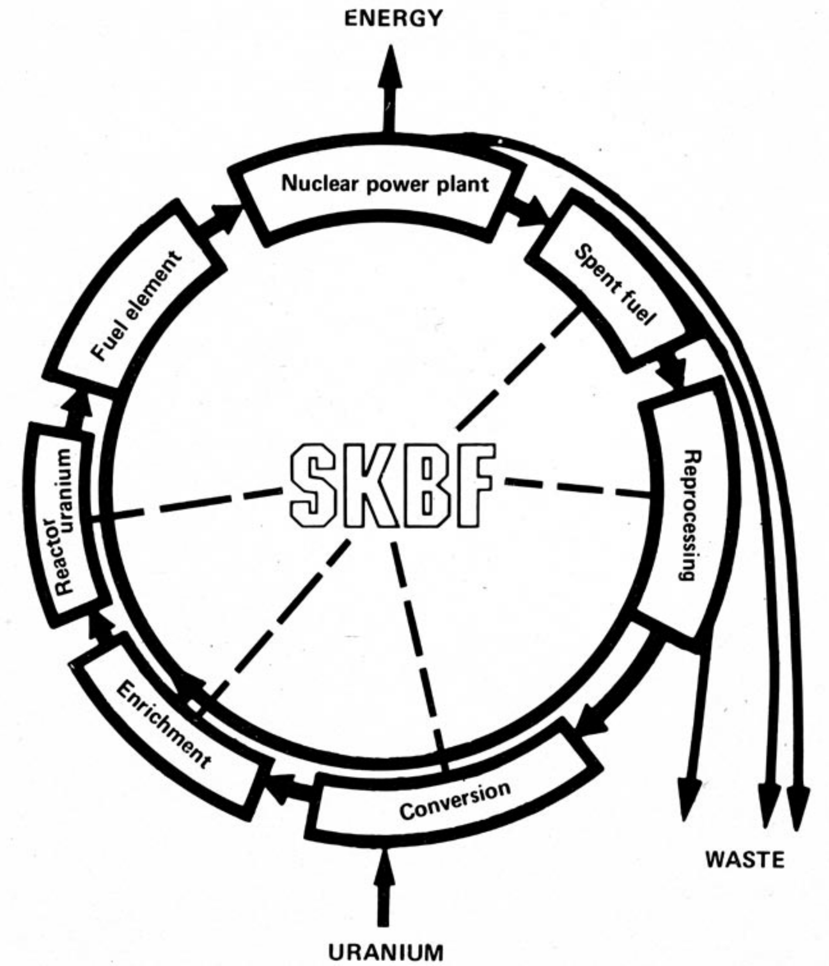
Report on the current situation with regard to nuclear fuel and the operations of Svensk Kärnbränsleförsörjning AB (Swedish Nuclear Fuel Supply Company) during the period October 1979 - September 1980

Report to the Swedish Ministry of Industry, November 1980



SKBF
SVENSK KÄRNBRÄNSLEFÖRSÖRJNING AB
SWEDISH NUCLEAR FUEL SUPPLY COMPANY

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Stockholm, November 1980

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REPORT ON THE CURRENT SITUATION WITH REGARD TO NUCLEAR FUEL AND THE OPERATIONS OF SVENSK KÄRNBRÄNSLE-FÖRSÖRJNING AB (SWEDISH NUCLEAR FUEL SUPPLY COMPANY) DURING THE PERIOD OCTOBER 1979 – SEPTEMBER 1980

SUMMARY

The report gives an account of the operations of SKBF (The Swedish Nuclear Fuel Supply Company) and lays down guidelines for future access to goods and services required for reliable supply to a Swedish nuclear power system with 12 reactors and a combined total capacity of about 9500 MWe.

It is assumed that enrichment and reprocessing facilities will not be built in Sweden. It is also assumed that most of the supply of natural uranium will be secured through agreements with foreign suppliers. It is further assumed that all types of radioactive waste from nuclear power generating operations will be disposed of in Sweden.

Reasonably assured and estimated uranium resources in non-Eastern bloc countries amount to some 5 million metric tons. This quantity is estimated to be sufficient for 100 years of operation of the nuclear power system already existing and under construction of 350 000 MWe. The uranium prospecting of the past few years has led to a considerable increase in known reserves.

As far as Sweden is concerned, Ranstad Skifferaktiebolag has concluded that an offer from SKBF to purchase the uranium output of a possible future plant in accordance with certain guidelines did not provide sufficient guarantees for the feasibility of an industrial project based on the very large, well-evaluated but low-grade deposit of uranium-bearing shale in Ranstad, Västergötland County.

Prospecting has continued in the North of Sweden. During the summer of 1980, a drift was driven in the Pleutajokk deposit to permit better evaluation of the mining plan, possible ore grade and whether a good working environment can be maintained. Test drilling is being pursued in an attempt to increase the known size of the uranium reserve, which is currently estimated at about 4000 tons.

Among other prospects is the technically favourable type of uranium mineralisation found in Lilljuthatten in the minicipality of Krokom. However, the currently evaluated reserve of 1600 tons is too small to permit an economical exploitation. Drilling is pursued.

Sweden's need of natural uranium up to the year 2010 - the estimated operating life of the 12 units - is estimated at 26 000 - 39 000 tons. The need for the 1980s is approximately 12 000 tons, of which supply contracts with foreign suppliers for delivery during the first half of the decade cover 4300 tons.

The aim is the signing of agreements directly with producer companies within the next few years to cover a considerable portion of the remaining unsatisfied need for the 1980s. A geographic distribution will be striven for. If the results of continued investigations and deliberations so motivate, SKBF assumes that a portion of Sweden's uranium needs will be met by domestic production.

International capacity in the area of conversion and enrichment is adequate, and capacity increases are deemed feasible if motivated by increases in demand. Enrichment services have been secured through foreign contracts up to the mid-1990s for all Swedish nuclear power units currently in operation and under construction.

Accordingly, SKBF is of the opinion that supplies of nuclear fuel can be secured by reliable agreements for the realistically foreseeable future.

In view of the large economic values represented by the Swedish nuclear power system and its importance in the nation's power supply - which will increase from the current level of 30 % to nearly 45 % - a reserve stockpile of low-enriched uranium is currently being built up. The present size of the stockpile is equivalent to 14 TWhe and is planned to grow during 1981 to 17 TWhe. Through the reserve stockpile and other reserves, the operation of the current nuclear power system is ensured for more than one year in the event of a complete cut-off of supplies from abroad.

The ultimate purpose of disposal is to make sure that all products with varying kinds and degrees of radioactivity that result from the nuclear reactions in the reactor are handled and finally disposed of in such a manner that the environment and living organisms come to no harm. The report has been broken down according to the facilities and systems that are considered necessary today to achieve this goal as well as the research and development work that is deemed necessary.

The time sequence of measures has been chosen with the purpose of ensuring the undisturbed operation of the nuclear power plants.

Consequently, a central temporary storage facility for spent fuel (Clab) is currently under construction on the Simpevarp peninsula north of Oskarshamn. Construction work commenced in May of 1980. The plant is scheduled for completion by the end of 1984. Up to this time, storage capacity is available at the nuclear power plants. Clab will have sufficient capacity to receive and store a quantity of spent fuel equivalent to 12 years' discharge from the 12 reactors in the Swedish nuclear power system.

SKBF has signed two types of reprocessing contracts with the French company Cogema on behalf of the Swedish nuclear power industry. The larger of the agreements provides for the reprocessing of 672 tons in a plant that is under construction and in which spent fuel from nuclear power reactors in six countries outside of France will be reprocessed. Construction of the plant is proceeding largely on schedule.

Work has begun on a sea transportation system for spent fuel etc., via which transports will be effected from Sweden to France - as well as return transports of waste at a later date - and from the nuclear power plants to Clab. The central feature of the system is a special ship designed by Salén Technologies AB. Procurement of the ship will be effected during 1980. Transport casks for spent fuel are under production.

A subsequent project being planned is a central facility for the final storage of reactor waste. By "reactor waste" is meant a group of radioactive wastes which arise during reactor operation and can be collectively referred to as low- to medium-level wastes. This radioactivity is expected to have declined to a harmless level after a period of time on the order of 500 years. The facility is planned to be ready to receive waste by 1989. Up to this time, radioactive wastes will be stored temporarily at the nuclear power plants.

Efforts to build up a safe and reliable system for the handling and final storage of high-level and long-lived radioactive wastes are being continued on the basis of the results of the KBS (Nuclear Fuel Safety) project. According to present planning the final storage facility is required around the year 2020. Until that time, facilities will be required for the temporary storage of waste. A plant is also needed for the encapsulation of the waste in corrosion-resistant and radiation-shielding canisters before disposal.

The reprocessing agreements with Cogema and the systems specified in KBS 1 for the handling and final storage of high-level waste have formed the basis for the granting of permission in accordance with the Stipulations Act to charge four nuclear power units with nuclear fuel.

