194013

JPRS 83390

3 May 1983

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 186

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LAKE WAY URANIUM DEPOSIT EMBROILED IN ABORIGINAL ISSUE

Canberra THE AUSTRALIAN in English 11 Feb 83 p 5

[Article by Danielle Robinson]

[Text] ONE of the country's biggest companies has slammed suggestions that the Federal and West Australian Governments are conspiring to close down an Aboriginal settlement to make way for uranium mining.

A spokesman for CSR said yesterday that the claim, made by the National Aboriginal Conference, was ludicrous, because the Lake Way uranium project had been shelved indefinitely until market conditions picked up.

The Lake Way uranium deposit, south-east of Wiluna in Western Australia, is near an orchard and emu farm set up and run by Aboriginals outside the town.

The NAC claimed yesterday that government funds for the farm were being cut and several hundreds of Aborigines would be left jobless to allow the project to go ahead.

"From our point of view, their claims are just not true. There is no guarantee that the project will even get off the ground," the CSR spokesman said yesterday.

"The beginnings of the project are so far into the future that the federal cutback in funds to the Wiluna Aborigines and our mining interest can't be related."

Excuse

The West Australian chairman of the NAC, Mr Robert Riley, has claimed that the Wiluna situation was a repetition of Noonkanbah.

An NAC member of the Wiluna area, Mrs Margaret Mallard, said yesterday that the Governments' assertions that the town's emu farm and orchard weren't economically viable was a weak excuse to end the project.

"The State Government is committed to promoting the Lake Way uranium project, which will diminish the area's water table and will create a fall-out hazard," Mrs Mallard said.

"These factors make it essential for the Government to have the Aborigines moved to ease the progress, and to do this, the emu farm and the orchard must be made to look like failures."

But the spokesman for CSR said yesterday that at this stage, the Lake Way project would have been considered for 1989 at the earliest.

CSO: 5100/7521

BRIEFS

NUCLEAR ENERGY PROGRAM--The head of the CNEA [National Atomic Energy Commission], Vice Admiral Carlos Castro Madero, said here that "after the four scheduled plants are built, Argentina should be very close to self-sufficiency in the field of nuclear energy." Castro Madero made this statement in Ezeiza after his return from Canada, where details were worked out for the start of service at the Embalse Rio III plant, and where he also explained "the payment delays" to Canadian firms, because of the "difficult situation in the external sector. The status of our foreign debt has forced us to reschedule our payments, based on the guidelines set up in accordance with the International Monetary Fund," he explained. He pointed out that "the Central Bank does have some funds available and has to optimize their use in the best way possible." He further reported that another reason for his trip was "to lay the bases for completion of the contract, since it is a very long contract, which was signed in 1974, and a number of modifications have been made in it. In this contract," said Castro Madero, "some points were left open which this administration had to complete." In speaking of the Embalse Rio III plant in Cordoba, he said that it will soon be connected to the power system, and in mid-April it will be officially authorized to operate. In closing, he explained that work on the Atucha II plant is proceeding, but at a much slower pace, because of the budget cutbacks which the deficit has required throughout the government. [Text] [Buenos Aires CONVICCION in Spanish 10 Mar 83 p 4] 7679

CSO: 5100/2051

BRIEFS

CANADA OFFERS NUCLEAR ASSISTANCE--The vice president of Atomic Energy of Canada International, Richard Wood, said yesterday that his country is willing to work with Mexico in developing an integrated, independent nuclear program aimed at achieving energy self-sufficiency for Mexico. "Canada does not stand beside Mexico only when it has money," he stated. He pointed out that Canada has not altered its policy of undertaking joint programs with Mexico even though the nuclear program contained in the Energy Plan that the previous administration proposed has been postponed. He stated, nevertheless, that the country would have to study its energy program, mainly in the nuclear sphere, to create a basic infrastructure and thus avoid buying turnkey nuclear plants, that is to say, plants that are 100 percent imported. [Text] [Mexico City UNOMASUNO in Spanish 17 Mar 83 p 8] 8743

CSO: 5500/2059

U.S. NUCLEAR NONPROLIFERATION POLICY VIEWED

BK150426 Calcutta THE STATESMAN in English 6 Apr 83 p 8

[Article by R. R. Subramaniam]

[Text] Nuclear non-proliferation was not one of the priority items on President Reagan's agenda when he assumed office in January 1981. Mr Kenneth Adelman, his nominee as Director of the Arms Control and Disarmament Agency, had in a 1979 study raised the question whether it was in U.S. interest to press countries like South Africa and Pakistan too much on the nuclear issue. Mr James Malone, who headed one of the transition team panels, argued in favour of making a distinction between friends and non-friends.

Of late, however the Administration has begun to focus increasingly on the issue of nuclear proliferation, especially in India and Pakistan. The NEW YORK TIMES published a report on September 21, 1982 that Pakistan had been aided by China to develop a capacity to enrich uranium for weapon use. The WASHINGTON POST said in a report on January 21, 1983 that China had helped Pakistan with advice on making atom bombs.

On February 25, 1983, Mr Howard Schaffer, the Deputy Assistant Secretary of State, in a testimony to the Foreign Affairs Committee of the U.S. House of Representatives, spoke of collaboration between China and Pakistan. He said he would divulge further details only in a closed session.

One is led to ask why an official of the Reagan Administration should choose to make any disclosure on the subject. It is possible that the Reagan foreign policy establishment itself is divided on the question of arms sales to Pakistan. In the U.S. system such differences come out into the open through leakages to the Press and Congressional testimony.

In India the existence of Sino-Pakistani nuclear connexion has been suspected by some since 1980 and it was traced to Bhutto's disclosure in his death cell testimony in which he had referred to an agreement he negotiated over a period of 11 years and concluded in June 1976. Subsequently, Western commentators also mentioned the possibility of an arrangement between China and Pakistan. Mr James Malone, who was U.S. Assistant Secretary of State in charge of nuclear affairs, visited Beijing in

September 1982. In an interview after this visit he alleged that China had been putting nuclear materials into the international market without undue concern about the end-users or about safeguards. With particular reference to Pakistan, he mentioned that China had given Pakistan technical help in respect of uranium enrichment technology.

This was cited as the reason for not proceeding with Sino-American collaboration in the field of power reactors, though an official of the Reagan Administration had stated earlier that the USA would be willing to share power reactor technology with China. The impression was conveyed that the only hitch in the way of this nuclear deal was Chinese refusal to accept IAEA safeguards on the reactor supplied to it.

According to some American Embassy officials in Beijing, Chinese interest in U.S. nuclear technology has not waned: but while China is prepared to sign only a bilateral safeguards agreement, the U.S. Congress is not likely to agree to this arrangement. But there is some support from the Chinese position both in Congress and in the commercial circles involved.

The U.S. Administration's motives in making a disclosure about Sino-Pakistan nuclear collaboration need to be considered against this background. One explanation may be that the Administration wants to apply pressure on China to bring it into an international safeguards system even if Beijing is not willing to join the Non-proliferation Treaty. The Americans could possibly hope that China would accept the guidelines of the London Suppliers Club just as France has done. Apart from diversion of fissile materials from U.S. military nuclear facilities, the French gave Israel the Domona-plutonium production reactor which helped it to manufacture nuclear weapons. The U.S., German and French collaboration enabled South Africa to reach a nuclear capability.

So long as nations pretend to observe the non-proliferation policy both in regard to transfers and to production of nuclear weapons, the U.S. Administration may not be greatly concerned about the actual possession of a nuclear arsenal by some countries. This is what seems to have happened in the case of Israel and South Africa. It is therefore, conceivable that the USA is now keen on getting China into the fold of the London Suppliers Club even if transfer of technology from China to Pakistan has become a fait accompli.

On the other hand, the purpose of the disclosure could be to justify the Reagan Administration's policy to those sections of U.S. opinion which are not in favour of continuing the various kinds of relations with Taiwan at the expense of the regime in Beijing. By this disclosure the Administration may be attempting to give a reply to those who argue that the Reagan Administration is not sensitive to Chinese national interests and perceptions. It is even possible that the Administration has come to the conclusion that China wants to distance itself from the USA and would attenuate its hostility towards the Soviet Union. If that happens, the Administration would like to have adequate justification to explain why it did not make serious efforts to win China over.

At the same time, it is necessary to note that this disclosure came in connexion with testimony on arms supplies to Pakistan. It is, therefore, extremely unlikely that the Administration has not taken into account the possibility of an adverse impact on the U.S. Congress in regard to these supplies. When in December Senator Glenn moved an amendment to the U.S. Arms Export Control Act to bar sale of American defence technology to countries that are likely to transfer it to a Communist country or to any country receiving arms from a Communist country, he named Pakistan and expressed dissatisfaction about the assurances given by Islamabad. He may have been hinting at the possibility of Pakistan transfering sophisticated U.S. technology to China as a quid pro quo for the latters help regarding nuclear weapons.

One must also consider the report in the WASHINGTON POST about India having allegedly considered a plan to destroy Pakistani nuclear installations and then given it up for the time being. More recently, there was a report about reprocessing of spent fuel from the Rajasthan nuclear power plant in the Tarapur reprocessing facility, suggesting that it was intended to acquire plutonium for weapons. This seems to have been a deliberate twist, since U.S. officials cannot be unaware that the plutonium to be obtained from power reactor fuel, though usable for a nuclear explosion, can hardly serve the purpose of making weapons.

One possible explanation is that the U.S. Administration is trying to put pressures on both India and Pakistan to start negotiating a mutual weapon renunciation agreement. This was a favourite idea of the Carter Administration and was repeatedly canvassed by various Pakistani officials as well. If this is still the intention, it might make sense to try to scare India about Pakistan going nuclear with disclosures about Sino-Pakistani nuclear collaboration and to scare Pakistan with reports about an Indian build-up of a plutonium stockpile and Indian plans for a preemptive attack. Yet another possibility is that the U.S. Administration has come round to the view that President Ziaul Haq is still pressing ahead with his nuclear weapons programme and that supply of conventional weapons to Pakistan has not had the expected effect of slowing down the programme.

It is interesting that the disclosure about Sino-Pakistani nuclear collaboration and large scale Arab financing of Pakistani defence purchases were made at the same time. If Pakistan has secured financial support from various Arab countries with assurances about an Islamic bomb, it will be necessary to demonstrate that the bomb has in fact been made. This would call for a nuclear test, which would jeopardize the supply of U.S. military equipment if conducted on Pakistani soil. Pakistan might therefore wish to conduct a test at the Chinese test site and take pictures and other evidence for its Arab financiers. The present U.S. campaign could be an attempt to forestall such a course.

