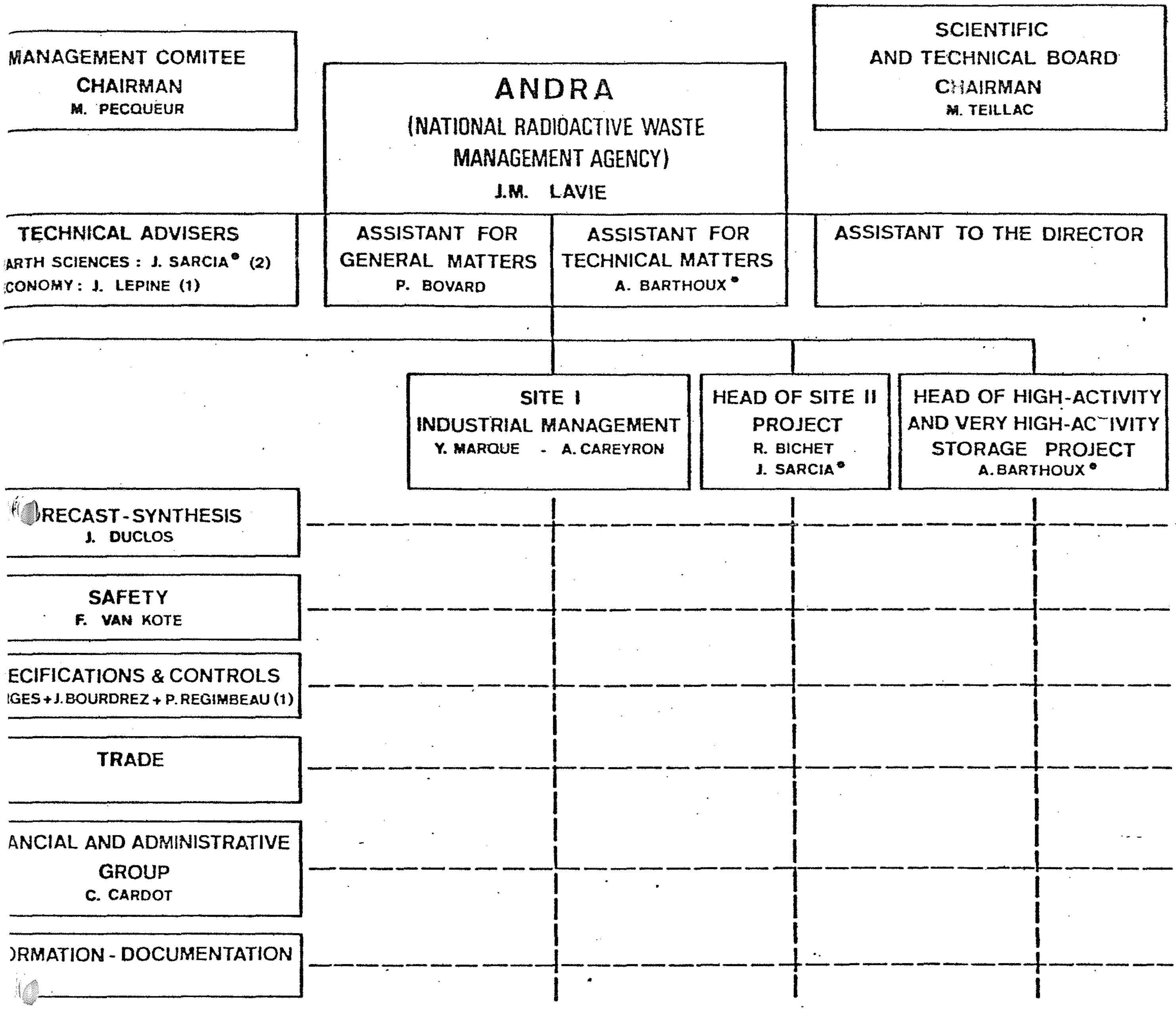


ORGANISATION CHART

SCHEME OF THE PROCEDURE RELATED TO CREATION AUTHORIZATION OF BASIC NUCLEAR FACILITIES



Réalisation D.S.P.S. Service Protection Physique 3479 Document ANDRA 10.80



• DOUBLE RESPONSIBILITY

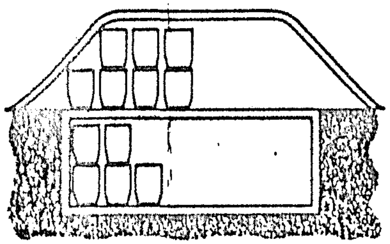
(1) E.D.F. (FRENCH ELECTRICITY BOARD)