The KBS 2 report, which deals with the final storage of spent fuel without prior reprocessing, has been reviewed by domestic and foreign experts. The comments will be of value for the continued work on this technique.

Extensive research, development and investigative work is being conducted in order to enhance deepened knowledge within a number of areas of importance for safe final storage. This work - most of which is being conducted under contract - covers such fields as hydrogeology, dissolution and leaching, material transport via the groundwater, corrosion of canister materials and their mechanical properties, buffer materials and their long-term stability, and methods of measurement and analysis. Efforts have been coordinated with the National Council for Radioactive Waste (Prav).

Large-scale experiments over a 4-year period are planned in the experimental station at a depth of 350 m in Stripa. These experiments will include hydrogeological studies, migration studies in fractured rock and tests on buffer material. This Stripa project is being organized in the form of an independent OECD/NEA project, with international participation.

The nuclear fuel cycle includes steps with "sensitive technology", namely enrichment and reprocessing. Specially designed plants based on such technology can be used for the production of raw materials for nuclear weapons. The conditions of international trade in the fields of nuclear power and nuclear fuel - and thereby the assurance of supplies for the Swedish nuclear power programme - are governed to a great extent by efforts to prevent misuse for weapons purposes. However, the enforcement of the requirements laid down by the supplier countries has taken an unsatisfactory turn. SKBF emphasizes the urgency of efforts by the Swedish Government and Swedish authorities to establish guidelines that satisfy international safeguards and safety requirements while ensuring reasonable conditions of trade.

The report concludes with a summary of intergovernmental cooperation and international cooperation in research and industry. The proposals in the recently published findings of a government commission of inquiry concerning radioactive wastes from nuclear power - organization and financing matters - as well as SKBF's viewpoints on these proposals will also be summarized. The findings of the commission are expected to have important consequences for SKBF's activities.

SKBF is owned

- to 50 % by Statens Vattenfallsverk (Swedish State Power Board)
- to 25 % by Sydkraft AB, and
- to 25 % by Oskarshamnsverkets Kraftgrupp AB (OKG)

The Chairman of the Board of Directors is appointed by the Swedish Government.

INTRODUCTION

The outcome of the national referendum on nuclear power of 23 March 1980 has established guidelines - described in the Energy Bill of 17 April 1980 - that permit a necessary long-range planning of the securing of supplies for Swedish nuclear power plants as well as the management and disposal of their wastes.

Against this background, the aim of the present report is to shed light on the premises and guidelines for our future access to goods and services within the entire nuclear fuel cycle for a system with 12 reactor units and a combined net output of about 9500 MWe. At the same time, it must be emphasized that such premises and guidelines are not to be regarded as fixed and static. With Sweden being primarily a consumer country within the nuclear fuel cycle, adjustments and reevaluations must be made in the light of the changing international situation. The importance of the conditions of international trade may be considered in the light of the fact that already 30 % - and by the latter half of the 1980s nearly 45 % - of Sweden's electric power will come from nuclear reactors.

Three categories of factors must be satisfied by the supply system:

1. economy
2. resources, availability, and radiological safety
3. prevention of misuse for weapons purposes.

These categories of factors are not ranked in order of importance. All are important.

The three categories constitute headings in the following report. Furthermore, an account is given of international cooperation and the proposals for the organization and financing of the activities involved in the "back end" of the nuclear fuel cycle that have recently been presented.

The premises for a safe and secure nuclear system are of considerable general interest. As far as commercial conditions permit, SKBF operates with openness to the public and to politicians. This is particularly true of efforts to achieve safe handling and final storage of radioactive products and waste. The report concludes with a summary of reports, lectures etc. published or presented through the company and through persons or organizations involved with the company's activities.

1 ECONOMY

Compared with the investment and operating costs for nuclear power plants, the corresponding costs for the entire fuel cycle are lower. Nevertheless, the size factor is of economic importance for certain parts of the nuclear fuel cycle. This applies above all to enrichment and reprocessing, where considerable savings can be made if the plants serve many reactors, but economy is also improved by the use of larger units for other activities, such as waste handling and temporary storage.

The quantities of products are small on an industrial scale, which facilitates transportation and storage. To illustrate this, it can be mentioned that the operation of a 1000 MWe power plant annually requires approximately 200 tons of natural uranium concentrate (with about 70 % uranium) if the heat source is a light water reactor, 1.3 million tons of fuel if the heat source is oil and 2.3 million tons if it is coal.

These factors, plus the fact that the importation of nuclear fuel materials and services imposes only a moderate burden on the trade balance of a nation - a smaller burden than the equivalent importation of fossil fuels - favour international trade in the nuclear fuel sector. However, a heavy dependence on imports can entail risks and conditions that are undesirable or even unacceptable in certain situations.

Owing to Sweden's considerable dependence on nuclear power in meeting its energy needs, a compromise must be struck between short term economic considerations and measures aimed at ensuring a continuous supply of fuel for the undisturbed operation of the nuclear power plants. For certain stages of the nuclear fuel cycle - mainly waste handling - domestic measures are necessary in any case.

The supply system for Sweden that is under development is described in the following. It includes selected measures on both the supply side and the disposal side to sustain power generation. It is assumed that, for economic and political reasons, facilities for enrichment and reprocessing will not be built in our country.

The economic scenario with regard to the availability of goods and services within the nuclear fuel cycle can be summarized as follows:

a) uranium can be procured from producers in different countries in competition with each other; there is government control of prices and contra terms in certain important supplier countries;

b) conversion services are offered in competition; in one case (Canada), the natural uranium purchased in the country must be converted there;

c) the prices of enrichment services are largely regulated by government agencies (USA);

d) fuel fabrication (also available in Sweden) is offered in competition;

e) reprocessing services are paid for in accordance with a cost distribution principle (France);

f) the costs of handling and final storage of waste are assumed to be paid by the power producers at cost price;

g) the power companies have means to affect the fuel cost through certain optimizations with respect to degree of enrichment, concentrations in enrichment tails, uranium cost and burnup.

2 RESOURCES, AVAILABILITY AND RADIOLOGICAL SAFETY

2.1 SUPPLY OF FUEL

2.1.1 Natural uranium

2.1.1.1 The international uranium situation

The supply of and demand for uranium have been investigated by the International Nuclear Fuel Cycle Evaluation (INFCE), Working Group 1. The Eastern bloc countries have not furnished information, so the following applies only to the rest of the world.

Reasonably assured and estimated additional uranium resources in this part of the world amounted to a total of 5.0 million metric tons of uranium in 1979. This uranium can be recovered at a cost of less than SEK 550 per kg uranium. Beyond this amount, an international geological inquiry estimates that there are 6.6-14.8 million tons of uranium in so-called "speculative resources", i.e. deposits that have not yet been found. In addition, certain quantities of uranium can be produced from phosphate rock in connection with phosphoric acid manufacture.

If an international agreement could be reached on nuclear disarmament, considerable quantities of civilian nuclear fuel could be obtained from these weapons.

Total investments in uranium prospection in recent years have been estimated at SEK 2000 million per year. The increase in reasonably assured and estimated additional uranium resources between 1977 and 1979 was about 700 000 metric tons of uranium, which is about 10 times more than the uranium production during the same period of time.

Important producer countries during the 1980s will probably be Australia, Canada, France, Gabon, Namibia, Niger, South Africa and the United States. Of these, France, Canada and the United States have considerable domestic consumption.

World production in 1979 was about 38 000 metric tons of uranium. It is believed that production from known ores and as a by-product of phosphoric acid production could rise to more than 100 000 tons of uranium per year during the 1990s.

Nuclear power plants that generate 120 000 MWe are currently in operation in the Western world, and nuclear power plants for an additional 230 000 MWe are under construction. It is estimated that the above-mentioned uranium resources of 5.0 million tons could sustain the generation of 350 000 MWe for nearly 100 years (it is assumed that the operation of one 1000 MWe plant requires 150 tons of natural uranium per year).

Even though the situation with respect to the supply of uranium and the results of the prospection work of recent years appears to be relatively satisfactory, continued prospecting efforts, along with the development of less fuel-demanding nuclear power systems, are necessary if nuclear power is to retain its importance as an energy source over the long run.

A certain surplus of uranium has arisen during 1980. This has led to price reductions for immediate purchases, which in turn has led to production cutbacks at certain uranium mills in the United States.

However, difficult-to-foresee political and economic factors could affect both the availability of uranium and the pace of expansion of nuclear power and thereby consumption.

2.1.1.2 Supplying Sweden with uranium

The uranium requirement

A rolling plan is aimed at meeting the uranium need for 12 nuclear power reactors over an operating life of 25 years.

The natural uranium requirement can vary with many factors. For example, it increases

- if the isotope enrichment plants are operated with a high residual content of uranium-235 in the depleted uranium
- with increasing operating life of the reactors
- with increasing number of operating hours per year
- if the operating period of the reactors is increased to 18 months (the present operating period is 12 months); in this case, the number

of operating hours per year will increase and less energy will be produced per ton of uranium used.