However, it is difficult to be certain that this is the only view in the U.S. Administration or that it is even a dominant view. The views put forward by Mr Adelman in 1979 and Mr Malone may still prevail in certain quarters, in which case the recent disclosures may be designed to mobilize Congressional support against U.S. connivance at Pakistani bomb preparations.

CSO: 5100/4710

DEVELOPMENT OF DOMESTIC NUCLEAR POWER PROGRAM EXAMINED

Nuclear Power Plants

Madras THE HINDU SURVEY OF INDIAN INDUSTRY in English 1982 pp 89-90

[Article by P. K. Iyengar, director, physics group, Bhabha Atomic Research Centre]

[Text] The discovery of nuclear fission reaction and the development of nuclear reactor technology to a stage of commercial deployment in the middle of this century gave hope that the availability of energy resources would not be a serious problem for many centuries by which time alternative sources or technologies could be developed.

Since 1955, nuclear power stations have grown in size from a mere 5 MW of a Russian reactor to the present day units producing more than 1,000 MW.

There are different types of thermal reactors developed to suit the individual conditions in each country. The more important among these are:

Natural uranium, heavy water reactors (Canada, India).

Light water, enriched uranium reactors (USA, Japan, Sweden)

Graphite, natural and enriched uranium gas-cooled reactors (UK, USA, France West Germany).

Graphite enriched uranium, water cooled reactors (USSR).

There are several other varieties. Today there are about 275 power reactors operating in the world producing nearly 155,000 MWe of nuclear power. The question of economy, environment, safety and acceptability by the common man, in addition to some technical difficulties of waste management have led to the evolution of several strategies compatible with national and international requirements.

The progress of nuclear energy in India in the last 25 years has been quite impressive with the build-up of a strong infrastructure to take care of a vigorous future programme. The largest nuclear establishment, the Bhabha

Atomic Research Centre, was set up in 1956 with the commissioning of the Apsara reactor. The other research reactors completed and now in operation are Cirus (1960), Zerlina (1961) and Purnima (1972). The fifth, R-5, is nearing completion. Four thousand scientists and engineers have been trained in the field and are today engaged in various aspects of peaceful utilisation of nuclear energy.

The first nuclear power station at Tarapur (400 MWe) started operation in 1969. The first unit of the Rajasthan power station, a 200 MWe natural uranium heavy water reactor, went into operation in 1973. The second unit of this station went on stream in 1981 and two more power reactors of 235 MWe each are ready for commissioning at Kalpakkam, near Madras. The fourth power station at Narora in U.P., consisting of two 235 MWe heavy water reactors, is under construction and is expected to be completed by 1986-88. Work on a new power station at Kakrapara has begun.

The domestic industry has grown both within the atomic energy organisation and outside in many private and public sector industries. Basic materials like zircalloy, natural uranium and heavy water are all produced in the country. Indian manufacturers have fabricated sophisticated equipment over the last few years. Capability for design and innovation has increased and operating experience has been gained. During this period the nuclear power plants have passed through several critical periods, and problems have been adequately solved. This has contributed to increased confidence in the nuclear area.

While a strong infrastructure for nuclear power has thus been built, experience shows that the capability to build power stations fast enough to make a greater impact on the total electricity generation in the country is questionable. Several factors contribute to this situation. One can see that some of the shortcomings are common with other industries as well. To be more specific, when in the Fifties and Sixties the attempt was to build up capability in the various disciplines of nuclear energy, decisions were made in quick succession, institutions were started and expanded rapidly, and several of them produced results very quickly.

Thus, one can see strong groups in basic sciences, in nuclear electronics, in nuclear fuels, in the applications of radio-isotopes in industry, medicine and agriculture, in the capability of generating manpower for operations, and radiation control in nuclear systems. During the initial years, though the rate of increase in total investments was smaller than at present, there was a dynamism at the decision-making level. This dynamism was less evident in the Seventies as could be seen from the teething troubles one had in the Tarapur and Rajasthan atomic power stations.

It was realised that TAPS, though a turnkey job, involved technology of the first generation and there were design deficiencies. There were problems associated with the interaction between the nuclear power stations and the overloaded grids, with inadequate quality control of imported fuel, and perhaps inadequate operating experience. The project was watched and commented upon by the press and the public who were unable to appreciate the difficulties, considering the nuances of the new technology. However, it must be said to the credit of the scientists and technologists that they overcame all the problems, learnt a lot from the experience and brought the

power station to a state of satisfactory operation.

In the case of the Rajasthan station again, it was built simultaneously with the first of the Canadian power stations. The Indian scientists and engineers learnt as much from the problems encountered in the operation of RAPS I as the Canadians did with their first reactor at Douglas Point. The Canadians had an aggressive plan and built several more systems with improved design but we failed to follow suit. Effort was more concentrated on indigenising the technology, finding proper industrial establishments in the public and private sectors to take up fabrication of nuclear components and equipment. The difficulties encountered in liaising with an industry not used to the demands of a sophisticated technology were sometimes frustrating. Importing and thus compromising between self-reliance and leapfrogging with imported components and systems, was constantly a subject for discussion.

In spite of all these problems, the reactors at Kalpakkam and Narora have made adequate progress and have been based entirely on indigenous fabrication. There are several lessons that have been learnt in the process. While the requirements in electronics, fuel and new materials were adequately met by departmental units like the Electronics Corporation of India Ltd. and the Nuclear Fuel Complex, manufacture of calandria, steam generators, heat exchangers, turbo generators, large-sized motors and pumps had to come from the engineering industry. There were inordinate delays in the fabrication and supply of some of these equipment and quality control was poor. These led to cost escalation of the projects.

In retrospect, while one may be satisfied with the technical progress, one may not be as happy with the results in toto. So far nuclear power has made only a marginal contribution to the total electricity generation and the experience with nuclear power has dampened the enthusiasm for a more aggressive rate of growth for the future in certain quarters. In one or two specific areas such as the production of heavy water, there have been shortcomings which have seriously affected the nuclear power programme and the nuclear industry.

Need for different management philosophy

But it must be said that with renewed emphasis on a more progressive management policy, the rate of introduction of nuclear power could be enhanced. The management of a frontier technology with timebound programmes and of the supporting research and development cannot be done by following the rules and regulations laid down primarily to ensure financial disciplines in the execution of large conventional civil engineering type projects. Decision making through stratified committees centering on finance has affected decisions on technical aspects. Intuitive individual technical judgment based on experience is still dependable and essential in arriving at decisions in a project involving frontier technologies. The management philosophy has to be different for decisions arrived at and recommendations made after careful consideration at the highest level of technical and scientific management should not have to be screened again from the lowest levels of the administrative secretariat.

Dependence on single type

The Indian nuclear power programme is handicapped by its total dependence on a single type of nuclear power reactor, namely, the pressurised heavy water reactor system. In other countries, there has been concurrent development of more than one system.

In the United Kingdom, while the graphite moderated magnox reactor formed the bulk of the power stations in the Sixties, in the Seventies it had gone over to advanced gas-cooled reactors of larger capacities, and now the pressurised water reactor is under serious consideration for the stations to be built in the Eighties.

These developments have been possible because of the availability of low enriched uranium and the ability to borrow technology as a part of international trade. These decisions are also made possible by a large programme of construction and operation of several reactors of each type. Generally the changes involve considerations based on economics, larger sizes and standardisation. The older models continue to operate efficiently and generate power at competitive costs even today.

France again started with gas-cooled reactors and changed over to the pressurised water reactors, while at the same timedeveloping its own expertise in fast reactors. It is the most advanced country in fast reactor technology having had experience of operating a power station Phoenix and building a Super Phoenix of 1200 MWe. France today gets 40 per cent of its power from nuclear stations, which has enabled it to cut down its import of oil.

India is the most developed in

nuclear sciences among the developing countries. It has had experience in indigenously fabricating 200 MW reactors. It has under control the entire fuel cycle from mining of natural uranium, processing of zirconium, fabrication of zircalloy components, and building fuel reprocessing plants to extract the plutonium. It has experience in operating power stations connected to weak grids and can take adequate precautions and safety measures for the smooth operation of reactors. It is in fact well poised to undertake export of small-sized nuclear reactors to other developing countries even though the present system as such may be looked upon as more complicated than necessary.

Fast breeder programme

A Fast Breeder Test Reactor is being built at Kalpakkam which will go into operation in 1984. Based on the experience gained and the technologies developed in the construction of this 15 MWe reactor, steps have been taken to design fast reactors of 500 MW capacity which could be built in the Nineties. However, each fast reactor requires an initial inventory of plutonium of the order of four kg per MWe. It is doubtful if such large quantities will be available from the Indian power programmes, taking into consideration the fact that each heavy water power reactor hardly produces 60 to 80 kg of plutonium a year.

The reprocessing technology is of foremost importance in the fast reactor programme. The growth of this technology has suffered on account of extraneous factors such as international clubs, inspection and safeguards. However, it is clear that the entire future of nuclear power, and therefore the availability of electrical energy, depends on the reprocessing of irradiated nuclear fuel and thus converting fertile material to fissile material. Fortunately, India has had an early beginning in this technology, but the tempo must be maintained in order to make use of the resources of uranium and thorium early enough in our nuclear energy programmes to make an impact. Otherwise, just as the heavy water constraint delays our progress now, inadequate availability of plutonium will hamper the nuclear power programme in the Nineties and beyond.

Heavy Water Production

Madras THE HINDU SURVEY OF INDIAN INDUSTRY in English 1982 pp 91, 95

[Article by N. Srinivasan]

[Text] ENRICHMENT has been achieved in the industrial scale heavy water plant at Kota using the hydrogen sulphide-water exchange process. A recovery efficiency of 70 per cent deuterium has been achieved in the ammonia-hydrogen exchange-based heavy water plant at Tuticorin. When a couple of tubes in the high pressure ammonia cracker of Tuticorin gave way the cracker was shut down in a safe manner and with no panic or damage to equipment.

Two new plants, one of each process, are coming up entirely on our own responsibility. We are in the initial stages of scaling up for even larger plants and for plants independent of fertilizer units. All this has become possible thanks to the intense efforts of the Department of Atomic Energy despite many frustrating problems.

