

Nuclear Politics in Sweden



BY NANCY E. ABRAMS

IN SWEDEN, THE MODEL of a prosperous modern country, with one of the most stable governments in the world, two governments have fallen from power since 1976, leaving the country in the hands of a minority government elected by a tiny fraction of the members of Parliament, and leaving the Swedish people seriously divided. At issue is the future of nuclear power in Sweden. What happened has not been well reported in the United States; yet despite, or perhaps because of, the lack of information and understanding here, the Swedish controversy has been used to support all sides in the nuclear debate in the United States.

Sweden has virtually no oil or coal of its own. About 70 percent of its energy needs are met by importing oil and 5 percent by importing coal. Most of the rest of Sweden's energy is supplied by hydroelectricity. However, Sweden has been developing its nuclear technology since the fifties, and as of 1970 its plans were to develop all parts of the nuclear fuel cycle domestically, including uranium mining, enrichment and fabrication, and ultimate disposal. Sweden has substantial uranium deposits, estimated at 12 percent of the world's known reserves, but buys all its uranium abroad. Every community in this individualistic country has a veto right over any project to be undertaken within it, and this has made the mining of uranium extremely difficult.

In 1973, one year after the first large commercial reactor for the production of electricity had gone into operation, Birgitta Hambreus, a member of Parliament, introduced a resolution, which the Parliament passed,

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calling for a moratorium on nuclear power until the implications of an expanding nuclear industry could be thoroughly studied. The controversy set off by this action has been one of the most heated and widespread in Swedish history. In 1975 the Social Democratic government responded by presenting an energy policy program aimed at reducing the rate of increase of energy consumption by 1985. The plan included conservation measures and research and development efforts in renewable energy sources, but it also projected a need for thirteen nuclear reactors by 1985. Five were operating at the time with several more under construction.

The following year the Social Democrats, who had governed without interruption for 44 years, were voted out of office and a new government took over. It was a coalition of the second largest party, the Center party (formerly the Farmers' party), with two small parties, the Liberals and the Conservatives (also called Moderates). Thorbjorn Fälldin, the Center party head who became Prime Minister, is a farmer who sometimes leaves Stockholm on weekends to go home and farm. He is a committed opponent of nuclear power. The smaller parties in his coalition were not anti-nuclear, however, and a compromise was reached at the beginning of the coalition's term. That compromise resulted in passage of the 1977 Stipulation Law, which proved central to the events that followed.

The Stipulation Law

The Stipulation Law provides that a utility may not obtain a permit to load fuel into a new nuclear power plant until it:

EITHER

- (A) (1) *presents a contract which adequately provides for the reprocessing of spent fuel from the reactor*

AND

- (2) *also demonstrates how and where the final deposition of the highly radioactive waste resulting from the reprocessing can be done with absolute safety*

OR

- (B) *shows how and where the spent but not reprocessed nuclear fuel can be finally stored with absolute safety.*¹

Nuclear proponents rejoiced at passage of this law because now, they assumed, all they had to do was produce a plan for nuclear waste disposal and some sort of contract and they would not be bothered again. The anti-nuclear forces were also pleased, thinking that it would be impossible for anyone to show that any method for nuclear waste disposal could live up to the standard of "absolute safety" required by the law, and that therefore nuclear power would be halted in Sweden. They were both wrong. Laws do not end disputes nearly as often as they create them.

Upon passage of the Stipulation Law, the utilities set up an organization called KBS, which stands for Nuclear Fuel Safety in Swedish. KBS, after one year's work, produced in the fall of 1977 the five-volume plan called the "KBS Report," which purports to demonstrate a safe method of disposal for high-level liquid waste from reprocessing. More than 400 scientists and other technical people had been involved in producing the report, a substantial fraction of the relevant technical talent in this country of eight million. The plan was generally laid out in Volume 1, with detailed technical explanation and appendices in the other volumes which were based largely on about forty technical reports (which have now been increased to more than one hundred).²

In December 1977 Vattenfall, the Swedish State Power Board, submitted an application under the Stipulation Law for permission to load fuel into the Ringhals 3 reactor. Vattenfall chose to apply under the reprocessing option (A) of the law and thus submitted, along with the KBS Report, a contract for reprocessing entered into with the French government-owned company, COGEMA. The resolve of the new government was now put to the test.