On the other hand, the natural uranium requirement decreases

- when uranium and/or plutonium from reprocessing are used
- with decreasing operating life of the reactors
- with decreasing number of operating hours per year
- with a trend towards increasing burnup of the nuclear fuel.

Since the uranium requirement may thus vary, it is important that supply planning be rolling and flexible.

The graph below shows the estimated uranium requirement per decade to around the year 2010. The total requirement through the year 2010 is estimated at 26 000 - 39 000 metric tons of uranium. This quantity of uranium is equivalent to 400-600 million tons of coal, if the same amount of electricity were to be produced in coal-fired power plants.

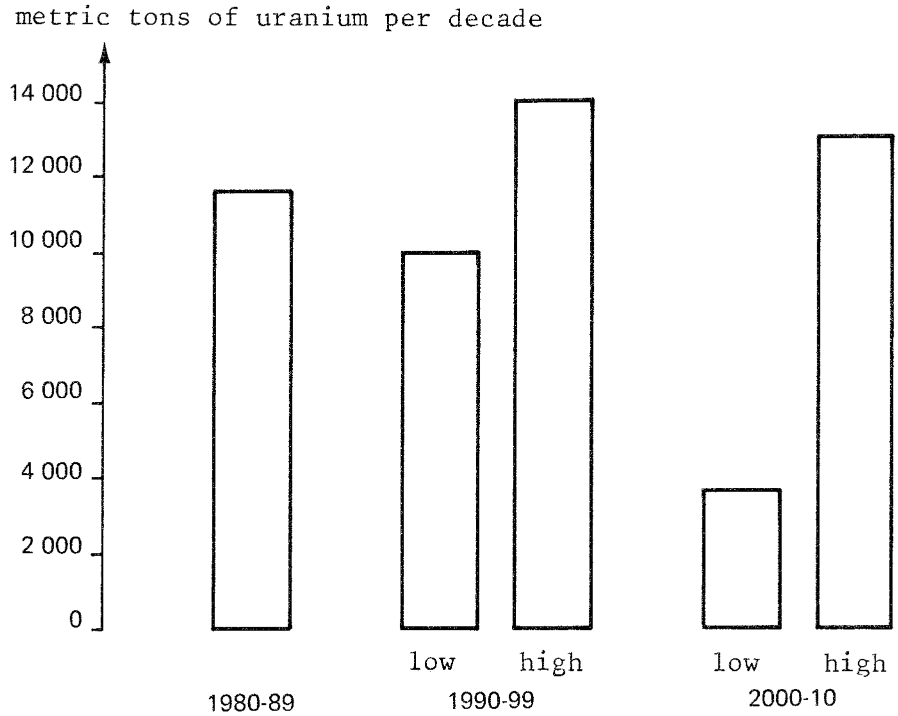

Figure 1. Estimated uranium requirement per decade up to the year 2010

Domestic uranium resources - Ranstad

Ranstad in Västergötland County is surrounded by a large area containing aluminuous shale, the most uranium-rich portion of which contains about 300 g of uranium per ton of shale. Since the municipalities of Skövde and Falköping vetoed a project for the exploitation of 1 million tons of shale, the research, development and project work has been conducted in Ranstad Skiffer AB (RSA), which is owned jointly by LKAB, Boliden AB and Studsvik Energiteknik AB. The state has supported the project financially in the form of loans and grants. Continued efforts are being made for protection of the external environment in the event of an industrial exploitation. Among other things, the replanting of reclaimed strip-mined areas has been demonstrated. The development programme will be concluded during the summer of 1981.

An offer from SKBF to purchase the uranium production from a possible future plant in accordance with certain guidelines has been evaluated by the board of RSA. The board found that the offer did not provide sufficient guarantees for the construction of a production plant in Ranstad.

RSA will draw up a plan to discontinue project activities in Ranstad by 30 June 1981. At the same time, the possibilities of continued development work are being explored.

Domestic uranium resources - Pleutajokk

LKAB has continued its investigations of the uranium deposits in Pleutajokk in Västerbotten County, financed partially by SKBF. During the summer of 1980 a drift was driven into the ore. One goal is to determine the average uranium content that can be obtained in the mined material. Studies are also being conducted to determine the necessary measures to obtain a good working environment in a possible mine. One important environmental measure will be sufficient ventilation in order to meet existing standards for air quality and radon levels.

The resources established this far amount to about 4 000 tons of uranium. Test drilling is continuing in an effort to increase this quantity. Studies of recovery technique and the surrounding environment have been conducted during 1980.

If the results of further studies are positive, the recovery of 200-300 tons of uranium per year may be considered.

Uranium prospecting

In 1976, SKBF concluded a 5-year agreement with SGU (the Geological Survey of Sweden) concerning uranium prospecting within an area corresponding to approximately 50 map-sheets in the southern part of Northern Sweden. Annual costs amount to SEK 10 million at 1976 cost levels. Regional studies in the form of aerial measurements and geochemical studies have been performed as well as local investigations of geology, geophysics and radon levels, including test drilling. SKBF has a cooperation agreement with the State Mining Property Commission so that the results of the uranium prospecting work will also be of value for prospecting for other minerals and contribute to general geological knowledge. The aerial measurements have covered approximately 47 map-sheets this far.

At the present time, SKBF has seven exploration licenses and has applied for an additional eight.

Test drilling at Lilljuthatten in the municipalities of Krokom has revealed a uranium mineralization in granite containing at least 1600 tons of uranium. Continued drilling is currently under way. During 1980, studies of the present aquatic environment were carried out in cooperation with the county administration. Preliminary studies of extraction and recovery technique have been commenced. Krokom municipality has appointed a joint consultation group to follow the investigations.

At Sågtjärn in the municipality of Ånge, test drilling has revealed a uranium mineralization containing at least 600 tons of uranium. Continued drilling is under way.

Other exploration licenses and applications for such licenses apply to areas within the municipalities of Åre, Ragunda, Ånge, Östersund, Bräcke, Ljusdal and Ovanåker. It is still too early to say whether any of the uranium mineralizations discovered within these prospecting projects are quantitatively sufficient for exploitation.

State-financed uranium prospecting is also being conducted by SGU. The budget for 1980/81 is SEK 14.5 million. The programme includes

- regional studies of the natural radioactivity level within the counties of Norrbotten and Kopparberg via aerial measurements

- evaluation of uranium prospects, primarily in the following municipalities: Boden, Arjeplog, Arvidsjaur, Sorsele and Storuman.

Supplying Sweden with uranium

The Swedish nuclear utilities have contracts with suppliers of uranium from France (uranium from Niger and Gabon), Canada and the United States. These contracts, together with uranium already delivered, provide for a total of about 4300 tons of uranium for the period 1980-1985.

Thus, uranium needs not yet met through the year 2010 amount to 22 000-35 000 tons of uranium. These needs can be met by purchases from foreign mining companies or by domestic mining. Some of the need may be met with recycling of fissionable materials recovered during reprocessing (chap. 2.2.2).

Additional quantities are intended to be purchased from abroad mainly via contracts with delivery periods from a few years up to ten years. The length of the delivery period for each contract will depend upon such factors as the commercial terms of the contracts and the conditions laid down by the supplier country. The intention is to sign these contracts directly with mining companies in different countries.

Uranium mining operations in Sweden might be set up at one or two locations within the country, provided that technology and economy are satisfactory and that the necessary permissions are obtained. This would improve security of supply for a portion of our uranium requirement.

In evaluating the future supply situation for uranium, it is appropriate to divide the period into three 10-year periods. Ten years ahead is the period for which the uranium situation in the world can be evaluated with some degree of certainty. Ten years is also the longest period for which the Canadian authorities can approve long-term contracts.

The total requirement for the 1980s is 12 000 tons of uranium. Contracts have already been signed for about 4300 tons of uranium, for delivery 1980-1985. The aim is to sign contracts for a considerable portion of the remaining requirement (about 7700 tons) within the next few years. The question of whether a Swedish uranium mining and milling operation may be initiated in order to meet a portion of the Swedish requirement will also be settled within the first few years of the 1980s.

The signing of contracts for deliveries during the 1990s will start in the mid-1980s. Conditions for purchases from abroad versus domestic uranium production will be compared.

It is assumed that the Swedish uranium requirement will be high for the entire 1990s, at around 10 000--14 000 tons of uranium. Possible changes in the concentration of uranium-235 in isotope enrichment are the reasons for the higher figure of 14 000 tons.

There is considerable uncertainty regarding the uranium requirement for the period 2000-2010, which will be dependent upon the operating lives of the nuclear power plants. In the event of a phase-out of nuclear power, the reserve stockpile will be used.

2.1.2 Conversion (transfer of uranium concentrate to uranium hexafluoride)

There are currently five industrial corporations in the West that carry out conversion, namely Allied Chemicals Corp. and Kerr McGee Corp. in the United States, British Nuclear Fuels Ltd. in Great Britain, Comurhex in France and Eldorado Nuclear Ltd. in Canada. In addition, conversion services can be purchased from the Soviet Union in connection with enrichment contracts.