No doubt, expectations regarding production of heavy water for the immediate nuclear power programme have not been realised in practice. But in retrospect it is clear that too much was expected too soon from the current plants. The technologies were new and untried in India. Constraints in information flow and equipment purchase have been many.

The best course will be to benefit by our hard earned experience, solve the problems that have arisen and those that are bound to come up in the existing plants and maximise production. In the event, the limitations of these plants, external or internal, may be such that the plant utilisation may fall short of rated capacity considerably. Since the capacities of the plants are not very large this eventuality would not involve a long-term adverse effect on the programme. There, of course, is a short-term handicap to the programme. The bulk of the requirements for the long-term power programme will be met from the newer plants, larger in size and better optimised for efficiency and capacity utilisation.

The present concern is to be able to have enough installed capacity to meet the increasing demand and to set up these plants at acceptable capital costs and to produce heavy water at reasonable prices.

Cost factor

When nuclear power plants were estimated to cost $200 per kilowatt and power was estimated at a few mills per kWh, heavy water cost was quoted as $28 a pound. Today these figures have become outdated. For the heavy water-based reactors, the capital and production costs of heavy water are of great economic significance. It is seen that for a given MWe of installed capacity in nuclear power the capital investment in the heavy water plant is about 40 per cent of that on the power plant. Every Rs. 1,000 of the cost of heavy water contributes 2.5 paise to unit cost of power.

For the 10,000 MWe programme, investment in the heavy water plants could be in the neighbourhood of Rs. 3,000 crores over two decades. A cost of Rs. 4,000 - 5,000 per kg for heavy water is not improbable and will account for 10-12 paise a unit.

Heavy water plants are capital-intensive and are sensitive to cost escalation. Hence there is need for continuous review of design and engineering to compensate for cost increases due to escalation. Scaling up and simplification of design for reducing capital costs and improving the availability and efficiency by proper engineering are two directions in which the problem has to be approached.

Our experience with the plants in operation and under commissioning has made long-term planning possible. In the design of the plant coming up at Thal Vaishet, steps have been taken for the conservation of deuterium in the syngas. In addition, coordination has been ensured with the ammonia plant during construction and later in operation, by appropriate organisational arrangements.

Manuguru project

In the design of the Manuguru plant in Andhra Pradesh based on hydrogen sulphide-water exchange process, all the modifications that have appeared necessary and advisable in the commissioning of the Kota plant are being incorporated. For the distillation unit a larger plant based on the design developed at the Bhabha Atomic Research Centre is being set up. A captive power plant will ensure high availability.

The question often asked is why both processes are being pursued in spite of the success elsewhere of the hydrogen sulphide-based plant and the problems and limitations of the ammonia-hydrogen exchange process based on synthesis gas from fertilizer plants. The concern is about the large volume and the toxic and corrosive nature of hydrogen sulphide. With stricter pollution limits the hydrogen sulphide-based plants could become uneconomical or even unacceptable. Hence the need for an alternative which does not have the same type of limitations. The ammonia-hydrogen-based plant is an elegant alternative if it can be made independent of a fertilizer plant.

Any technology is developed through various stages, namely laboratory experimentation, pilot plant and prototypes. Even so, they become techno-economically viable only after two or three plants are operated on an industrial scale and all the operational problems are identified to optimise for availability and efficiency.

In the case of heavy water plants based on ammonia-hydrogen exchange we have not had the benefit of any of these stages of development nor have we the advantage of the experience of others. Despite this handicap, the technology has been sufficiently absorbed to enable us to design a large-scale industrial plant at Thal on our own. To some extent, the problems encountered in operation so far have helped us in ensuring at the design stage that such deficiencies are corrected. It is, therefore, a matter of credit for Indian engineers that this process is coming of age much faster than other areas of technology in spite of the serious limitations on information and experimentation.

Indigenous effort at Kota

There is an impression that technology for the Kota plant was availed from the Canadians probably because at the early stages of the project the engineering consultants were associates of a Canadian company. In this connection, it should be recalled that this company was replaced by an Indian company soon after commencement of the project and the Indian consulting company guided by the scientists and engineers of DAE provided the engineering. **At no stage was there any Canadian involvement with the project nor was any information made available for the design from anybody outside the country except what used to be published and what information was gathered during visits to facilities abroad when such visits were not prohibited.**

It is this experience of having to depend on our own resources for design and engineering for this plant that has made it possible for the department

not only to undertake the setting up of a large plant at Manuguru with substantial modifications as in the distillation unit but also attempt scaling up the capacity for the future on our own with the aid of Indian consultants.

One often comes across uncomplimentary reference to the heavy water programme. It must be realised that under normal circumstances, the programme would not have been undertaken at all on account of the tremendous constraints under which it has to be developed. This would have meant the end of the nuclear power programme unless the country is willing to accept safeguards with all its unpalatable implications. In spite of the many difficulties in the current phase of the programme there is enough confidence to attain self-sufficiency in this strategic material in four or five years.

Self-Reliance Urged

Madras THE HINDU in English 5 Mar 83 p 8

[Editorial]

[Text] INDIA'S NUCLEAR ENERGY programme has reached a sensitive stage where its progress depends critically on a set of interrelated — and demanding — policy decisions and actions that wait to be taken. Thanks to the early start, the steady and incremental build-up of the technical as well as industrial capability as a matter of national policy and the evolution of a sound long-term fuel cycle strategy, it ranks (along with China's military-oriented programme) as the developing world's pre-eminent nuclear energy venture. In addition, there are complex technical areas such as reprocessing and waste disposal where its expertise could conceivably be exported in future even to parts of the developed world. Programmatically, the investment, the comprehensive and rounded approach to the peaceful uses of nuclear energy and the self-reliant thrust have clearly paid off. As the head of the atomic energy establishment, Mr. H. N. Sethna, recently summed up the experience in Madras: the founding genius of a Homi Bhabha far-sightedly lay the stress on self-reliance (as distinct from self-sufficiency or autarky), a goal that has imposed a number of problems and frustrations, but has guaranteed the integrity and future of the programme. "There have been occasions when we have deviated from the policy of self-reliance and indigenisation... we are now in a position not to have to deviate from the policy... which has caused a large number of problems for the programme of the Department and brought a tremendous amount of criticism over its failures in terms of delays in its implementation... (Nevertheless) but for our equipping ourselves over two decades to be on our own, the nuclear power programme would not have continued except under unacceptable and humiliating conditions of external extraterritorial supervision infringing on our sovereignty".

True, and for this the scientists and technologists in the field — as distinct from some political decision-makers who have, especially over the past half-decade, shown signs of vacillation — must be given the credit. Yet a self-critical look would also demonstrate that the Indian nuclear programme needs to be revitalised and the quality of its management and planning upgraded as a priority task. Take the power generation effort, the undisputed core of the nuclear energy activity (as matters stand). The paradox is that India is perhaps the only developing country that designs, fabricates and builds its nuclear power reactors entirely through its own effort — and yet the current contribution of the nuclear component to overall power generation is, at best, marginal. The pace of progress in the heavy water production programme, on which the current strategy vitally depends, is seriously disappointing. A view expressed by some experts recently (see, for example, Dr. P. K. Iyengar's article in THE HINDU's 1982 Survey of Indian Industry) is that "the Indian nuclear power programme is handicapped by its total dependence on a single type of nuclear power reactor, namely the pressurised heavy water reactor system. In other countries, there has been concurrent development of more than one system". The suggestion is that where international nuclear export policies allow, it might be advantageous to consider the acquisition of new types of nuclear power systems, including of the light water variety. The Government of India is reported to have under consideration the Soviet offer of an advanced large-size (going up to 1000 MW) nuclear power system. The point is that while propositions of this kind might meet the requirements in one respect — not merely the task of power generation but also the business of upgrading the level of India's reactor systems — they have to be carefully evaluated to see if they put pressure at the points where the self-reliant thrust comes up against the discriminatory and hostile "non-proliferation" environment. Therefore a difficult balance has to be struck with due weightage, of course, assigned to the expert points of view. This problem aside, there is a significant gap in India's (otherwise comprehensive) approach to the *nuclear fuel cycle* — defined in the IAEA's safeguards glossary as a system of nuclear installations, interconnected by a stream of nuclear material, encompassing uranium mines, ore-processing plants, conversion plants, enrichment plants, fuel fabrication plants, reactors, spent fuel storages, reprocessing plants and associated storage. Given the mature phase of the national effort, the likely requirements in the future and the uncertainties of external supply of enriched uranium, it is certainly time to make an unapologetic and serious start at building systems for the enrichment (low as well as high) of natural uranium. Simultaneously, the technology of reprocessing — of central relevance to the Indian fuel cycle strategy — must be developed without paying too much attention to the outcries of Western non-proliferation warriors who cannot answer elementary questions about why India should be denied this route while, say, Japan can be helped along it.

CSO: 5100/7074

FRANCE'S STAND ON NUCLEAR AID WELCOMED

GF121802 Islamabad THE MUSLIM in English 31 Mar 83 p 4

[Editorial: "French Nuclear Policy"]

[Text] Mr. Claude Cheysson, the French foreign minister currently visiting Pakistan, has reaffirmed the right of any African or Asian country to develop nuclear technology for peaceful purposes. Mr. Cheysson admitted to having discussed the question of cooperation in the nuclear field, as well as support to Pakistan's nuclear programme during his talks with the foreign minister, Sahabzada Yaqub Khan. The minister clarified that it had been decided by both sides not to make the outcome of the talks on the subject public, but the talks on the question of stopping the supply of a French nuclear reprocessing plant to Pakistan are expected to be continued.

Mr. Cheysson has asserted that his country has not always had the same approach to the nuclear issue as the United States. But it will be recalled that it was primarily due to American pressure that France reneged on its agreement with Pakistan to supply a nuclear reprocessing plant in 1978. Conversely, France has been actively encouraged by the United States to step up nuclear cooperation with India, including the provision of enriched uranium for India's Tarapur nuclear plant.

The statement of the French foreign minister is to be welcomed as a reaffirmation of French commitment to an independent stance in its foreign policy vis-a-vis Third World countries. As France is aware, Pakistan is in desperate need of adequate energy for the uplift of its industrial and rural sectors. Pakistan's nuclear plants are checked periodically by representatives of the International Atomic Energy Agency which has so far not found any reason for complaint regarding conformity to the prescribed safeguards. Pakistan has always maintained that its nuclear programme is for peaceful purposes only and we hope that France will recognise Pakistan's intention and agree to a positive cooperation in this field.