The KBS Plan

In outline, the KBS plan is as follows: spent fuel rods are to be stored for up to ten years in a central storage facility in Sweden, but shipped as soon as possible during that time to France for reprocessing at La Hague, near Cherbourg. There COGEMA is to separate out the

uranium and plutonium, which remain Swedish property, and vitrify the remaining high-level liquid wastes. More precisely, COGEMA is to combine the highly radioactive waste with molten glass at a concentration of 9 percent waste by weight, and then encase the glass blocks in 3 mm stainless steel for reshipment to Sweden, starting not earlier than 1990. In Sweden they are to be stored for thirty years more, cooled by electric fans, then encased in 10 cm of lead and 6 mm of titanium and buried in tunnels 500 meters deep in granite. The buried blocks are to be retrievable until the last one is emplaced, during which time the clay packed around the blocks underground is to be constantly irrigated to keep the blocks cool. Finally, the tunnel is to be back-filled with a quartz sand and bentonite clay filler material.

When a complex governmental decision must be made, it is Swedish practice to circulate the relevant documents to various agencies, professional organizations, universities, labor unions, and others for review in what is called the "remiss process." Each institution sends its comments back to the responsible agency in Sweden (in this case, the Ministry of Industry), where they are summarized and forwarded to the government. Due to the importance of the nuclear waste issue, two extraordinary reviews were also undertaken: one by foreign individuals and institutions (including many Americans) and the other by the Swedish Energy Commission. This latter body was a politically appointed group whose work was handled mainly by five technically expert working groups responsible to it. Its working group on "safety and the environment" was called EK-A (Energy Commission, group A), and to it fell the task of reviewing the KBS Report.

"Scientific Mediation"

My involvement in the events in Sweden came about as a result of EK-A's decision to use a scheme inspired by "scientific mediation" in performing the review. I had published an article with a scientist co-author in April 1977³ proposing the idea of

"scientific mediation"—a scheme by which we believed a government agency (or anybody in the position of making a policy decision) could obtain clear, balanced technical advice on issues where the decision makers themselves did not fully understand the technical aspects and when, to make things worse, the technical experts disagreed with each other. This is, unfortunately, a very common situation and one of the major causes of government paralysis on such technological issues as energy policy.

Our scheme was quite simple. One scientist representing each main position on a scientific question—someone recognized as an expert on the subject—would meet with other such scientists and write a joint paper, with the assistance of a mediator, in which the scientists would explain: (1) their areas of agreement; (2) their areas of disagreement; (3) each scientist's actual reasons for disagreement on each point; and (4) what information had to be obtained before a sensible decision could be made.

The radical innovation in this approach is that the scientists are asked why they disagree. People who have not worked in government may not appreciate how intimidated even powerful politicians can become when confronted with scientific jargon, and how unlikely it is that they will ask the questions that could enable them to figure the issues out for themselves. Ordinarily, one of two things occurs: opposing conclusions are justified in separate papers, relying on differently selected data and emphasizing different aspects of the issue (papers like this are difficult if not impossible for the lay reader, including government officials, to reconcile); or a scientific advisory committee is established and produces a compromise report in which opposing views are papered over or made to appear reconciled by the use of purposely vague language (this also is frequently useless to all concerned).

Scientific mediation aims to produce a single, primary source in which opposing arguments and interpretations are clearly presented and answered *point for point* by experts in the field. Scientific mediation has the further advantage—which probably attracted the Swedes more than anything else—that it cannot easily be attacked as biased by

any of the main parties to the controversy since their points of view are not only equally represented but equally explained. The purpose of the mediator is to hold the participants to the agreed-upon procedure, to help them ask the hard questions scientists are often too polite to ask each other, and to shame them into writing intelligible prose.