Total conversion capacity in the West in 1980 corresponds to the conversion of about 40 000-45 000 tons of uranium. An expansion of capacity at present-day plants by an additional 20 000 tons is planned for 1984. According to current assessments, conversion capacity will catch up with demand during the 1980s, and there will be no obstacle to further capacity expansion if required.

Conversion represents only a small portion of the total nuclear fuel cost. It is roughly one-tenth of the enrichment cost.

In 1978, the company signed a contract with Comurhex for the conversion of uranium concentrate, which was previously produced in Ranstad. Uranium concentrate containing approximately 100 tons of uranium will be converted by Comurhex during 1980. The converted uranium is isotope-enriched in the Soviet Union and will be added to the reserve stockpile.

2.1.3 Enrichment

2.1.3.1 The United States

As has been described in greater detail in a preceding report to the Ministry of Industry, the power companies have "requirement contracts" with the US Department of Energy (DOE) for Oskarshamn units 1 and 2, Ringhals units 1 and 2 and Barsebäck units 1 and 2. SKBF is the Swedish party to additional contracts of a later type with DOE - providing for more fixed commitments (quantity contracts) - that have been concluded for Ringhals units 3 and 4 and Forsmark units 1, 2 and 3.

The price of enrichment under the terms of the requirement contracts, which was $95.05 per separative work unit (SWU) up to 1 July 1979, has been raised in stages and is expected to reach a ceiling price of $111.32 during the first half of 1981.

The price of enrichment under the terms of long-term fixed commitment contracts is $98.95 per SWU, but will be raised to $110.00 as of 29 November 1980.

2.1.3.2 The Soviet Union

The 1970 Swedish-Soviet nuclear cooperation agreement permits isotope enrichment for Swedish needs in the Soviet Union. In 1974, the company signed a contract with Techsnabexport for 300 tons of separative work with delivery in 1979. In 1975, the company concluded an agreement with Techsnabexport concerning the excercise of options. These options permitted the purchase of an annual enrichment quantity for the period 1981-2000 corresponding to one reactor unit plus an additional 300 tons of separative work for delivery in 1982-83.

The enriched uranium delivered in 1979 under the terms of this contract has been set aside as a reserve stockpile for the Swedish nuclear power plants.

2.1.3.3 Other suppliers

Eurodif in France is now completing the construction of a plant utilizing the gas diffusion method. Shipments of enriched uranium from the plant began in early 1979. The full capacity of the plant - 10 800 tons of separative work per year - is expected to be available in 1982.

Urenco has plants utilizing the gas centrifuge method in the Netherlands and Great Britain. To date, limited quantities of enriched uranium have been delivered. Urenco's current capacity in the two countries is a total of 460 tons of separative work per year. Urenco plans to expand its capacity to 2000 tons of separative work by 1985 and 4000 in West Germany around 1990. These plans include a new plant in Gronau.

Prototype plants for isotope enrichment exist in Japan (gas centrifuges) and South Africa (helicon process).

In 1978, France presented a new method for isotope enrichment based on chemical exchange. It is said that this method cannot be used in practice to produce highly enriched uranium, which means it cannot contribute to the risk of nuclear weapons proliferation.

The total enrichment capacity currently under construction is expected to be sufficient for the planned nuclear power programme during the 1980s. Additional expansion is deemed quite feasible in the event of a rise in demand.

2.1.4 Conversion and fabrication of fuel assemblies

In the first phase in fuel manufacture, isotope-enriched uranium hexafluoride is converted to uranium dioxide. Pressed and sintered uranium dioxide is enclosed in cladding tubes, which make up fuel assemblies for the power reactors.

Foreign and domestic industrial capacity (Asea-Atom) is available for both conversion and fuel assembly manufacture. Further expansion is quite feasible in the event of an increase in demand.

2.1.5 Reserve stockpile

On the basis of enrichment agreements concluded during the period 1974-1975 with the Soviet Union, a reserve stockpile of low-enriched uranium has been built up since 1979. Natural uranium from Agnew Lake Mines and from Ranstad has been converted through the Eldorado Nuclear Ltd. and Comurhex and has been isotope-enriched in the Soviet Union. The stockpile is now equivalent to about 14 TWhe. Both enriched and depleted uranium is sent back from the Soviet Union in the form of uranium hexafluoride in cylinders.

The total quantity of uranium is equal to the quantity of natural uranium delivered to the Soviet Union. The enriched uranium is stored at Asea-Atom's fuel factory in Västerås, and the depleted uranium is stored in Studsvik.

Thanks to the stockpile and other reserves, the operation of the current Swedish nuclear power system is ensured for more than one year in the event of a complete cut-off of supplies from abroad.

Continued deliveries of enrichment services from the Soviet Union for the reserve stockpile corresponding to approximately the annual requirement for one reactor are planned during 1981. The natural uranium for these deliveries will come from Ranstad and will be converted at Comurhex.

A quantity of enriched uranium corresponding to about 11 TWhe will be added to the reserve stockpile in 1982.

2.2 DISPOSAL

In connection with the nuclear reactions in the fuel in the power reactor, products of a highly varying nature and with a varying degree of radioactivity are produced. The ultimate aim of disposal is that these products should be handled and terminally isolated in such a manner that no harm comes to the environment and to living organisms.

The following report on disposal has been broken down according to the facilities and systems that are currently considered necessary in order to effect the final disposal of all types of waste.

Since many of the facilities dealt with below have not yet been finally planned and designed, the schedules for and descriptions of these facilities should be regarded as tentative. Future developments and experience may also show that the functions of the different facilities in the disposal system can be combined in another manner than that on which the studies are based today.

For the present time, research and development work is being concentrated on necessary functions within the disposal system, and only some work is being done on the development and demonstration of specific facilities. Research is therefore dealt with in a special section. In order to provide a complete picture of activities within this field, research efforts being conducted through the National Council for Radioactive Waste (Prav) have also been summarized.

The various areas are dealt with below under the following headings:

2.2.1 Central temporary storage facility for spent fuel (Clab)

2.2.2 Reprocessing

2.2.3 Transportation

2.2.4 Final repository for reactor waste (Alma)

2.2.5 Temporary storage facility, encapsulation plant and final repository for high-level waste and for long-lived waste

2.2.6 Research
Efforts associated with the Stipulation Act
Fundamental data and mathematical models
Handling and disposal methods
Research through the National Council for Radioactive Waste (Prav)
The Stripa project

A rough schedule based on current assessments is presented below. The lines mark the building activity and the triangles the time when it is estimated that the system or the facility can be completed.

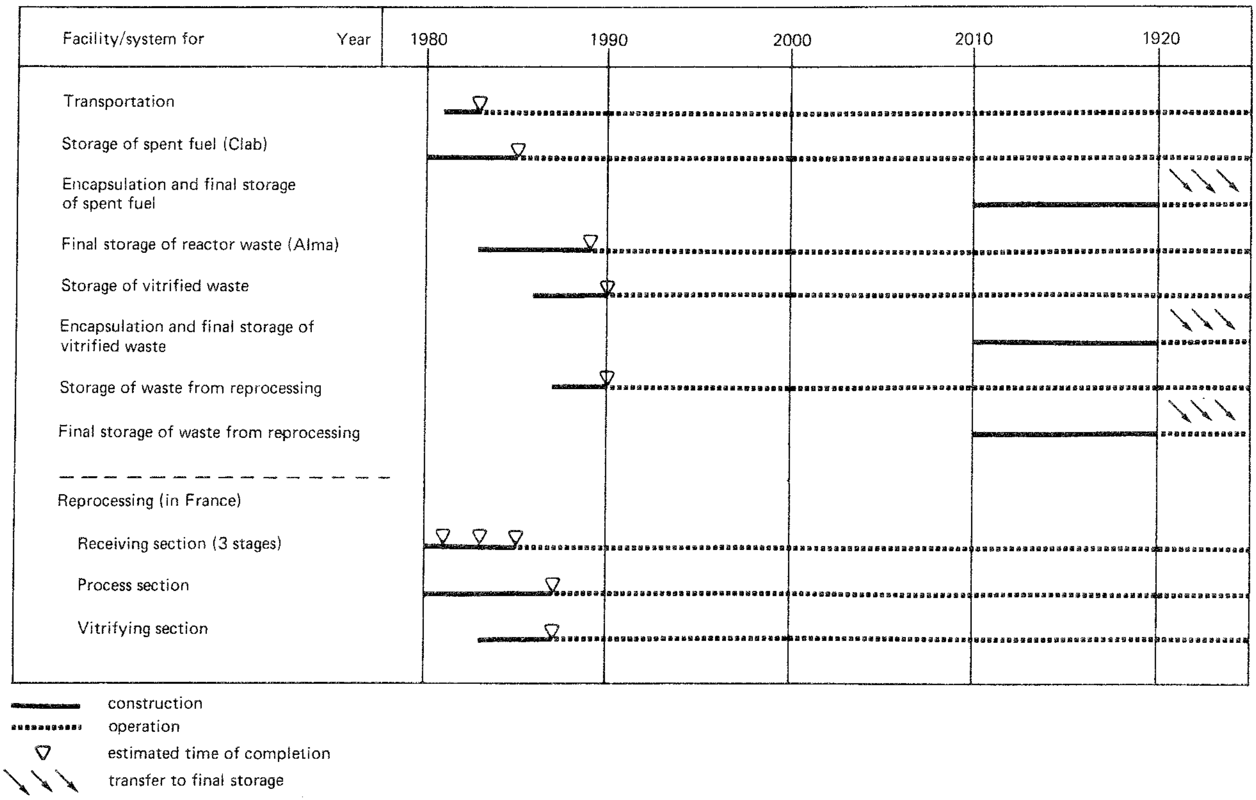

Figure 2. Schedule

The time sequence for the various facilities and measures has been chosen with the aim of ensuring undisrupted operation of the nuclear power plants as far as disposal is concerned for a long period of time. The first phase in this effort is the central temporary storage facility for spent fuel, Clab (chapter 2.2.1), with transportation system (chapter 2.2.3), both of which are currently being constructed. A second phase will be the construction of a storage facility for reactor waste (chapter 2.2.4) and its associated transportation system.