CSO: 5100/4709

KOEBERG ATTACK, SOUTH AFRICAN NUCLEAR CAPABILITY EXAMINED

London SECHABA in English Feb 83 pp 20-23

[Text]

At 3.23p.m. on Saturday, 18th December 1982, an explosion occurred on the site of the Koeberg nuclear power station in Cape Town. Escom later announced that it had taken place in a 'nuclear auxiliary' building. A second explosion shook the same building at 8.36 p.m. There were two further blasts, one at 11.24 p.m. and one at 2.53 a.m. on the Sunday morning. The police will not state where the last two explosions took place, but admitted that one was about twenty metres from the reactor itself. The head of the security police, Lieutenant-General Johann Coetzee, came in to supervise the investigations. The ANC claimed responsibility for the attack, and neither Escom nor the police have been able to deny that sabotage was the cause.

South African nuclear capability

From the beginning, publicity and protest surrounded the plans for the Koeberg reactor. From the beginning, the ANC took an uncompromising stand on the whole question of South African nuclear capability, declaring that the regime intended to use this capability for purposes of war.

A variety of other voices was later added to that of the ANC. In 1979 Leslie Harriman, Nigerian Ambassador to the United Nations protested, accusing the British Government of collaboration in South African nuclear projects. Later, a retired nuclear engineer named J.W. Vogt wrote an open letter to the South African Minister of Mines and Energy, questioning the secrecy that surrounded the plans of the Koeberg plant, since, he claimed, there were no secrets about nuclear power plants. When a representative of the conservationist organisation, Friends of the Earth, visited Koeberg in July 1981, he said that the 'tenuous political situation' in South Africa made the use of nuclear energy 'inherently risky.'

In spite of the apartheid regime's frequently reiterated claim that the Koeberg plant was nothing more than a power station for providing electricity, there is ample evidence to support the opinion of those who have been opposed to letting nuclear power fall into the hands of the South African racist government.

Two years before, the South African Prime Minister had told a press conference for military correspondents that South Africa was able to build nuclear weapons, but intended to use this capability for peaceful purposes only. Various experts agreed with the Prime Minister in his estimate of nuclear technology in South Africa, but many had serious doubts about his promises of peace.

In 1981, Dr George Whitman, director of the Defence Issues Programme at the Hudson Institute, told a conference on South Africa and the World that South Africa was likely to acquire nuclear weapons, or the capacity to assemble them at short notice. In the same year, Dr Frank Barnaby of the Stockholm International Peace Research Institute said that South Africa should be regarded as a nuclear power, which could manufacture nuclear weapons if it had not already done so.

Testing of a nuclear device

All evidence seems to point to South Africa's having produced and tested a nuclear device long ago. In 1979, the ANC published maps which showed that, as early as 1972, the Atomic Energy Board (a state-owned corporation) was concerned to identify areas of the country in which it would be possible to detonate nuclear devices.

In September 1979, an unannounced flash in the South Atlantic was picked up by both Soviet and US satellites. Though the South African regime denied having detonated any nuclear device, both Moscow and the US State Department confirmed that this flash had been an atomic explosion.

There is plenty of evidence to show that the apartheid regime is lying when it claims

that the nuclear energy it controls is intended for peaceful purposes only. South Africa is rich in coal, used as the fuel in conventional power plants. In fact, South Africa is at present exporting coal, and Escom is at present constructing no less than four giant, coal-using power stations, one of which is to be the biggest in the world. There is also some hydro-electricity in the country. It is unnecessary to provide a form of energy that the country already possesses in plenty.

Increasingly war-like stand

A sinister factor in this situation is the increasingly warlike stand the South African regime has taken, and the obvious preparations it has made for war. In the last few years, Armscor, another state corporation, has become the biggest arms manufacturer in the southern hemisphere, and has begun to export arms. In 1979, it announced the development of a new missile, which it claimed was the most sophisticated in the world at that time.

Magnus Malan, chief of the South African Defence Force, has alleged that South Africa is in danger of attack. Other regime spokesmen have talked about the 'total onslaught' they allege is being made on South Africa, and the 'total strategy' the regime needs to pursue in order to maintain itself. The apartheid regime and its allies have shown an increasing concern over control of the Cape sea route, and increased budgetary expenditure was called for in order to increase naval defences in Durban. South Africa has continuously and viciously attacked Angola over the past few years, as well as attacking over the borders in Mozambique and Lesotho, and announced its intention of 'destabilizing' neighbouring independent governments. The National State Security Council, responsible only to the Prime Minister, has grown in power and importance, and the regime is now preparing legislation to enable the State President to declare war without reference to Parliament, and even to suspend Parliament altogether.

Western military collaboration

In 1979, the question was raised in the United Nations as to how South Africa had managed to acquire a nuclear capability. The ANC has brought forward a great deal of evidence to prove the collaboration of the Federal Republic of Germany, Israel, Britain and the USA. The steam generator for Koeberg was built in France, in 1981 the delivery of a 900 megawatt French reactor to South Africa was confirmed, and the fuel rods for Koeberg are at present being manufactured in France from uranium originally intended for a Swiss power station. It is beginning to seem that there is collaboration with Taiwan also. The US trained twenty more nuclear scientists from South Africa in 1981, and President Reagan has now approved collaboration in what he calls 'non-sensitive' nuclear matters.

Nevertheless, it seems that world protest was enough to prevent other countries from collaborating with South Africa too openly, and to prevent South Africa from getting all the enriched uranium it wanted through legal channels. This was possibly the reason for South Africa's decision to go it alone, and produce enriched fuel locally. If we are able to believe a statement made in mid-1981 by Ampie Roux, it seems that the resistance of our people within the country has served to discourage collaborators, for he claimed that as a result of the uprisings of 1976, a German firm had withrawn from partnership with Ucor, and that South Africa had therefore 'lost its chance to produce enriched uranium on a world scale.'

Safety Precautions

The secrecy surrounding the construction of the Koeberg reactor made it impossible for the public to feel any kind of certainty about the safety precautions there, and the *Rand Daily Mail* reported that Ampie Roux was not available for comment about where waste products were to be stored. In

November 1982, Escom fell into line with the requirements of the Atomic Energy Corporation by opening a special treatment centre for Koeberg employees who fall victim to radiation. However, this unit is equipped to handle only five victims at a time. A statement made at the time by Dr B de Villiers, medical officer for Escom, further exemplifies a cynical disregard on the part of Escom for the safety of its employees. He said that the best advice he could give the public for treatment in the event of an overdose of radiation was that they should 'go and swim in the sea,' and wash themselves in the largest amount of water they could find. It is, in fact, also necessary to get rid of all clothing worn at the time to irradiation, to scrub the skin all over, to cut back hair and nails, and as medical officer he certainly knows this; but he ommitted to give these extra, vitally important, pieces of advice.

In July 1982, more fears were expressed about the safety of the plant, when it was revealed that there had been a fire there. Later, the authorities admitted that there had been an explosion as well as a fire, in the 'nerve centre' of the whole complex. The ANC claimed responsibility for the explosion, in a broadcast from Ethiopia, but a spokesman from Escom denied that there had been any possibility of sabotage. There can be no doubt this time, and there have been no denials.

Our people's army fights on

After the murderous attack on our people in Maseru, made by the army of the South African regime on the 9th December 1982, eve of Human Rights Day, South African Defence Force spokesmen claimed that it had been a 'pre-emptive' strike to prevent the army of the ANC attacking South Africa over Christmas and the New Year. 41 of our people in Maseru died; but the units of Umkhonto we Sizwe were not prevented from attacking installations in South Africa. The Saturday of the Koeberg explosions was the very day on which the victims of the Maseru massacre were buried, and previously, on the 14th December, the ANC attacked the Escom station at Ennerdale in the Transvaal. On the 23rd December, there was an explosion in an electricity sub-station on the West Rand, which the security police have explained by saying that a transformer overheated, and set alight to two others next to it. Early in January, there was another explosion, at the Magistrates' Court in Johannesburg.

The heroic work of our people's army goes on, and the attack on Koeberg, above all, proves that we are capable of penetrating the security of what is clearly a military installation, and the most closely guarded of all South Africa's installations. As the ANC said in a statement made on the 19th December from Dar es Salaam, this should be a warning to foreign investors not to invest their money in South Africa, for no plant is safe from the units of MK.

Note: State-owned corporations involved in the Koeberg installation are:
Escom – the Electricity Supply Commission
AEB – Atomic Energy Board
Ucor – Uranium Development Corporation
In 1981, Ucor and the AEB were joined under one administration.

CSO: 5100/32

LACK OF FUNDS IMPERILS FAST BREEDER, HIGH TEMPERATURE REACTORS

Hamburg DER SPIEGEL in German 4 Apr 83 pp 66-71

[Text] That which environmentalists could not pull off with all their protests is now becoming possible because of a lack of money: The cancellation of the fast breeder at Kalkar and an end to the high-temperature reactor at Schmehausen.

At the Juelich nuclear power facility, North Rhine-Westphalia science minister Hans Schwier paid tribute to a renowned physicist. He solemnly decorated Prof Wolf Haefele with the Federal Service Cross.

This ceremony was not greeted with applause alone. The Federal Association of Citizens' Initiatives on the Environment congratulated the professor on being awarded the "most expensive Federal Service Cross of all times." The environmentalists said on the services of this scholar: "It is owing to his untiring work that the fast breeder at Kalkar has not yet been mothballed."

Indeed, this is what Wolf Haefele, who likes to be called the "father of the breeder," has succeeded in doing: In fascinating the politicians with the idea that the energy problems of the future can be solved with the controversial breeder technology. With its very first charge of nuclear fuel, the promise goes, the fast breeder will someday "breed" more fissionable material, in the form of plutonium, than it uses itself for electricity generation.

Although the price for this gigantic nuclear project has skyrocketed in the course of the year from 500 million marks to about 7 billion marks, and although the completion of the construction has continued to be delayed year after year, the politicians of the former Bundestag parties have stood by their breeder unswervingly.