(2) COGEMA (COMPANY COVERING THE WHOLE FUEL CYCLE)

BETA-GAMMA WASTES

SHORT HALF-LIVES

^{137}Cs	30 YEARS
^{90}Sr	30 YEARS
^{60}Co	5 YEARS
^{55}Fe	2,5YEARS



SUB-SURFACE STORAGE

TRANSPORT-HANDLING

NON-IRRADIATING < 200mrad / h

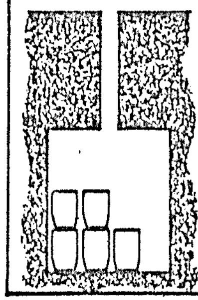
IRRADIATING > 200mrad / h

CUMULATED PRODUCTION IN THE YEAR 2000: $\sim$ 1.000.000 m^3

ALPHA WASTES

LONG HALF-LIVES

^{237}Np	210^{6} YEARS
^{239}Pu	2.410^{4} YEARS
^{243}Am	8.10^{3} YEARS
^{241}Am	4.10^{2} YEARS



DEEP STORAGE

TRANSPORT-HANDLING

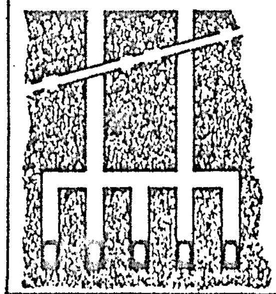
NON-IRRADIATING < 200mrad / h

IRRADIATING > 200mrad / h

CUMULATED PRODUCTION IN THE YEAR 2000: $\sim$ 30.000 m^3

VITRIFIED WASTES

LONG HALF-LIVES	HIGH ACTIVITY
^{237}Np	^{60}Co
^{239}Pu	^{90}Sr
^{243}Am	
^{241}Am	^{243}Am



COOLING

DEEP STORAGE

TRANSPORT-HANDLING

IRRADIATING >> 200mrad / h

CUMULATED PRODUCTION IN THE YEAR 2000: $\sim$ 2.000 m^3

REALISATION: DSPS - SERVICE PROTECTION PHYSIQUE . 3531.