2.2.1 Central temporary storage facility for spent fuel (Clab)

The central temporary storage facility for spent fuel (Clab) described in the previous report is now under construction on the Simpevarp peninsula north of Oskarshamn in the vicinity of the nuclear power plant located there, which belongs to Oskarshamnsverkets Kraftgrupp AB.

The design of Clab entails a capacity to receive and store the spent fuel that is discharged from the Swedish nuclear system over a period of 12 years.

According to the schedule, the facility is expected to be ready by the end of 1984 to receive spent reactor fuel and certain core components from the nuclear power plants. Up to this time, storage capacity is available at the power plants.

All necessary licenses and permits for Clab, except for the commencement permit, were received during the month of August, 1979. The County Employment Board in Kalmar County granted commencement permission for the construction of the facility on 15 April 1980. Due to the Government's decision in connection with permission according to the Atomic Energy Act not to allow start of building before 1 May 1980, the project was subjected to a 7-month delay. This caused a slow-down in the planning and design work during the period September 1979 to February 1980.

Somewhat delayed due to the labour market conflict in the spring, clearing of the worksite began on 19 May 1980. Tunnel-driving and blasting for the foundations of the surface portions of the facility are currently under way. By the end of September 1980, approximately 110 metres of tunnel had been driven. Approximately 20 000 m^3 of a total of 45 000 m^3 of rock had been blasted out for the surface portions of the facility.

Figure 3. Worksite for Clab, 29 September 1980

The procurement of mechanical equipment for the receiving and storage section as well as monitoring equipment has commenced.

2.2.2 Reprocessing

In connection with reprocessing, spent reactor fuel is treated by mechanical and chemical processes so that the content of uranium and plutonium is separated in pure, concentrated form, while other radioactive components are transferred to various types of waste. Uranium and plutonium can be returned to the fuel cycle.

One advantage is that the long-lived toxicity of the waste is reduced compared to if the spent fuel were to be treated directly as waste. In addition, the recovered uranium and plutonium constitute usable nuclear fuel.

The disadvantage is the demanding industrial handling of highly radioactive products that is necessary and the fact that the total volume of waste increases.

Viewpoints on the risks entailed by the reprocessing and the plutonium for nuclear weapons proliferation are given in chapter 3.

As was mentioned in the preceding annual report, SKBF signed a reprocessing contract in 1978 with Cogema, the national French company in the nuclear fuel sector, on behalf of Sydkraft and the Swedish State Power Board for a nominal quantity of 620 metric tons of spent nuclear fuel, of which 160 tons were for Sydkraft and 460 tons for the Swedish State Power Board. This contract was part of the documentation submitted with the application for permission in accordance with the Stipulation Act to charge the Ringhals 3 and Forsmark 1 units with nuclear fuel, which was granted on 21 June 1979.

In March of 1980, SKBF exercised an option whereby the nominal quantity of spent fuel to go to this reprocessing was increased from 620 tons to 672 tons. The increase of 52 tons was solely for the Swedish State Power Board. The resultant enlarged contract was included in the documentation submitted for the permission according to the Stipulation Act that was granted on 10 April 1980 to charge the Ringhals 4 and Forsmark 2 units with nuclear fuel.

The project work for the UP3 reprocessing plant, which is under construction at La Hague for this and other contracts, is continuing more or less according to plan.

The first storage pools will be ready to receive spent nuclear fuel in the beginning of 1981. The most important administrative milestone for UP3 was passed in May of 1980, when the French Prime Minister, after approval by the "Conseil d'Etat", signed the "Décret d'Utilisation Publique". This means that the project has been accepted as being in the public interest and as complying with French laws and ordinances.

140 tons of spent light-water fuel were reprocessed in the existing UP2 reprocessing plant - also in La Hague - during the period from November 1979 to June 1980, bringing the total to 255 tons that have been reprocessed in UP2. The overall operational experience from this period is considered satisfactory, and the plant was run at full nominal capacity during certain periods. During the second half of 1980, mainly Magnox fuel will be reprocessed, plus some breeder fuel, followed by light-water fuel once again at the end of the year.

Results from the vitrification plant in Marcoule are judged to be good. Since the start of the plant about two years ago, 380 waste cylinders containing radioactive glass have been produced. The cylinders are 1 m high and have a diameter of 0.5 m. They are kept in an air-cooled temporary storage facility in Marcoule.

At British Nuclear Fuels Limited, the national British company in the nuclear fuel sector, work is in progress on a reprocessing plant for light-water fuel, but is considerably delayed compared to the situation at the Cogema in France. The delay was caused by a hearing mentioned in the previous report, which has now been held.

In Japan, a small reprocessing plant is operating in Tokai Mura with permission from the United States. This permission has been extended repeatedly. A special company has been formed with general industrial support for construction of a larger reprocessing plant with a capacity of 1200 tons per year.

2.2.3 Transportation

The Swedish nuclear power plants and Clab are located on the coast and have harbour facilities. The foreign reprocessing plants whose services may be used can also be reached via sea transport. Development work has therefore been conducted through SBKF aimed at a reliable sea transportation system for spent fuel and components. The central unit in this system is a specially-designed ship. Later on, when waste from reactors and reprocessing has to be transported, sea transportation will constitute an important alternative here as well. Experiences from the sea transportation system currently being planned will then be of value.

Design work through Salén Technologies AB on the specially-adapted roll-on/roll-off ship continued up to the end of 1979. Detailed technical procurement specifications have been drawn up. Tenders from Scandinavian, French and West German shipyards have been invited during the spring and summer of 1980. The choice of supplier will be made at the end of 1980. In April of 1980, a preliminary safety report for the transportation system as a whole was submitted to the appropriate Swedish authorities. Preliminary approval was obtained on 1 July 1980. At the present time, the preliminary safety report is being examined by the appropriate French authorities, whose findings are expected during 1980.

A transport cask contract was signed in 1980 between SKBF and Cogema, guaranteeing SKBF the right to use four transport casks, which are required for shipments during the 1980s in accordance with the reprocessing contract with Cogema (chapter 2.2.2). The casks will be manufactured at Uddcomb in Karlskrona.

The transportation system - consisting of ship, transport casks and terminal equipment - is expected to be ready for operation by the autumn of 1982. Shipments to France are planned up to the mid-1980s. From this time, shipments to Clab are also planned.

2.2.4 Final repository for reactor waste

Reactor operation gives rise to a group of radioactive waste that can be collectively designated as low- to medium-level. Data on these wastes - type, properties and quantities as well as available treatment methods - have been compiled and a report on them will be completed during 1980. The radioactivity of wastes of these types is expected to have declined to a harmless level after a period on the order of 500 years.

Project studies have been initiated - based on preliminary work done through Prav - on a plant for the final storage of low- and medium-level wastes (Alma).

Alma will be built adjacent to an existing nuclear facility, i.e. at a power plant site or at the Studsvik research station. Preliminary studies have been begun at Forsmark and Studsvik. The geological site investigations will be completed during 1981. Siting applications will then be submitted to the Government. The current aim is that the construction work shall begin in 1984 and the plant shall be finished and ready to receive waste in 1989.

2.2.5 Temporary storage facility, encapsulation plant and final repository for high-level waste and long-lived waste

By "high-level waste" is meant here such waste from the reprocessing process as contains most of the fission products formed in the fuel during reactor operation, as well as spent fuel, if it is decided to dispose of this directly without reprocessing. These high-level wastes are also long-lived, since they contain uranium, plutonium and heavier elements that have been formed during reactor operation, including the decay products of the elements. Examples of wastes that are long-lived but not high-level are various types of operating waste from reprocessing plants, such as certain filters and ion exchange resins. By "long-lived" is meant that the half-lives of the radioactive elements are often more than 100 000 years.