The realization as to what sort of venture they had let themselves in for dawned on the research ministers of the SPD-FDP coalition only after they had lost office. He had just been moved up to the office of finance minister when former research minister Hans Matthoefer (SPD) lamented the decision he had made back in 1977 to not discontinue Haefele's breeder. That had been his "greatest political mistake," he said.

After only a few months in the opposition, the last Social-Democratic research minister, Andreas von Buelow, astonished the public with no less than a confession that he would not invest a single mark more in Kalkar from now on. The financial risks are incalculable, and the economic benefit is dubious, he said.

The incumbent research minister, Heinz Riesenhuber (CDU), did not learn anything from such belated realizations of his predecessors, and after the change in government he behaved like his Social-Democrat colleagues: Since the installation of the CDU/CSU-liberal coalition, Riesenhuber has begrudgingly signed checks, which are nonetheless valid, amounting to about 1 billion marks, for the Kalkar billion-mark sepulcher.

Tax monies have come in rapidly and in abundance, although Riesenhuber does not know either whether the breeder will ever be completed. As before, at least 1.5 billion marks are lacking, and as before there is no telling how much this enormous nuclear machinery will finally cost.

Like his predecessors, Riesenhuber is forced to beg the managing boards of the electricity enterprises for money for the breeder. But so far, the heads of the electric-power concerns are showing just as much reticence towards the Christian Democrat as they did towards Social Democrat von Buelow. Even after the election victory of the business-friendly coalition, their readiness to contribute has not grown in the least.

The nuclear and electric-power concerns believe themselves to be in a good negotiating position in every respect vis-a-vis the research minister. Riesenhuber has to negotiate under extreme pressures of time. If the entire financing is not in place by the beginning of May, a decision on discontinuing the breeder construction will be superfluous: Since no more money is at hand, then nothing more will happen in Kalkar in any case.

Even as he assumed office it was clear to Riesenhuber that his chances of wheedling money for the breeder out of the ostensibly so interested electric-power producers would decline with each mark spent on construction at Kalkar. As more and more tax money is spent, the politician Riesenhuber becomes less and less able to threaten convincingly and without loss of face that the breeder will be abandoned.

The total costs for this lump of concrete on the Rhine are currently estimated at 6.9 billion marks. Many experts regard this figure as too low still. But at present, 1.5 billion is still lacking from even this 6.9 billion marks. Finance Minister Gerhard Stoltenberg is firmly resolved to keep a tight rein on his colleague Riesenhuber in the budget negotiations. In the year 1984 at least, the research budget is supposed to contract slightly in real terms.

Riesenhuber now sees the risk that eventually his ministry may have only enough money to pay for the breeder and the second experimental reactor, the high-temperature reactor in Schmehausen of Westphalia. In that case, the research ministry would again turn into what it once was at the beginning--strictly a nuclear-power ministry.

"I do not want that, and I do not fear that," says Riesenhuber bravely. He says that there is a limit beyond which he does not see any chance for financing the breeder: "But where this limit lies, I am not saying right now."

"The minister was saying more to the representatives of industry. They tell about his proposal: 25 percent of the missing 1.5 billion should be paid by the electric-power concerns, which would pass this on to their per-kilowatt rates, some 3 percent should come from the breeder manufacturer, the Siemens subsidiary KWU [Kraftwerk Union], and 7 percent could be supplied from the investment allowance of the finance minister.

Some 65 percent, or about 1 billion marks, would still remain for the research minister to pay. Riesenhuber's party colleague Lutz Stavenhagen, a breeder expert sitting on the research and budgetary committees, says about this division: "It is not very neat, but it is feasible."

Even now, the research minister is spending annually about 1 billion marks solely for nuclear energy from his budget of 7 billion marks. If industry were to accept his distribution of burdens, Riesenhuber would have to increase this sum again by 200 million annually up to 1987.

Before doing this, Riesenhuber wants to have reliable information from industry on whether the 6.9-billion cost framework can be adhered to, and whether or not permanent operating losses will arise. The Christian Democrat believes quite rightly that the firms involved can "make this clear" only "by making commitments on the underwriting of these costs." Otherwise, the finance minister will "raise very critical questions."

Such critical questions do not impress the sharply calculating leaders of these concerns as much as they do the minister. The electric-power managers have an only limited interest in the breeder.

They have been aware for a long time now that not even in the year 2050 will breeder technology be producing electricity cheaply enough to cover costs. They were interested in the breeder reactor only so long as they could get the State to finance almost entirely this risky research toy.

The expert with the Union parties, Stavenhagen, also assumes that the electricity managers would not particularly regret the demise of the breeder. They can put the blame for the bad investment on the politicians. Stavenhagen: "They are just waiting for this chance!"

Meanwhile, even CDU/CSU politicians are having doubts about the usefulness of the breeder and of the high-temperature reactor, which carries a price tag of 4 billion marks itself. Follow-up projects for the two demonstration facilities are not in sight. From the Union's point of view, the only thing speaking in favor of continued construction is primarily the consideration that a halt would not come much more cheaply than its completion.

"If we were confronted once again with the decision to begin on it," says Stavenhagen, "then we would see the matter differently."

That is probably true also of the high-temperature reactor. The urgently needed 510 million marks for the continued construction of this facility at the eastern end of the Ruhr area are supposed to be covered by a loan from the High-temperature Nuclear Power Plant GmbH, which wants to produce the electricity. This "operator company" will lend the millions only if the Federal Government vouches for it. But there is a hitch with this.

Both the economics minister and the finance minister are balking at any surety, however. The two ministers complain that it has not been made clear how the reactor is to be financed up to its completion.

"A solution is feasible only through a political crash campaign undertaken promptly on the leadership level," challenge the officials of the research ministry in an internal memorandum to their chief.

This campaign would have to be directed at the High-temperature Nuclear Power Plant GmbH. This enterprise, the property of the electric-power producers, is to operate the Schmehausen reactor in days to come. Moreover, it would also have to address itself to the "High-temperature Reactor Construction Company" (HRB). This firm, in which the electricity outfit BBC [Brown Boveri & Cie.] has a 55-percent ownership share, is building the demonstration project.

The officials are accusing the electricity enterprises of not showing any concrete intentions to have a follow-up project at their own expense. But as BBC board member Wolfgang Mattick recognized and heralded as long ago as in November 1981, without such a follow-up project there is no point in completing this facility.

In addition, "because of the attitude shown hitherto" the Riesenhuber experts also doubt whether the electricity firms "will operate the prototype reactor with the requisite commitment." But, they say, a lack of commitment can affect the operating results and thus have an influence on the "availment of the risk-participation contract and the repayment of the guaranteed loan."

In plain words: Assuming that the reactor does go on line, the officials are afraid of large government subsidies.

Even more severe is the scolding given to the construction company, the BBC subsidiary HRB. "By and large the impression has prevailed," they are saying about a talk with BBC board chairman Herbert Gassert, "that the BBC would get out of the contract if this could be done without a loss in money and reputation."

The temptation for those in charge of the Mannheim undertaking is great enough. According to the supply contract, if there were a stop to construction work at the high-temperature reactor, the BBC group would have to pay only 20 million marks more. On the other hand, they will have had to contribute over 100 million marks more by the time the project is completed. The conclusion of the Riesenhuber experts: "The risk for the high-temperature reactor cannot be calculated."

In case the many imponderables connected with the high-temperature reactor and with the fast breeder lead to the premature stopping of construction, Minister Riesenhuber could turn to the firm of Miller & Miller, auctioneers in Fort Worth, Texas. From 4 April on, this enterprise will be running "one of the largest auctions in the world."

In Surgoinsville, Tennessee, Miller & Miller are auctioning off the Phipps Bend boiling-water reactor, which had been 1/3 completed, along with equipment and material valued at $2 billion. The owner, the Tennessee Valley Authority, has reached the conclusion that it no longer pays to continue the construction.

Perhaps the experiences of Miller & Miller with the cut-price selling of uncompleted reactors could be useful to Riesenhuber soon.

12114
CSO: 5300/2645

COMMITTEE PROPOSES FIFTH NUCLEAR PLANT BE BUILT IN 1990'S

Helsinki HELSINGIN SANOMAT in Finnish 31 Mar 83 p 21

[Text] The Electricity Supply Advisory Committee is urging that a new nuclear power plant be built.

A proposal for a fifth nuclear power plant is included in the general electricity supply plan drafted for 1983-1992, which was submitted to Commerce and Industry Minister Esko Ollila (Center Party) on Wednesday.

According to agency head Esko Ylikoski, who is serving as chairman of the advisory committee, nuclear power was decided on especially because it is economical.

In the advisory committee's economic comparison, the nuclear power program clearly proved to be the most economical. According to advisory committee calculations, putting a power plant into operation by 1990 would enable us to achieve national economy savings at the rate of 600 million markkas a year.

On the basis of the advisory committee calculations, nuclear power may be considered to be a third more economical than the coal alternative. According to the advisory committee evaluation, a nuclear construction program for 1989-2000 would be 2.413 billion markkas cheaper than a coal program in terms of total costs.

It is estimated that the total investment for a 500-Mw coal-powered plant would come to 3 billion. Despite the lower cost of the investment, the high cost of fuel would rob the plant of its ability to compete. According to a comparative estimate, 7.5 billion would have to be invested in a nuclear power plant before it would match the price of the coal alternative in terms of economy.

In the opinion of the Electricity Supply Advisory Committee, the new nuclear power plant should be operational by the early 1990's.

If construction on the nuclear power plant were to begin this year, the plant could be in operation by 1990. The project would require investments totaling 6 billion markkas between 1983 and 1991. Its immediate effect on employment would be 16,000 man-years and the biggest year would be 1985 with 3,830 man-years.

The Electricity Supply Advisory Committee has not taken a stand on the location of the nuclear power plant. The power plant would be built with Teollisuuden Voima (TVO [Industrial Power Company]) in cooperation with Imatran Voima (IVO [Imatra Power Company]). According to the preliminary reports, about 70 percent of the entire project would be handled by the domestic economy.

Council of State Will Approve

The electricity supply general plan will be approved in the Council of State and it will be the basis for granting permits in accordance with the electricity law for the construction of power plants.

According to Ollila, the present government will probably not have time to discuss the advisory committee proposal. In no event will the government take a stand on the design for the nuclear power plant.