DOCUMENT: ANDRA - 1-81

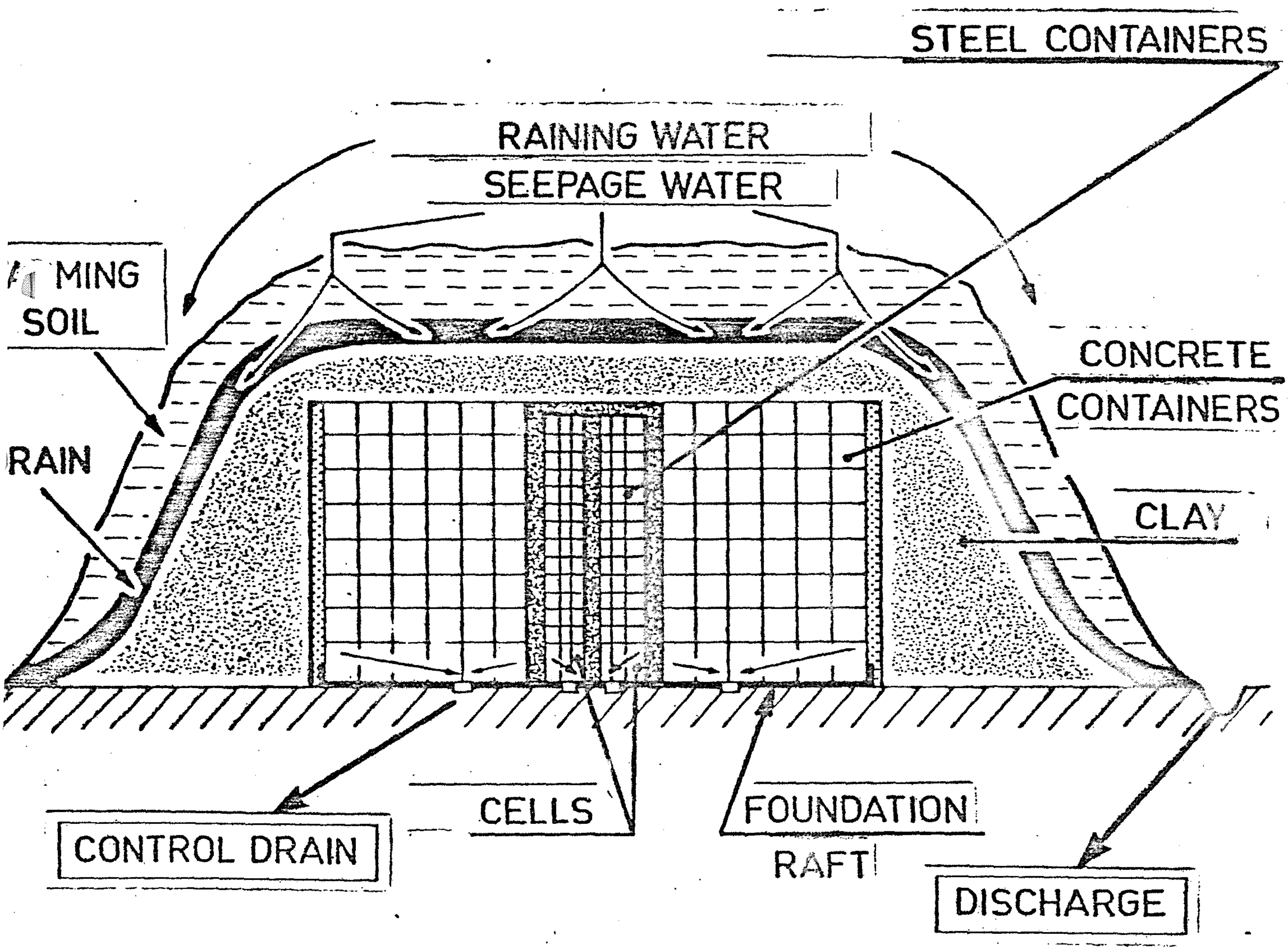
PREVISIONS OF WASTES DELIVERIES

	1980	1992	1995	2000
LMA	20 000 / 20 000	50 000 / 500 000	65 000 / 650 000	70 000 / 900 000
ALPHA	270 / 270	2 000 / 9 000	3 000 / 18 000	3 000 / 35 000
GLASSES	0 / 0	380 / 380	175 / 850	190 / 1 650

ANNUAL DELIVERIES (upper left of each cell) CUMULATED (lower right of each cell) IN M3

DELIVERIES (IN %) IN RELATION OF DIFFERENT ORIGINS							
		DEFENSE WASTES (reprocessing)	CEA	COGEMA	EDF direct	EDF rep.	OTHERS
IMA	1981	6 %	9 %	31 %	32,5%	7,5%	14 %
	1992	2 %	5 %	0 %	77 %	10 %	6 %
	1995	2 %	4,5%	0 %	76,5%	11,5%	5,5 %
ALPHA	1981	0 %	0 %	0 %	0 %	0 %	0 %
	1992	0 %	7 %	31 %	0 %	62 %	0 %
	1995	0 %	6 %	5 %	0 %	89 %	0 %
GLASSES	1981	0 %	0 %	0 %	0 %	0 %	0 %
	1992	38 %	0 %	37 %	0 %	25 %	0 %
	1995	3 %	0 %	0 %	0 %	97 %	0 %
	2000	3 %	0 %	0 %	0 %	97 %	0 %