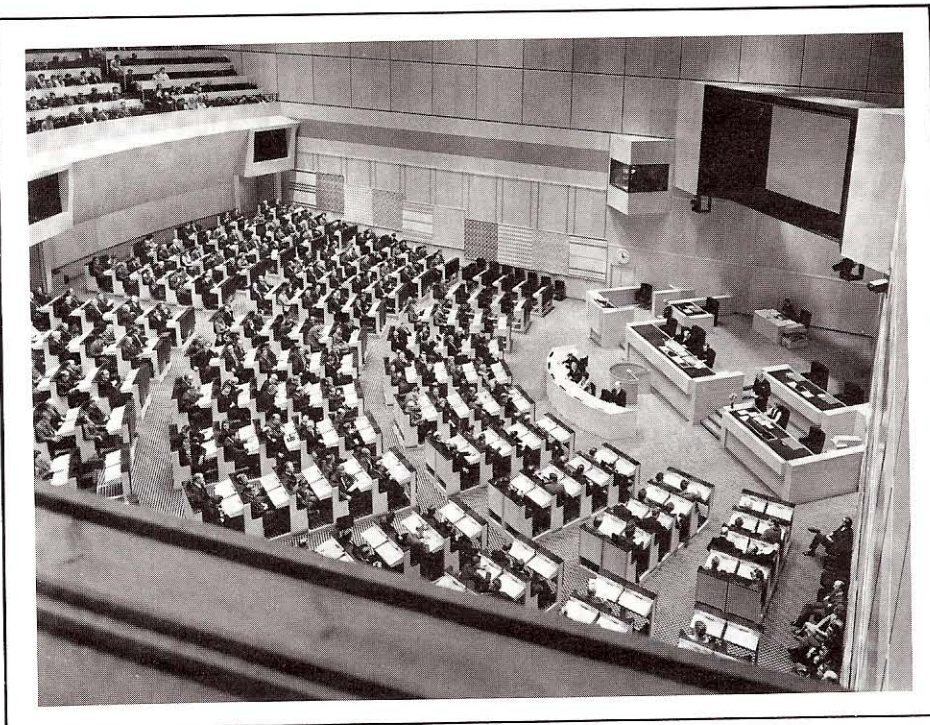
The Rydberg-Winchester Review

The members of EK-A felt strongly that the public deserved better information than they had so far received and that what was needed was a review of the KBS Report which would be accepted as fair by both sides. EK-A chose to use the basic scientific mediation concept—that is, to have a joint paper co-authored by opposing experts who explain not only their views and disagreements but the grounds for those disagreements—but decided to have the scientist-authors work together without a mediator. In addition, a panel of expert technical consultants was set up to review each draft of the joint paper, to make suggestions to the co-authors (which they were free to

accept or not as they chose), and to be generally available to the co-authors for consultation.

The two scientists chosen to perform the main work of the review were John W. Winchester, a professor of oceanography and earth chemistry at Florida State University in Tallahassee, and Jan Rydberg, a professor of nuclear chemistry at Chalmers University of Technology in Gothenburg, Sweden. On the basis of their background knowledge, Winchester was basically skeptical and Rydberg was quite confident that nuclear wastes could be safely disposed of by burial. EK-A was unable to find a competent scientist in Sweden to take the skeptical role, they said, because so many had been involved in the KBS study. Rydberg, in fact, had been heavily involved in the study. He and members of his laboratory were responsible for the KBS Report's main technical appendices on rates of migration of nuclides in groundwater. This is a crucial factor in determining the safety of underground nuclear waste disposal since it is part of the basis for predictions as to how long it will take for radioactivity to be carried by

The Swedish Parliament was controlled by the Social Democratic party for 44 years until 1976, when they were replaced by a coalition headed by Center party leader, Thorbjörn Fälldin, a committed opponent of nuclear power.





Photos courtesy of Swedish information Svc.

Entrance to the Ringhals atomic energy plant at Väröbacka, Sweden, which began operation in 1974. The application for a third reactor at Ringhals precipitated a government crisis.

groundwater to rivers, lakes, wells, and the biosphere in general. Regardless of how the radioactive waste is encased, the question is not *whether* but *when* the long-lived radioisotopes will escape into the groundwater.

After about five months' work, including many meetings in Stockholm not only with EK-A and the expert consultants but also with KBS spokesmen, Rydberg and Winchester completed their review in April 1978.⁴ The review succeeded in organizing and analyzing many of the central technical issues, and it explained, in a clearer way than was anywhere else available, many of the uncertainties, methodological inconsistencies, and omissions involved in the KBS plan. There was a considerable amount of agreement on technical issues in the review; it was striking, for example, that even Rydberg, the scientist confident that the KBS plan would work, recognized many of its deficiencies and justified his continued confidence by his faith in the ability of technology to solve any problems the plan might create.