As far as a decision on the power plant is concerned, there is, in his opinion, reason to expect that the preparation of reports will be one of the conditions in the energy policy program. Ollila also believes the new government will expect that these reports be prepared before it begins to deal with the nuclear power plant issue.

The Council of State appointed the Electricity Supply Advisory Committee in July 1980. Electricity producers, power plants, the national administration and consumers are represented on it.

2.5 Billion for Other Power Plants

The total consumption of electricity will rise to 70 billion kwh in Finland by the year 2000. By the end of the planning phase of the general plan in 1992 total consumption will be 60 twh (terawatt hours) or 60 billion kwh, the Electricity Supply Advisory Committee estimates. Last year Finland's electricity consumption came to 41.8 twh.

Taking into account a reserve power capacity of 17 percent, total requirements in terms of power production capacity and imports will amount to 12,000 Mw by 1992. Including already completed power plants and those under construction, the capacity is now about 10,900 Mw.

The advisory committee stated that, in addition to the nuclear power plant, construction of new plants guaranteeing us a total peak capacity of 580 Mw would be set in motion between 1983 and 1985. Investments in these plants would total about 2.5 billion markkas.

In addition to the construction program proposed by the advisory committee, it is estimated that it would be possible to build up a supplementary capacity of 450 Mw between 1986 and 1992. Together with the current large amount of electricity that is imported, all this would be sufficient to satisfy the demand for power until about 1991, by which time at the latest the nuclear power plant must be gotten into operation.

The advisory committee proposes that construction begin on the next over-10-Mw power plants by 1985. Power plants to supply heat would be built at Vaasa (160 Mw), Tampere (60 Mw), Kajaani (30 Mw), Kuusankoski (30 Mw), Forssa (15 Mw) and Pori (60 Mw). Kemira in Pori, Metsa-Botnia in Aanekoski, Neste in Porvoo and Tervakoski Oy in Tervakoski would build plants to supply power for industrial processing. It is proposed that water power plants be built at Portimonkoski on the Tengelio River (10 Mw), Kyroskoski on the Pappila River (11 Mw), Kurittukoski on the Kitinen (13 Mw), Kollaja on the Ili River (40 Mw) and Raasakka (22 Mw).

The advisory committee proposes that power lines and transformer stations be put into operation in different parts of the country. Investments required for transmission equipment arrangements to be initiated from 1983 to 1985 will amount to about 350 million markkas.

IVO and TVO Consider Joint Company

Lovisa (HS)—An entirely new power company may have to be created to run the next nuclear power plant. The founding of a new company is a strong alternative in the IVO-TVO joint report on the administration of a major power plant.

The legal committee, which has considered the matter, also has other alternatives. According to general manager Kalevi Numminen, they are still also contemplating some sort of broader form of cooperation.

One of the essential questions in the report on the creation of a major power plant is how tax matters relating to the plant would be handled.

Matters still to be clarified also pertain to the distribution of shares between the power companies. If they decide on a new company, the way things look now, we assume that TVO and IVO would each own half of it.

At the present time they are also trying to determine what the power needs of TVO's current stockholders are and consequently what their share of the power from a 1,000-Mw plant would be.

According to general manager Numminen, there is, however, as yet no hurry as regards arrangements relating to the administration of the company. "The most important thing is to obtain an approval in principle to build the plant."

As for TVO general manager Magnus von Bonsdorff, he stated that a new company is a strong alternative, but that other alternatives have, nonetheless, not been excluded.

"A decision on the matter must be reached by the end of the year at the latest, at which time the current TVO-IVO joint agreement expires."

Two Differing Opinions, KTM Representatives in Different Camps

The general plan for supplying electricity that was submitted on Wednesday contains two differing opinions. Both official Pekka Tuomisto, who advises the Finance Ministry, and chief inspector Erkki Eskola, who works in the Energy Department of the Commerce and Industry Ministry (KTM), feel that the general plan should not be approved as far as it concerns the construction of a nuclear power plant.

Thus the opinions of representatives of the KTM Energy Department as to the necessity of building a fifth nuclear power plant were totally at odds with one another in the advisory committee, since the other representative of the Energy Department, agency head Esko Ylikoski, who serves as chairman of the advisory committee, voted with the advisory committee majority opinion for a new nuclear power plant.

The motion for adoption of the Electricity Supply Advisory Committee's general plan proposal was carried by a vote of 9 to 2.

Both officials who registered a dissenting opinion criticized the economic growth forecast on which the power consumption estimate was based as being overly optimistic.

Advisory committee estimates of an increase in power consumption are based on an economic growth rate of about 3 percent. Among other sources, the Economic Planning Center growth forecast was used as a basis for the estimates.

As for the advisory committee report, it emphasizes that economic growth is by no means solely determined by the need for power production capacity, but also the need for electricity and the economical production of electricity.

They believe that the consumption of electricity is growing faster than the consumption of energy in general.

The two who presented differeng opinions would like to see the advisory committee's competence on energy and the national economy increased.

In his differing opinion, Eskola also devoted attention to the fact that the building up of power production capacity was investigated only on the basis of a relatively high estimate of electricity consumption. "An alternative plan for a possibly lower growth situation was not presented, even though the Council of State had stipulated that as a condition when it approved the previous general plan," Eskola asserted in his differing opinion.

11,466
CSO: 5100/2584

URANIUM EXPLORATION FOR 1983 TO BE CARRIED OUT IN 13 AREAS

Athens ELEVTHEROTYPIA in Greek 18 Mar 83 p 15

[Text] Explorations in search of uranium will be carried out in 13 different areas of the country in 1983 by the Ministry of Energy and Natural Resources, it was announced yesterday by Minister E. Kouloumbis. Four of these areas are located in eastern Makedonia, two in Thraki, three in central and western Makedonia, two in Ipeiros, and two in the Aegean Islands.

The emphasis of this search effort will be in those areas where the most favorable geological conditions exist for finding developable concentrations of uranium.

To this end, a total of 40 million drachmas will be spent from the Public Investments Budget in 1983.

It should be noted that exploration for radioactive ores has been substantially lagging in our country in comparison both with the developed states and with our neighboring countries, despite the fact that the energy, foreign-exchange, and strategic value of uranium is very significant.

Within the framework of the 5-year program of exploration for radioactive ores, the following have been set as primary objectives for this purpose: 1. The locating of economically exploitable deposits of uranium, and expanding the known reserves. 2. The recording, evaluation, and full cognizance of the country's potential in terms of radioactive ores. 3. The creation of the suitable scientific and organizational infrastructure, with the expansion of exploratory activity also outside Greece.

12114
CSO: 5100/2583

ASCO STATION RECEIVES PERMISSION TO GO OPERATIONAL

Madrid LUZ Y FUERZA in Spanish Jan-Feb 83 pp 5-12

[Text] According to the president of FECSA [Electric Power of Catalonia, Inc], Juan Alegre Marcet, "Asco I is extraordinarily important, because it represents for Catalonia a step forward toward its total energy development, since it is where the powerplant is located and it is where the electric power produced there will be sent."

The site of the Asco I Nuclear Powerplant is located adjoining the Ebro River, the leading one in Spain owing to the size of its volume of flow, and the only large river irrigating part of Catalonia, with an average rate of about 500 cubic meters per second in the Catalonian section throughout the years. Hence, a project of major scope has been sited next to the Ebro River, which has required the removal of 2.6 million cubic meters of rock and earth, the pouring of 420,000 cubic meters of concrete, the reinforcement of the latter with 45,000 tons of iron rods, the pipe-to-pipe welding of 150 kilometers of pipework and the laying of 3,500 kilometers of electric cable. This is the plan of the spectacular Asco I project, to which must be added the reactor itself and all the safety and protection systems. Obviously, this colossal structure can produce 12 billion kilowatt-hours per year, which will make it possible to provide the industry and people of Catalonia with increased power as anticipated during the present decade, with a resultant savings in hard currency that will mean a substantial reduction in imported oil.

The building of the Asco I Nuclear Powerplant offers the prospect of a group of structures wherein one main building (the containment building, with a wide dome 40 meters in diameter) dominates other surrounding buildings: the turbine building, the control building, the building for fuel and the auxiliary building. And that enormous mass, this splendid industry located next to the Ebro, will perform its work, contrary to what people feared, without causing harmful effects on the fauna or flora, or on the population of the riverbank, stemming from the river water downstream of the powerplant.

It is also important to note, owing to the beneficial effects from the amounts that the region will receive as a result of the implementation of the energy tax, that in 1983 the Asco I Nuclear Powerplant will bring about 760 million pesetas to Tarragona; and that, once Asco II goes into service, which it will about next year, Tarragona's income will increase to approximately 1.55 billion per year, when the two Asco powerplants are in full operation.

Although at least a dozen different Westinghouse organizations participated to a greater or lesser extent in the Asco I project, the information sources may be summarized in a description of the leading centers: Westinghouse Pressurized Water Reactor Division, in Pittsburgh; Westinghouse Nuclear International, in Pittsburgh; Westinghouse Nuclear International Europe, in Brussels; and Westinghouse Nuclear Espanola, in Madrid and Barcelona. The first-named is the one responsible for the design and development of pressurized water powerplants throughout the world, and no change can be made in the design philosophy without previous study and approval by this organization, which is also in charge of the purchase of components not manufactured by Westinghouse that are not available on the Spanish market. The engineering applications have their center in Westinghouse in Brussels. The Westinghouse organization in Madrid is essentially one for monitoring manufacture, although it also performs engineering service, quality control, safety control, etc. The Westinghouse office in Barcelona was set up precisely to provide a Westinghouse presence in Catalonia, close to the owner's organization.

The Operating Permit

Labor disputes interfered with the projects during 1980 in particular, from the time when the first load of fuel was transported from its manufacturing site in the United States to the Asco I fuel building. The labor disputes continued throughout the first months of this year. Nevertheless, the installation of Asco I continued its progress and, gaged by the physical dimensions achieved, represented a rise in overall progress from 85 percent in early 1980 to 90 percent in December of the same year. In June 1981, the overall progress exceeded 95 percent, and in December 1981, it reached 99 percent, attained in all areas. On 31 December 1981, the preliminary operations were carried out before the performing of the hot operation tests at the Asco I powerplant; the dynamic venting of the primary circuit, carried out through consecutive primary circuit pump operations. On 5 January 1982, these were started in the presence of the inspectors from the Nuclear Safety Council and the Ministry of Industry. These tests consist essentially of a simulation of normal operating conditions, particularly pressure and temperature, in the primary and secondary circuits, as well as in the auxiliary systems, using as a heat source the reactor's coolant pumps and the pressurizer heaters.