In the studies carried out through the Nuclear Fuel Safety project (the KBS project), the results of which have formed the basis of applications in accordance with the Stipulation Act, approved by the Government (KBS 1), a period of about 40 years is assumed to elapse between the time when the spent fuel is discharged from the reactor and the time when the high-level waste from the reprocessing of the fuel is placed in a final repository. In the studies conducted of the direct disposal of spent fuel without reprocessing (KBS 2), the same time delay has been assumed.

For the time being, there is no reason to alter this assessment. A final repository for products from 12 reactor units would thereby have to be completed by around the year 2020, and if it is assumed that the last completed nuclear reactor has an operating life of 25 years, waste from this reactor would be deposited in the final repository around the year 2050.

Due to this time factor, temporary storage capacity must be planned for a) vitrified high-level waste, b) cladding waste etc. from reprocessing, and c) spent fuel. Temporary storage of spent fuel takes place in Clab, which, as mentioned in chapter 2.2.1, is already being built. If it should ultimately be decided that spent fuel is to be directly disposed of without reprocessing, the capacity of Clab will have to be expanded. The technology for the other facilities already exists, and further development can be expected during the 1980s. A decision on the location of these facilities for temporary storage will have to be made around the middle of the 1980s. A site will have to be chosen for the final repository around the turn of the century.

Before the final repository is put into use, a plant for the encapsulation of waste or spent fuel in corrosion-resistant and radiation-shielding canisters will also have to be operational.

2.2.6 Research

A large concerted effort by the nuclear utilities in the field of waste disposal (the KBS project) was initiated after the 1976 Government declaration, followed by the 1977 "Stipulation Act". The work of the KBS project was concentrated entirely on the final storage of high level waste or, alternatively, spent reactor fuel in compliance with the requirements set forth by the law.

This limitation is artificial in relation to the requirements that must be made on a fully adequate and acceptable waste management system. The activities - as described in the preceding report - have therefore been extended to include all types of waste that arise in connection with the operation of nuclear power plants and the handling of spent fuel. Work is also being done on the dismantling of nuclear power plants.

A brief account of procedures and facilities for the final storage of the wastes, classified according to the duration of their radioactivity, was presented in the preceding chapters. The general principle is that the environment should be protected by a number of artificial or natural barriers. The more long-lived or high-level the waste is, the higher the demands on the barriers. By safety assessment it is then determined whether the system provides adequate safety against future excessively high radiation levels in the human environment.

The research, development and investigative work that is currently being done as a continuation of the efforts of the original KBS project is aimed at gaining further knowledge in a number of areas of importance for achieving safe final repositories. This work - most of which is contracted out to institutes, universities, consultants etc. - covers such fields as

- hydrogeology
- dissolution and leaching
- material transport via the groundwater
- corrosion of canister materials and their mechanical properties
- buffer materials and their long-term stability
- methods of measurement and analysis

Attempts are being made in most fields to develop or refine the mathematical models that have to be used to describe reality.

Efforts have been coordinated with the National Council for Radioactive Waste (Prav). Prav is in charge of a survey of the properties of various types of rocks with respect to their suitability for the location of a final repository as well as geochemical studies aimed at determining the rate at which the waste elements can be transported through the bedrock.

2.2.6.1 Work connected with the Stipulation Act

On the basis of the results of the investigations done in the KBS project and reported in the report KBS 1, applications from the power companies to fuel four new power reactors have been approved as follows:

	date of approval
- Forsmark 1	79-06-21
- Forsmark 2	80-04-10
- Ringhals 3	79-06-21
- Ringhals 4	80-04-10

Most of the data used for the safety analysis in the KBS 1 report on vitrified waste are from 1977 or before. Much better data are now available in many areas, and a revision of the safety analysis is planned.

The report KBS 2, which deals with the final storage of spent fuel without reprocessing, has been examined by 32 domestic and foreign bodies of experts. The final commentaries were obtained in June, 1980, and are now being analyzed. Viewpoints will be submitted to the Ministry of Industry. In many cases, the examination has resulted in extensive analysis and criticism of value for the continued work on this technique.

2.2.6.2 Fundamental data and mathematical models

The work has been concentrated on hydrogeological studies in a study area near Lake Finnsjö where seven boreholes to a depth of between 500 and 800 metres are available. Instrumentation has been improved, as have methods for sampling and measuring in boreholes.

Laboratory research is being carried out into the properties of clays and the migration and retention of nuclides in clays. The results from this research will be of importance for large-scale tests of buffer materials which will be performed in the Stripa project.

The mathematical models for groundwater movements and nuclides transports in fractured rock are being developed and refined. Work has begun aimed at developing mathematical models that describe the complex transport mechanism in the clay barrier around the encapsulated waste. The effects of radiolysis are also being taken into account.

2.2.6.3 Handling and disposal methods

In cooperation with Asea, a method for fixing cladding waste in a compact product has been studied. The method is based on hot isostatic pressing. It has also been presented to German and French experts.

The question of encapsulation and handling of so-called α-waste and medium-level wastes from reprocessing is being explored by a joint group with representatives from Cogema and Cogema's foreign reprocessing customers. The waste products must be acceptable in terms of safe transportation and final storage.

A study of the use of aluminium oxide as a canister material for spent fuel in a final repository has been concluded and will be published.

2.2.6.4 Research through the National Council for Radioactive Waste (Prav)

1) handling of low- and medium-level reactor waste

2) transport and storage of spent nuclear fuel and spent reactor components

3) reprocessing of spent nuclear fuel and solidification of high-level waste

4) final storage of radioactive waste in rock

5) information, risk analysis and other work for the programme areas collectively.

Within area 1), the preliminary study of a facility for low- and medium-level waste mantioned in section 2.2.4 has been carried out, as have studies of transportation needs and methods. New methods for treating radioactive waste have been studied, with the emphasis on the transfer of radioactive elements from organic to inorganic ion exchangers.

The work in areas 2) and 3) has largely been a follow-up of SKBF/KBS' activities, as well as certain work concerning actinide separation.

Work in area 4) has been coordinated with SKBF/KBS in the manner described on page 28. The survey of the Swedish bedrock has so far included surface investigations of eight rock types, and the geochemical studies cover the chemical equilibrium between waste elements and groundwater, the sorption of radioactive elements on minerals and rock faces and field measurements.

2.2.6.5 The Stripa project

Series of experiments concerning the conditions for the final storage of high level waste were carried out in the Stripa mine during the period 1977-80 in the form of a joint programme sponsored by the US Department of Energy, through Lawrence Berkeley Laboratory of California, and SKBF.

The experimental station at a depth of 350 m at Stripa has attracted international interest. A new research programme called the Stripa project, to explore various factors of importance for the final storage of high-level waste, will now be conducted in the Stripa facility. Participants include organizations from Canada, Finland, Japan, Sweden, Switzerland and the United States.

The work is being organized as an independent OECD/NEA project with KBS/SKBF as the host organization for the project.

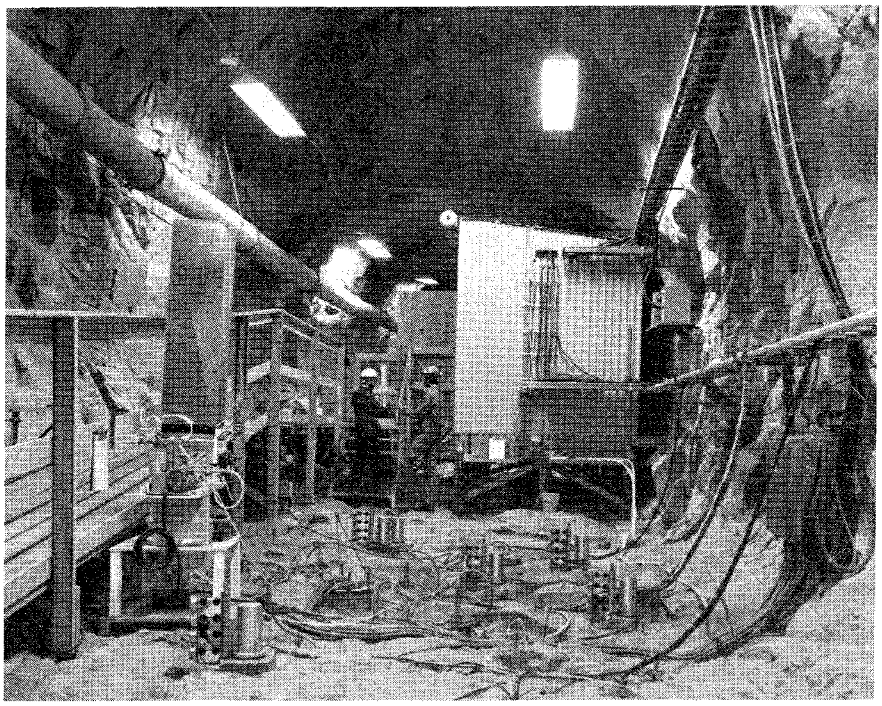

Figure 4. Experiments in the Stripa mine

Experimental programmes are proposed by the participant organizations and are examined by various technical subgroups that cover hydrology, geochemistry, migration, rock mechanics and barrier research. Each programme has a Principal Investigator, and a Joint Technical Committee consisting of representatives of the different countries is in charge of the entire project. The contribution for full members for a four-year period is at least SEK 7.2 million per member.