The main shortcomings of the review resulted from the fact that the

co-authors were unaccustomed to the kind of procedure they were to follow—in particular, the central purpose of producing a report that explained in plain language why they differed on specific issues and conclusions. This result was probably partly due to the fact that they had no mediator to hold the process tightly together. Professor Winchester has also told me that although he feels very positive about the experience of undertaking a joint technical review, one of his and Rydberg's main difficulties was in maintaining a common attitude of objectivity while working in areas where their viewpoints differed substantially. The tensions which arose at times from this situation could, I believe, have been reduced had a mediator been there to assist the co-authors with their main task. Since many of their differences were not explicitly reconciled but rather discussed in separate sections, the review does not treat directly the basis for their differences.

The report does contain, however, some of the most important of the published comments on the KBS plan. Thomas B. Johansson, one of the two people responsible for compiling the

Department of Industry's superb summary and analysis of all the review comments,⁵ had also been heavily involved in the EK-A review, including the selection of both the procedure and the co-authors. He understood the Rydberg-Winchester review thoroughly, and it is reflected in his writing of the summary.

The technical competence of the review was acknowledged by both sides in the debate, but what was most welcomed, especially by environmentalists, was its openness in a country where a critical analysis of the technical data behind a government plan or decision is difficult to obtain. In decisions about technology policy there is a shortage of informed critical input in all countries, but certain opportunities for input do exist in the United States—such as Congressional hearings, the environmental impact review process, and an active public interest movement funded by membership dues and by private foundations—which do not exist in Sweden.

The importance of the Rydberg-Winchester review is also indicated, somewhat indirectly, by the fact that, for two months after the review was completed, members of EK-A who were also members of KBS (there were several) insisted on their rights as EK-A members to have various trivial corrections made and questions answered. This contributed to a delay in publication at a crucial time in the public debate, decreasing to some extent the review's impact.

It should be made clear that Rydberg's close involvement in the KBS project, whose report he was supposed to be reviewing, was not regarded as especially surprising by the Swedes. What seem to an American to be direct conflicts of interest are almost the rule in Sweden, where individuals openly work at the same time for as many as five boards and agencies, which may include the utilities; the Swedish Nuclear Inspectorate, which regulates them; and the Swedish Energy Commission, which recommends policy concerning them. I learned to check the letterhead of stationery to discover under what hat my correspondent was writing to me.

The Swedish parliamentary system is strikingly different from the American system of checks and balances. In the parliamentary system there is, generally speaking, one master—the parliament—which determines policy for the country. All people who work for the government are supposed to cooperate. In the United States, on the other hand, since each branch of government is supposed to counterbalance the other two, a person working for one branch must protect its interests against the other two in order for the system to work. Even within the executive branch, the agencies often take adversary positions with respect to each other. The United States thrives on internal conflict, and this requires that the public as well as every agency and member of Congress be as informed as possible. This is not the norm elsewhere and it is in fact bewildering to many Europeans that the United States can function with such continual inefficiency and apparent disorder.

Far from feeling, as many Swedes apparently do, that an intelligent person can do several things, Americans are suspicious of a person who does not give undivided loyalty to his main job, and the burden is always upon him to show that his other activities do not conflict with the primary one. Apparently the only conflicts of interest officially frowned upon in Sweden are economic ones, although I did hear complaints from environmentalists and journalists that a few people in the nuclear industry held too many key positions. Upon inquiring, I was usually told that Sweden is a small country with not enough talent to go around and that, when a single party is in power for 44 years, things work on the basis of friendships and long-term loyalty, not formal rules.

Other Reviews

The Rydberg-Winchester review thus took its place in the review process together with the reviews performed by the foreign experts and the remiss organizations. Of the 24 foreign organizations and individuals who were sent the KBS Report for review, three liked it (the International Atomic Energy Commission, a Finnish geologist, and a German geologist); three or four more gave reserved approval; and the rest were to

varying degrees negative. Some of the most negative responses came from the California State Energy Commission, the U.S. Geological Survey, and scientists from the Jet Propulsion Laboratory in Pasadena (writing as individuals). Twenty-five organizations in Sweden were sent the KBS Report under the remiss system and many of their comments were also negative. Two of the reviews given the most weight in Sweden—those of the Swedish Radiation Protection Institute and the Swedish Nuclear Power Inspectorate—approved the plan. However, there is not exactly an arm's length relationship between these agencies and the KBS, nor between the two agencies. Furthermore, by Swedish standards this was an unusual remiss. According to the Department of Industry's summary:

The task of the remiss organizations usually is, within the context of their own competence and interests, to comment on the desirability of proceeding with the described action. The strength of the remiss process is that it provides a formal mechanism for elements of society, holding very diverse opinions and values, to express their opinion as to whether or not a proposed action is acceptable, not whether or not it is technically possible. . . . [I]t is obvious that what was hoped for in the KBS case was a technical review, not a remiss. [Emphasis in original.]