In this way, an overall check is made of the proper operation of all systems, even including the synchronization of the powerplant with the system, which took place on 19 February 1982. These tests concluded, with complete success, on 24 February 1982.

Finally, on 22 July 1982, following a favorable report from the Nuclear Safety Council, the Ministry of Industry and Energy granted a provisional operating permit for the Asco I Nuclear Powerplant; and, on 31 July, the loading of fuel started, ending on 4 August, the date on which the nuclear test program began.

Asco I will not cause heating of the Ebro water downstream of the powerplant, after the water returned by the powerplant is mixed with the direct river water; and, in any event, the conservation of the river's biological conditions is assured. Insofar as additional radioactivity due to the powerplant is concerned, in the opinion of the technicians and, on the average, expressed in layman's terminology, it will be 100 times less than the natural radioactivity of the river water, 200 times less than that of beer and 1,200 times less than that of the cow's milk ordinarily consumed. Only in the event of a maximum accident at Asco I, the likelihood of which is, fortunately, infinitely slight, could the radioactivity of the river water be temporarily greater than that of beer; but it would still be far less than the radioactivity of the milk.

Since nuclear powerplants are considered close, though peaceful, relatives of atomic bombs, many people accuse them of being annoying, contaminating and dangerous neighbors. But, in fact, nuclear powerplants have been producing electricity for over 25 years, with nearly 300 of them in operation in the world, and no fatal nuclear accident has occurred for strictly nuclear-related reasons.

The Generalitat and Asco

As may be recalled, a Generalitat-Municipal Council Joint Commission was formed in the Asco area, to find solutions for,and oversee compliance in matters relating to the Asco Nuclear Powerplant. The Joint Commission consists of the mayors of the main localities in the Asco-Asco area, the l'Espanyol tower area, Flix and Vinebre, as well as the chairman of the Inter-District Council of Ebro Lands, and the general directors of the Generalitat's Departments of Industry and Energy, Agriculture, Government, Health and Social Security, and Policy and Public Works. The Generalitat's representatives are acting on the basis of a moral imperative and responsibility freely assumed with respect to the population concerned.

Since the day of its establishment, the Joint Commission has held several meetings, and the topics discussed have been primarly the following: urban development and siting, quality control, radioactive level in the vicinity of the powerplant, coolant water taps, impact on agriculture and a general consideration of the group of legal measures and provisions to be taken into account. For reasons of urgency and operational ones, the Joint Commission decided to concentrate its discussions on Asco I, and subsequently to undertake a study of Group II of the same powerplant.

The topics which have most concerned the mayors of the area have been focused on whether or not there exists an emergency plan in case of accident, as well as whether there is insurance against nuclear risk, inasmuch as the nuclear fuel has already been stored. The company responsible for the Asco I Nuclear Powerplant has, as part of its functions, set up a detailed internal emergency plan for the powerplant which covers the company's personnel, and also has provided for the insurance covering public liability involving third parties for nuclear fuel storage, according to the legislation currently in force.

Asco and the Catalonian Nuclear Area

The two units comprising the Asco I and II Nuclear Powerplant are located in Tarragona Province 55 kilometers from the capital as the crow flies. The first group, Asco I, is owned by FECSA; the second group, Asco II, is owned by ENHER [Ribagorza National Hydroelectric Enterprise], HECSA, SEGRE and FECSA, and its construction is also well under way. Although it may not be connected to the system within the anticipated period of time, it is expected that this will be possible in 1984, if the labor-political incidents stop hampering its construction. Each of the powerplants occupies an area of about 200 X 150 meters according to the ground plan, an area where most of the main structures are located, such as the reactor building, the control and fuel buildings, the turbine, etc.

Each group consists of a pressurized water reactor (PWR) with a gross power of 930 Mwe, and the cooling is carried out with water from the Ebro River, using complementary cooling and discharge towers.

Upon the initiation of the projects, the budget for both Asco groups amounted to about 60 billion pesetas, although the final cost of the project, surcharged as a result of incidents dissociated from the wishes of the companies, will amount to considerably more. In any event, once the two Ascos, I and II, are in operation, they will put into the system 12 billion KW/h; this is over a tenth of the production accrued by the electrical sector in 1980.

The two fundamental systems of both groups are, basically, the steam generation nuclear system and the electric generation system. The first, generally called NSSS, consists of a pressurized water reactor, a coolant system for the reactor and the associated auxiliary systems. The reactor's coolant system is made up of three closed loops connected in parallel fashion to the reactor's vessel, each supplied with a reactor coolant pump and a steam generator; and a pressurizer heated electrically is connected to one of the loops. The second fundamental system in the powerplant, the one for generating electric power, consists essentially of the turbine, the generator, the condenser and the heating circuits for the feed water condenser.

One of the main features of Asco I and Asco II is the cooling. The water for the cooling system's cold source at Asco is taken from the Ebro River. After circulating through the condensers, it is taken directly through the cooling towers to a mixing pool, from which it can be returned to the river or recirculated to the condenser. This water for cooling does not come in contact with the reactor's core, but rather is insulated from it by two consecutive insulated circuits, the secondary and the primary circuits. Part of the river water is used to cool various components of the powerplant, but in any case it is separated from possibly contaminated elements by at least two consecutive closed circuits.

The concession of water for cooling at the Asco Nuclear Powerplant made by the General Directorate of Water Works on 28 June 1977 includes 33 conditions imposed by highly restrictive terms, in order to guarantee the absence of harmful effects on the river, with regard to both the thermal aspect and the radioactive one.

In any case, the maximum increase in river water temperature allowed will be 3 degrees centigrade, gaged by the difference between the temperature present in the water circulating through the intake canal 1 meter in depth, as a minimum, and the maximum water temperature in the channel in a section located below the pouring point where atomic dispersion could be considered to be found.

A continuous temperature control system, which will include the intake, the discharge canal and the point at which dispersion may be found, will allow for monitoring of compliance with the regulations.

The cooling towers will divert part of the heat to the atmosphere, in order to limit the thermal increments in the river to those stipulated in the concession.

The system is designed to operate using different methods, depending on the river channel and the power produced by the plant. For river volumes of flow exceeding 288 cubic meters per second, in fact, the condition relating to 3 degrees centigrade, does not necessitate the cooling towers; a situation which, from the experience gained over the past 10 years, will occur two thirds of the year. For volumes of flow under 200 cubic meters per second, the cooling towers would be put into operation.

If necessary, and for lower volumes of flow, there is the possibility of increasing the towers' discharge output, by recirculating part of the water. The limiting of the increase in temperature to 3 degrees centigrade, precisely, necessitated the construction of the cooling towers which, with their attached structures, meant an additional investment of 700 million pesetas.

Work has been under way at Vandellos II since 1977, with prior authorization granted and with over 2,000 workers participating in the projects. It is estimated that they will require over 150,000 cubic meters of concrete, 70 kilometers of piping and 1,000 kilometers of cable, in addition to equipment of widely diversified origin and of different types. The weight of the containment building, including the equipment, will be about 65,000 metric tons, a weight very similar to that of a large modern aircraft carrier. The savings that will be represented by the replacement of the fuel with enriched uranium will be about 4.5 billion pesetas per year. There has been another authorization for Vandellos III, with the same power and features as those of Vandellos II, planned exclusively by FECSA and already under construction, along with the other two Vandellos powerplants, Asco I and II.

Importance of Asco to the Economy

With the entry of FECSA's Asco I into operation, we shall concentrate the following comments on the benefits that electrical production of nuclear origin have for the Spanish economy; particularly inasmuch as Asco I, which will be followed in 1984 by Asco II, in which the four large Catalonian companies are participating, will be a continuation of the same idea of achieving a strictly Catalonian electrical supply, manifested in the association which made the nuclear dream of Vandellos I a reality. Moreover, the opening of Almaraz I and Asco I, after surmounting the countless obstacles which interfered with their construction, represents the maturing of nuclear technology in Spain; and, in a more concrete and particular manner, Asco I represents the maturing of Catalonian nuclear technology.

Spanish Nuclear Technology

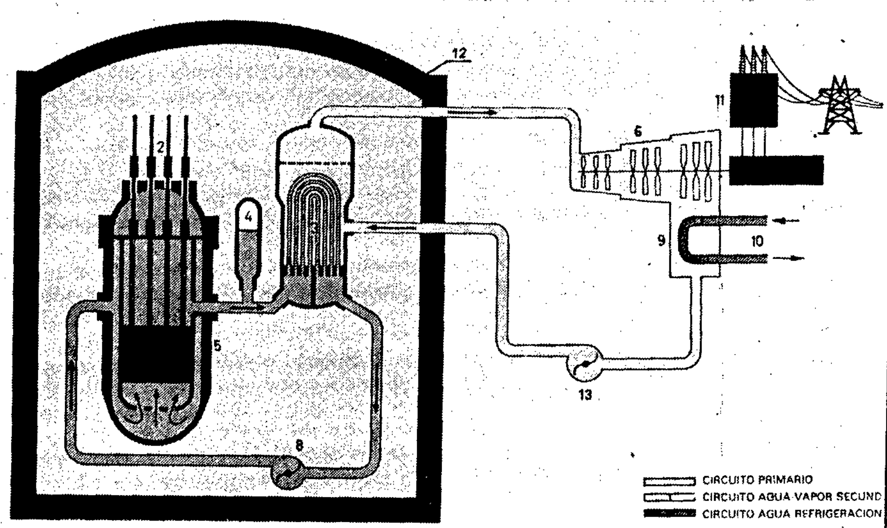
Major difficulties had to be overcome, not the least of which was that involving the credibility of nuclear technology which, although unquestionable and undeniable today, was not so much so 10 years ago, when effective, normal service was already being rendered by the first three Spanish nuclear powerplants; at which time, more or less, the foundations for Asco I, sponsored by FECSA, were being laid. Because it must be stressed that Almaraz I and Asco I represent the consolidation of the second generation of Spanish nuclear powerplants; since the other five will come thereafter, consecutively, with the acceptance of opposing factions, except for what may have been stipulated for Lemoniz.