The following programmes have been scheduled this far:

Hydrogeological studies in boreholes

The purpose of the experiment is to develop and test instruments for geological and hydrogeological studies in horizontal and deep vertical boreholes. The programme will also provide additional information on groundwater chemistry at depths down to about 1400 m below the surface.

Migration studies in fractured rock

The goal is to determine the migration rate in a water-bearing fracture of the nuclides contained in the waste and to verify laboratory results concerning adsorbing substances.

Buffer tests

Highly compacted bentonite and mixtures of bentonite and sand are proposed buffer materials for the storage of high-level waste in rock.

The buffer shall fill up the space between the waste canisters and surrounding rock. Its purpose is to provide mechanical support and protection for the canister, to serve as a heat-conducting medium from the canister to the rock, to stabilize the chemical environment around the canister and to constitute a barrier against water flow directly up to the canister surface.

The purpose of this investigation is to test the suitability of bentonite as a buffer material under actual conditions. Simulated waste containers surrounded by compacted bentonite are placed in large holes drilled in the bottom of a test tunnel. Parts of the tunnel are filled completely with a proposed mixture of sand and bentonite. Measurements of temperature, swelling pressure and water uptake in the buffer materials will be made for about four years.

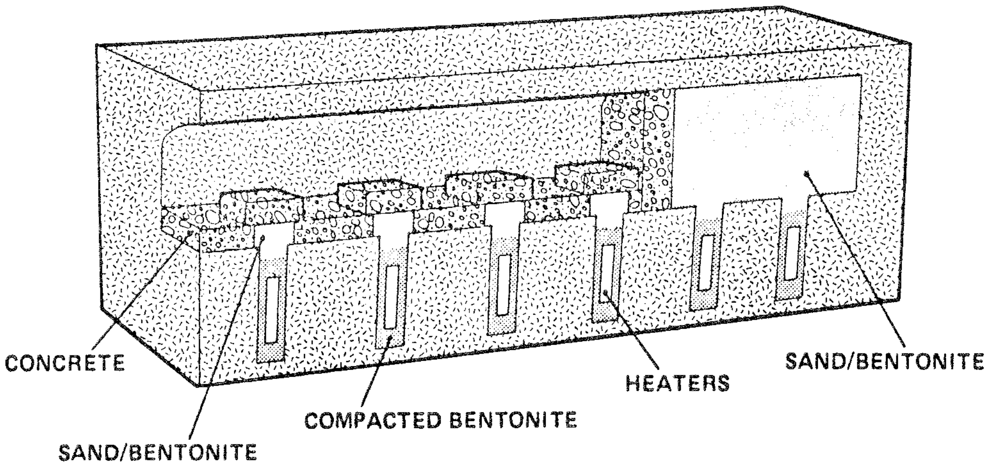

Figure 5. Buffer tests in Stripa

3 ENSURING THAT PRODUCTS AND SERVICES ARE NOT MISUSED FOR WEAPONS PURPOSES

The conditions for international trade - and thereby security of supply for Sweden - in goods, services and equipment in the peaceful nuclear energy sector are controlled to a high degree by safeguards measures adopted to prevent misuse for weapons purposes. At the same time, sound international trade in the nuclear fuel sector can only work within the framework of an effective and generally accepted non-proliferation system.

Up to the latter half of the 1970s, the Non-Proliferation Treaty (NPT) and the agreement on supervision of a country's nuclear energy activities through the International Atomic Energy Agency (IAEA) in Vienna constituted the framework within which a relatively free trade could proceed. However, India's detonation of a nuclear device led to regulations or laws in important supplier countries (mainly Canada and the United States) to be enforced through bilateral treaties, which have greatly affected the trading conditions.

Demands imposed by important supplier countries apply to both the delivery of products and services (uranium and enrichment) and the delivery of equipment. The supplier country must give prior consent for certain industrial uses or sales of delivered uranium or products thereof from the importing country to other countries. This applies especially to enrichment, reprocessing and plutonium handling.

While such regulations, which aim at reducing the risk of misuse of equipment and materials, are acceptable in principle, there are examples of enforcement by the supplier countries in unacceptable forms. One example is the short-sighted processing of permission applications case by case. This makes it difficult or impossible for the nuclear power producers in the consumer countries to plan ahead and increases their economic risk-taking. The credibility of the supplier as a reliable source can also be questioned, since there is a risk that the decision in the matter of permission will be based on values or requirements that have nothing to do with the question of weapons proliferation.

A burdensome administrative system for control, has also emerged. The country of origin of shipments of uranium, enrichment services, fuel assemblies, losses etc. must be recorded and reported. If several supplier countries are involved, the control system becomes increasingly complicated and burdensome ("double labelling"). However, nature's elements are identical, regardless of country of origin. Nor is it possible to identify the nation of origin of e.g. enrichment services. Control measures of this type may have a symbolic value, so that uranium from a specific supplier country does not form part of a nuclear weapons arsenal, but their practical value in terms of preventing nuclear weapons proliferation is highly dubious.

Enrichment and reprocessing represent "sensitive technology", which means that facilities for peaceful use can be modified to produce highly enriched uranium or plutonium of weapons grade. Domestic facilities of this type are currently not included in Swedish plans, as mentioned above. SKBF considers it a matter of national interest that such facilities be developed under multinational auspices and under IAEA control.

SKBF considers adequate safeguards in this area to be fundamental for a satisfactorily functioning nuclear power programme, both in our country and internationally, and important in ensuring public confidence in nuclear power. SKBF believes that it is urgent that the Swedish Government and the Swedish public authorities pursue a consistent international atomic policy that satisfies both political and radiological safety requirements and establishes reasonable conditions for trade.

4 INTERNATIONAL COOPERATION

The conditions for nuclear power and the nuclear fuel cycle are dependent upon the international situation and international cooperation, and no national programmes can be developed in isolation.

4.1 INTERGOVERNMENTAL COOPERATION

During the period covered by this report, the International Nuclear Fuel Cycle Evaluation (INFCE), in which SKBF has participated with personnel, was concluded and the results reported. The work involved evaluations of the risks in the nuclear fuel cycle of contributing to nuclear weapons proliferation. Nothing fundamentally new in technical terms has emerged from the evaluation. Technical choices or safeguards measures in civilian nuclear power systems that provide a complete quarantee against misuse do not exist and can never exist. The issue of nuclear weapons and the risk of weapons proliferation is a political problem and should be dealt with politically. This in no way contradicts the importance of a "non-proliferation regime" with an associated international system of control and supervision (IAEA). At the same time, the system must be functionally and commercially practical.

Important international and bilateral agreements have been postponed pending the results of the INFCE. With the large-scale expansion of nuclear power that is currently taking place in the world, it is urgent that a continuously improved system of non-proliferation and trade be initiated in international cooperation to replace the existing patchwork of rules and regulations, which do not serve their purpose.

An initiative has recently been taken in this respect, namely the formation of the Committee on Assurances of Supply within the IAEA in Vienna. It appears as if this committee will be the forum within which intergovernmental work on the conditions of international supply and trade can be pursued.

The importance for Sweden of a trading system that satisfies non-proliferation requirements while permitting planning ahead and autonomy in the design of the Swedish industrial nuclear power programme has been strongly emphasized earlier in this report.

In addition, SKBF would like to emphasize - against the background of the worldwide spread of nuclear power - the urgency of international guidelines governing safety in the various phases of handling associated with the generation of nuclear power. There is no other industrial sector within which accidents, mishaps or improper industrial handling can have such negative effects in other countries as in the nuclear power sector. The nuclear power industry will benefit from uniform international rules of safety and commerce of good standard.

Responsibility for these matters lies with international governmental organizations, mainly the IAEA in Vienna and the NEA (Nuclear Energy Agency) within the OECD in Paris. As far as bilateral agreements are concerned, these are naturally the concern of the governments involved. SKBF participates with consultants in the Swedish Government's efforts in these respects, with the fundamental points of views described above.

4.2 INTERNATIONAL COOPERATION IN RESEARCH AND INDUSTRY

SKBF is participating in many different ways in bilateral and multinational cooperation in research and industry. The company is a member of the Atomic Industrial Forum in Washington, D.C., and the Uranium Institute in London. In the latter organization especially, persons from SKBF have actively participated in studies of the conditions for trade on the nuclear fuel market, among other things, where conclusions and recommendations represent the shared view on the part of both producers and consumers in the world's most important nuclear power countries (see chapter 6).

SKBF also follows the work being done in such organizations as UNIPEDE (the organization for the European power companies), the Nordic Contact Agency for Atomic Energy Matters and NORDEL (the organization of the Nordic power companies).

Extensive international cooperation has been brought about through the KBS project, especially as regards research and development within the area of nuclear waste. A multinational agreement on an exchange of experiences was signed in 1980. As was mentioned above, the Stripa project is being conducted as an international development project. Outside foreign experts and organizations are being used both for the development work and for the work on specific projects, such as Clab, transportation systems and prospecting.