PRINCIPLE OF STORAGE: PLATFORMS AND DRAINS



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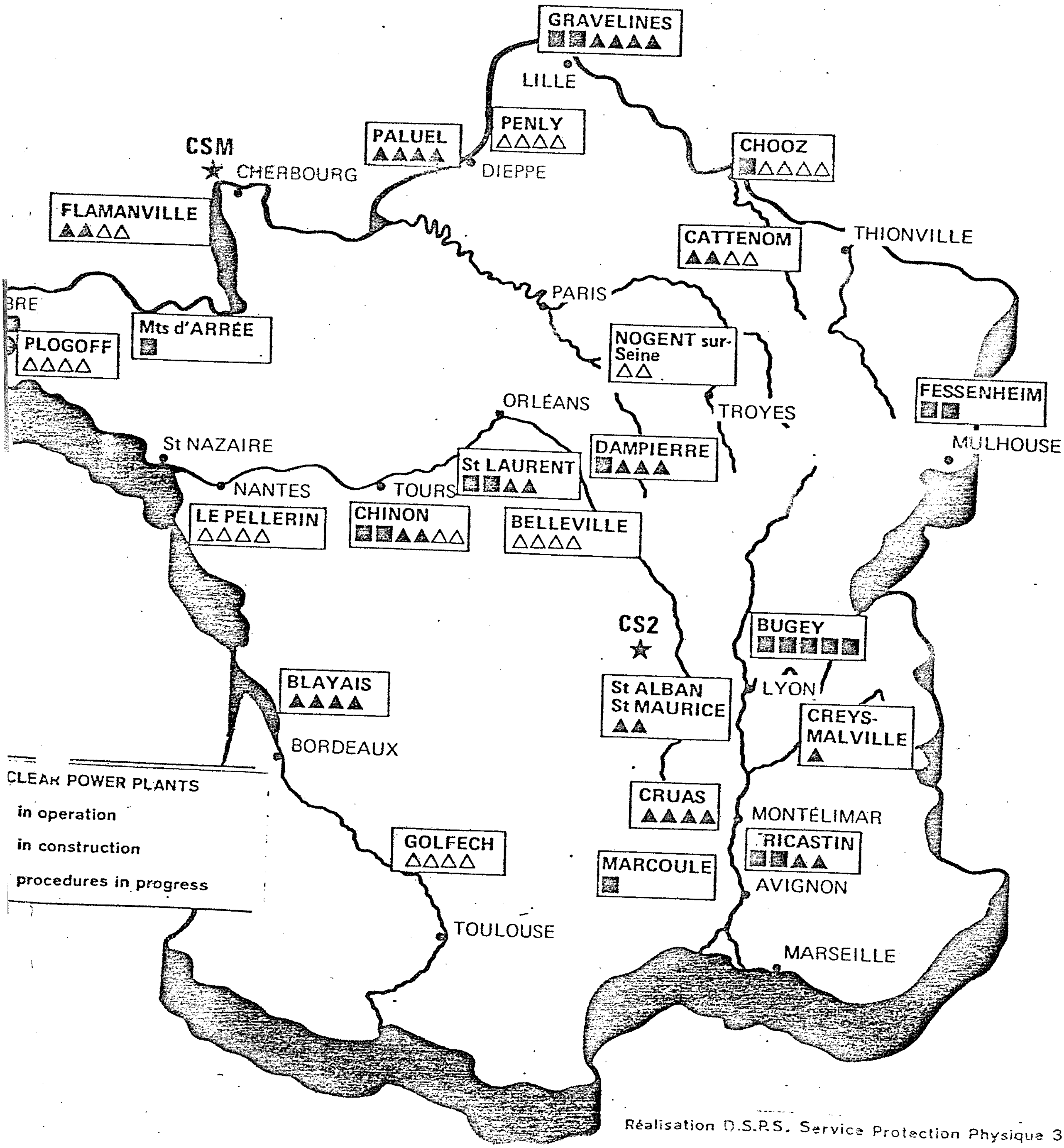
NUCLEAR REACTORS
IN OPERATION, IN CONSTRUCTION AND PLANNED

September 1, 1980



Réalisation D.S.P.S. Service Protection Physique 3479

Document ANDRA 10.80

ANDRA'S FIVE-YEAR PLAN
1980 - 1984
MILLIONS $ 1981

	1980	1981	1982	1983	1984	TOTAL
ANNUAL OPERATING COST	7	8	10	17	20	62
CAPITAL COST	8	12	20	28	16	84
TOTAL	15	20	30	45	36	146