It is also fitting to point out that there is now a highly perfected nuclear technology that is typically Spanish, with a very high percentage of nationalization in its elements, and that these two latest powerplants, especially Asco I, the most recent in time, have received recognition in the international area, and have found support among all the Spanish professional organizations, associations, institutions and business firms linked with nuclear power, which have cooperated very actively in the definitive confirmation of the validity of the second generation of Spanish nuclear powerplants, opening up the promising interval of the third generation of Vandellos, Trillo and Valdecaballeros, in an advanced stage of development.

FECSA's first contact with the nuclear sector took place upon this electrical entity's participation in the Hispano-Franco Nuclear Energy Association (HIFRENSA) which, 10 years ago, put into service the third Spanish nuclear reactor at Vandellos, as we have observed. It was a natural uranium reactor with a French system, different from the enriched uranium reactors installed at Zorita and Garona. The new results of this first Catalonian nuclear powerplant may be demonstrated with the annual production data from Vandellos I. This participation by FECSA in Vandellos enabled it to begin training personnel specializing in nuclear powerplants, which prompted the company to propose to the government agencies the construction of the Asco Nuclear Powerplant in 1970, while other companies were proposing Almaraz and Lemoniz. These powerplants were approved jointly, and the contract was made with Westinghouse jointly. Asco I, owned 100 percent by FECSA, the prior authorization for which was granted in April 1972, delayed about 10 years in going into service, and preceded another powerplant with the same power and the same siting, Asco II, in which, as we have noted, FECSA has a 40 percent share, in conjunction with the other three Catalonian electric companies.

Moreover, FECSA has an 0.08 percent share in Vandellos II, which is under construction, together with the other Catalonian companies; and is 100 percent owner of Vandellos III, with 950 KW, which has already received provisional authorization. Vandellos II and III are part of the third generation of Spanish nuclear powerplants, together with Trillo I and II, Valdecaballeros I and II and Sayago.

The 1978-87 National Energy Plan which, as is well known, was subjected to a revision by the government in 1982, a revision which did not reach the Cortes for discussion because of the political events that occurred as a result of the general elections in October, called for the entry into operation of a series of new powerplants to meet the energy needs. In this regard, the president of FECSA which, as we have seen, has an ambitious nuclear program under way, the imminent entry into service of Asco I being good evidence of this, believes that the fact that at least 8 or 9 years are needed, from its beginning, for a nuclear powerplant to be connected to the system, requires the scheduling and construction, sufficiently in advance, of the nuclear powerplants needed to guarantee and meet the demand for electric power that the country requires; although the companies supplying equipment are certainly opeaating now with a normality that at first took a great deal of effort to achieve.



1. Núcleo del reactor (Lugar de la vasija que contiene las barras de combustible)
2. Barras de control (Sirven para regular la reacción nuclear)
3. Generador de vapor (Se representa uno, pero en cada Central de Ascó hay 3 generadores de vapor)
4. Presurizador (Sirve para regular la presión del agua)
5. Vasija
6. Turbina
7. Alternador
8. Bomba (En cada central de Ascó hay 3 bombas, una por generador de vapor)
9. Condensador
10. Agua de refrigeración (Procedente en este caso del río Ebro)
11. Transformador
12. Recinto de contención
13. Bomba de alimentación

Key to Diagram:

1. Reactor core (site of vessel containing fuel bars)
2. Control rods (used to regulate the nuclear reaction)
3. Steam generator (one is shown, but there are 3 steam generators in each Asco powerplant)
4. Pressurizer (used to regulate the water pressure)
5. Vessel
6. Turbine
7. Alternator
8. Pump (there are 3 pumps in each Asco powerplant, one per steam generator)
9. Condenser
10. Coolant water (in this case originating in the Ebro River)
11. Transformer
12. Containment area
13. Feed pump
14. Primary circuit
15. Secondary water-steam circuit
16. Cooling water circuit

2909
CSO: 5100/2590

NUCLEAR ENERGY INSPECTORATE: RINGHALS 1 HAS SERIOUS FAULTS

Stockholm DAGENS NYHETER in Swedish 7 Apr 83 p 10

[Article by Ingvar Andersson]

[Text] "It looks very difficult. The whole matter is much worse than we had anticipated."

That is the assessment of the State Nuclear Power Inspectorate (SKI) of the cracks in the pipe that were detected around Eastertime in the Ringhals 1 nuclear power reactor in Halland.

So far more than 30 pipes in the reactor's cooling system have been investigated with ultrasound and X-rays. In most cases, the investigations have revealed cracks.

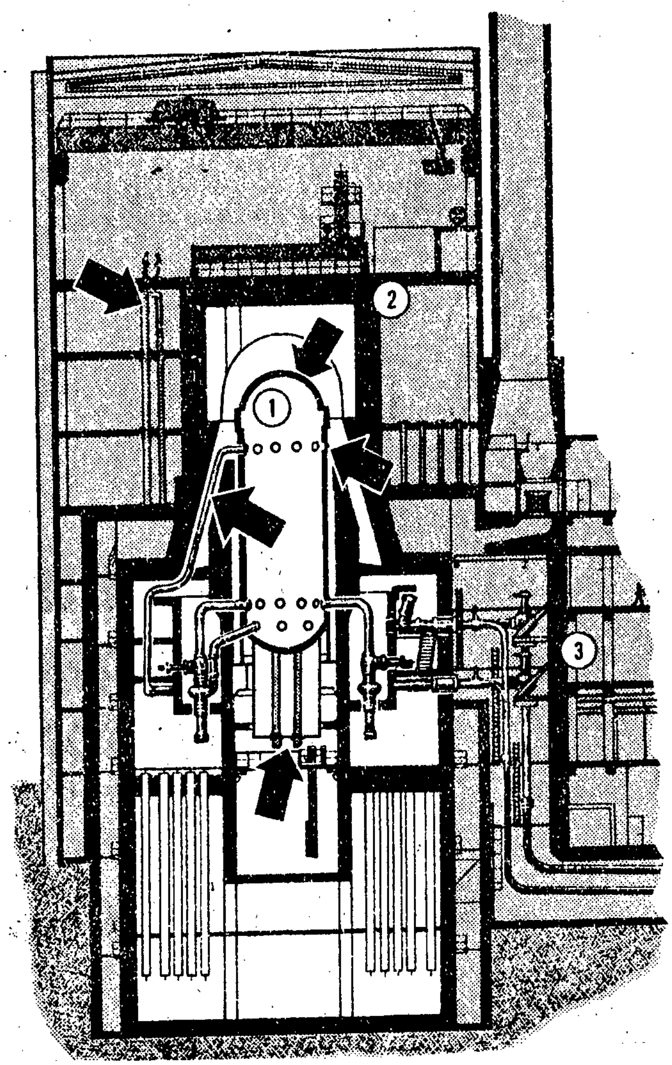
"There are a lot of cracks," said reactor inspector Frigyes Reisch. "The extent of the cracking is more widespread than we had thought."

The cracks now being discovered occur in the welding seams in pipes of a certain quality and dimensions. The pipes are a common feature in reactors and can be found in such places as the central nozzle and the residual effect cooling system at the bottom of the reactor tank, in pipes that regulate the water level in the reactor tank and in pipes outside the reactor tank in the reactor building. Large segments of the pipe system are located in highly radioactive areas.

Small Leaks

It was around Christmas that serious doubts first arose on the cracks. During the fall, Ringhals 1 had had small leaks and a fresh leak occurred at Christmastime. The Nuclear Power Inspectorate had a suspicion that the leaking was due to stress corrosion which occurs in particular in stainless steel pipes with a high carbon content.

"The X-ray and ultrasound tests showed that the cracks exist," said Frigyes Reisch of SKI. "Now we must try to find out how big and how deep they are."



So far, pipes in the rapid shutdown system, the central nozzle system and the residual effect cooling system at the bottom of the reactor tank as well as the level-regulating pipe around the reactor and a pipe system outside the reactor enclosure have been checked (see arrows). Almost all the pipes checked revealed cracks. The diagram above shows the central parts of Ringhals 1, with the reactor tank shown at (1) and the reactor enclosure at (2). The cooling system and generators continue at (3). The light area in the reactor enclosure is highly radioactive. (Diagram by Peter Wider)

This must be done by conducting a microscopic study of the places where cracks have been detected. So far this kind of inspection has only been done on a couple of pipes that were sawed out of the cooling system outside the reactor enclosure. The analysis has not yet been completed, but when it is, within the next few days, it will be possible to determine how deep and how broad the cracks are.

"But it is quite clear that the cracks are big enough and deep enough so that liquid can spray out of them if the reactor is started up," Frigyes Reisch said.

But SKI does not believe that any sudden break in the pipes--so-called shearing--could occur. Shearing in these particular pipes could produce a very dangerous nuclear power accident, since it would damage the reactor's cooling system.

"American studies have shown that cracks like these are always revealed in good time because they start leaking," said Frigyes Reisch. "And if there is something we are good at here in Sweden, it is checking for leaks. A leak would be detected quickly and operations would be halted."

The damage that has now shut down Ringhals 1 "for an indefinite period" has earlier shut down one reactor in the United States, two in West Germany and one in Italy. Nuclear power experts do not rule out the possibility that this typical "boiler disease" could also shut down Barseback 1 and 2 and Oskarshamn 1 and 2, all of which are boiler reactors. On the other hand, Forsmark 1 and 2 are considered too new to have been affected.

The cracks are primarily believed to have something to do with the quality of the pipes and the welding methods, not with who supplied the reactors. The boiler reactors in Sweden were produced by ASEA-Atom [the nuclear division of the Swedish General Electric Corporation].

It is a combination of the carbon content of the stainless steel in the pipes, oxygen in the cooling water and the heat created when the pipes are welded that is the most likely cause of the cracks.

The alternatives for fixing the reactors are putting sleeves over the cracks or replacing the pipe system.

The sleeve method is just a stopgap measure and can never be a permanent solution.

The Nuclear Power Inspectorate has been especially disturbed by the rapidity with which the cracks have developed.

When Ringhals 1 had a leak around Christmas, 34 pipes were investigated and 5 leaks detected. At Eastern, when the pipes were checked again, cracks were found in almost all the pipes.

Barseback 1 went into operation in 1975 and has now been running for just under 8 years.

"That is a very short time," said Frigyes Reisch, "and the present fault can hardly be attributed to symptoms of age."

On 15 April, Barseback 2 will be checked in the same way as Ringhals 1.

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