In the wake of the reprocessing contracts with Cogema, joint consultation groups have been organized between Cogema and its customers for technical-economic follow-up of the plant project, transportation matters and specifications of the wastes.

5 COMMISSION OF INQUIRY CONCERNING RADIOACTIVE WASTES FROM NUCLEAR POWER – ORGANISATION AND FINANCING MATTERS SOU 1980:14

The commission that presented its findings on 17 April 1980 is expected to have an important influence on the future role of SKBF. A short summary with comments by the company is given below.

The commission has considered different organizational alternatives and recommends:

- that the direct handling and storage of the radioactive waste products be entrusted to a limited company owned jointly by the nuclear power companies
- that a new agency be created for certain control and supervisory functions
- that Prav be dissolved.

With respect to the financing of the waste costs of nuclear power, the commission finds that the final solution will depend upon developments in the field. The commission therefore proposes only the main features of a system. They are, in brief, as follows.

The nuclear power companies and the company owned jointly by them are responsible for allocating and managing the necessary funds so that they are available when needed. The allocated funds are to be managed by the nuclear power companies themselves. The new agency is to exercise a general supervisory and watchdog function. To the extent that allocated funds are invested or lent, adequate security should be provided. The allocation for electricity produced by nuclear power and delivered through 1979 should be SEK 0.014 per kWh.

The nuclear power companies share in essence the view of the commission. SKBF has announced that it is prepared to assume the functions of the outlined jointly-owned company. But the nuclear power companies feel that it is not necessary to create a new agency. The functions are more suitable for a board, which would also permit a more direct and flexible handling of matters.

The nuclear power companies also share the view of the commission that the costs for the waste products of nuclear power shall be borne by the electrical production that gave rise to these products, and that allocations must be made for this purpose, since certain costs will fall due at a later point in time. The necessary funds should be allocated within the nuclear power companies themselves. However, the nuclear power companies do not feel that there is any reason to try to treat the allocated funds in a special manner, such as by demanding special securities in certain situations. The power industry is deemed to be a stable industry with competence and resources to assume responsibility for the handling and storage of the waste products, at least in the short and medium-long run. This responsibility carries a corresponding financial responsibility. Demands for special securities for funds that are handled normally on a balance sheet are not considered to be justified in view of the requirements, controls and regulations already provided for by pertinent legislation.

It is pointed out that certain legislation permitting allocations for the above-specified purpose has already been enacted at the initiative of the nuclear power companies (via SKBF) and that the allocations made as of the end of 1979 for Sydkraft and OKG and as of 1 July 1980 for the Swedish State Power Board amounted to a total of about SEK 1100 million.

6 LECTURES AND PUBLICATIONS

6.1 CERTAIN EARLIER LECTURES AND PUBLICATIONS

Handling of Spent Nuclear Fuel and Final Storage of Vitrified High Level Reprocessing Waste
KBS final report 1, volumes 1-V, Stockholm 1977

Handling and Final Storage of Unprocessed Spent Nuclear Fuel
KBS final report 2, volumes I-II, Stockholm 1978

Safe Handling and Storage of High Level Radioactive Waste
A Condensed Version of the Proposals of the Swedish KBS-Project regarding Reprocessing Waste and Spent Fuel - Stockholm 1979

Handling of Spent Nuclear Fuel and Final Storage of Vitrified High Level Reprocessing Waste
Supplementary Geological Studies
KBS, Stockholm 1979

A Central Spent Fuel Storage in Sweden
B Gustafsson and R Hagbert (SKBF/Clab)
NEA Technical Seminar on the Storage of Spent Fuel Elements, Madrid, June, 1978

Consuming Country Safeguards
E Svenke (SKBF)
International Bar Association, Biennial Conference Sydney, September 1978

Report on the Current Situation with Regard to Nuclear Fuel and the Operations of Svensk Kärnbränsle-försörjning AB
(Swedish Nuclear Fuel Supply Company) during 1978 and 1979 up to the month of September
Report to the Swedish Ministry of Industry, November 1979

Bentonite-based Buffer Substances for Isolating Radio-active Waste Products at Great Depths in Rock
R Pusch (University of Luleå), A Jacobsson (University of Luleå) and A Bergström (KBS) IAEA-SM-243
Underground Disposal of Radioactive Wastes, Vol. 1
Helsingfors 1979

Transport Mechanisms and Rates for Transport of Radionuclides in the Geosphere as Related to the Swedish KBS Concept
I Neretnieks (Royal Institute of Technology, Stockholm)
IAEA-SM-243
Underground Disposal of Radioactive Wastes,
Helsingfors 1979

The Swedish Nuclear Fuel Safety Project for Long-Term Disposal of High-Level Waste
B Allard (Chalmers University of Technology)
Trans. American Nucl. Soc. Ann. Meeting 32 (1979) 162

6.2 LECTURES AND PUBLICATIONS DURING THE PERIOD COVERED BY THE REPORT

The KBS Annual Report 1979
Including Summaries of Technical Reports Issued during 1979
KBS Stockholm, March 1980

Corrosion Resistance of Canisters for Final Disposal of Spent Nuclear Fuel
E Mattsson (Swedish Corrosion Institute)
Scientific Basis for Nuclear Waste Management 1 (1979)271

Highly Compacted Sodium Bentonite for Isolating Rock-Deposited Radioactive Waste Products
R Pusch (University of Luleå)
Nuclear Technology 5 (1979) 153

Nuclear Power and Nuclear Weapons (in Swedish)
F Barnaby (SIPRI) and E Svenke (SKBF)
The Coordinating Board of the Swedish Research Councils, Stockholm, 1980

Safe Handling and Storage of High-Level Radioactive Waste
P-E Ahlström (KBS), S Löfveberg (Prav), LB Nilsson and T Papp (KBS)
Radioactive Waste Management 1, 1 (1980)57

Feasibility of Safe Terminal Disposal of Spent Nuclear Fuel
LB Nilsson and T Papp (KBS)
IAEA Bulletin 22, 3/4 (1980) 63

Ceramic and Pure-Metal Canisters in Buffer Material for High-Level Radioactive Waste
P-E Ahlström (KBS)
Nuclear and Chemical Waste Management 1,1 (1980) 77

Towards Nuclear Waste Storage
B Allard (Chalmers University of Technology) CHEMTECH, April (1980)

The KBS Project - an Overview from the Viewpoint of
Rock Mechanics (in Swedish)
A Bergström (KBS)
BeFo Rock Mechanics Day, Stockholm 1979

Political Factors in the Nuclear Fuel Trade and
Nuclear Fuel Supply (in Swedish)
E Svenke (SKBF)
Engineers' Club in Falun, 28 February 1980

Nuclear Power and Nuclear Weapons (in Swedish)
E Svenke (SKBF)
Rotary, Stockholm, 20 February 1980

The Management of the Nuclear Fuel Cycle - A Swedish
Approach
E Svenke (SKBF)
Introduction at German-Swedish Seminar, April 14, 1980

Highly Compacted Bentonite for Borehole and Shaft
Plugging
R Pusch (University of Luleå) and A Bergström (KBS)
OECD/NEA Workshop on Borehole and Shaft Plugging
Columbus, Ohio, May 1980

Radioactive Waste Management in Sweden
T Papp (KBS)
ANS Meeting, Las Vegas, June 1980

The Need of Nuclear Energy and its Problems:
Availability of Supplies within the Nuclear Fuel Cycle
E Svenke (SKBF)
11th World Energy Conf., Munich, Sept. 1980

The Back End of the Nuclear Fuel Cycle Technical
Solutions and Safety Analysis in the KBS Concept
P-E Ahlström, LB Nilsson (KBS)
11th World Energy Conf., Munich, Sept. 1980

Assurance of Supply - A Matter of Confidence
E Svenke (SKBF)
Atomic Industrial Forum, International Conference on
the Nuclear Fuel Cycle, Amsterdam, Sept. 1980

The Swedish Nuclear Waste Management Programme
T Papp (in Swedish)(KBS)
NKA Seminar 1980, Ebeltoft, Denmark, 29 Sept.-1 Oct.

"Front End" - the Current Situation in the Nordic
Countries (in Swedish)
I Lindholm (SKBF)
NKA Seminar 1980, Ebeltoft, Denmark, 29 Sept.-1 Oct.

"Back End" - The Current Situation in the Nordic
Countries (in Swedish)
B Gustafsson (SKBF)
NKA Seminar 1980, Ebeltoft, Denmark, 29 Sept.-1 Oct.

6.3 PUBLICATIONS FROM THE URANIUM INSTITUTE

SKBF has participated in the making of the following reports from the Uranium Institute, London:

Government Influence on International Trade in Uranium October 1978

The Nuclear Fuel Bank Issue as seen by Uranium Producers and Consumers - May 1979

The International Nuclear Fuel Cycle Evaluation Report: Initial Comments by the Uranium Institute - March 1980