Continuing Uncertainties

My own view of the adequacy of the KBS plan is that it pays too little attention to immediate and short-range problems and places too much reliance on very uncertain data regarding the long-term behavior of the repository. The plan focuses on the isolation of nuclear wastes from the biosphere once they are buried in the final repository. But the more immediate problems—problems that, in my opinion, are the most crucial—include such serious issues as the organization and management of a complex, expensive, and dangerous program which must run for at least one hundred years; the possibilities of sabotage, war, or social instability while the wastes are not yet sealed below ground; safe transportation of the radioactive wastes at each step of the plan; the fate of the recovered plutonium and uranium (which are not dealt with because

they are not considered “wastes”); and the ramifications of dependence upon another country—France—to perform reliably the reprocessing upon which the entire plan depends. These weaknesses were mentioned by some reviewers but, in general, the reviews stuck to issues presented by the KBS.

A number of important technical issues relating to the final repository also remain unresolved. For example, although KBS claimed to use “conservative values” in its safety analysis, many reviewers felt the values chosen were not only not conservative but without any substantial basis. The uncertainties are enormous, in some cases by many orders of magnitude, regarding leach rates of glass, the expected lifetime of the lead-titanium capsule, the flow of groundwater, the solubility of the escaping nuclides in groundwater, the tightness (lack of cracks) of the rock, and the behavior of the bentonite clay filler (which has never been tested outside a laboratory).

The models used by KBS vary only one parameter at a time so that the sensitivity of the conclusions to different variables is never made clear. The U.S. Geological Survey, for example, has pointed out that the KBS Report treats each component of the waste containment system separately, although in fact these components form a complex system whose behavior over time has not been studied. The California State Energy Commission, using KBS's own data, calculated a groundwater transit time from the repository to the biosphere of less than one hundred years, compared to what KBS calls a “very conservative value” of four hundred years.

Other nonconservative elements are introduced by the fact that KBS did not consider the wastes which would be produced by a reactor burning plutonium as fuel, although its plan calls for reprocessing, and reactor fuel is the only civilian use for recovered plutonium. KBS did not consider whether the plan could be safely scaled up for the wastes of more than thirteen reactors (the number contemplated in the 1975 energy policy), although it assumed a “nuclear era” of five hundred years over which electricity consumption would be 10 kW per capita—more than five times current Swedish usage.

There is also considerable uncertainty today in estimating the biological damage resulting from radiation. The trend is toward lowering what have hitherto been considered "acceptable" limits. KBS, however, interprets "absolute safety" as meaning that present limits will be acceptable indefinitely (and misstates the present limit set by the International Commission on Radiological Protection as being five times higher than it actually is). KBS has made fairly precise predictions of radiation exposures over thousands of years on the basis of a simplified model of pathways of radioactivity from groundwater to man which does not take into account such factors as the concentration of certain substances in the food chain, the varying susceptibility of different organisms to ionizing radiation, or future changes in food consumption leading to higher exposures.

The Reprocessing Contract

One of the aspects of the KBS review process that most disturbed me was the ease with which the reprocessing contract was kept secret, thus effectively cutting off any public debate about it. The description of the Stipulation Bill presented to Parliament stated that:

The term contract implies that there be a legally binding agreement. . . . The agreement shall furthermore be made with someone who has the means of reprocessing and who otherwise can be expected to fulfill those demands.

Winchester and Rydberg had the contract "explained" to them by KBS spokesmen, as they mention in their review, but they were denied access to the document itself. One of the shortcomings of their review was their hesitancy as scientists to touch anything that *appeared to them* to be an economic or legal issue, and their perception of the vague dividing line between these issues and the technical ones was very cautious. This combination of their hesitancy in matters which might not be purely technical and the classified status of the contract was unfortunate, since the adequacy of the reprocessing contract is to a large extent a technical

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question upon which their input would have been helpful.⁶

I decided to try to find out why the contract was beyond discussion. Since I was living in Paris at the time, it seemed easier to find out from the French side, and I arranged interviews with, among others, a director of the French Atomic Energy Commission (which owns COGEMA), an official of the French atomic workers' union,⁷ one of the chief economic advisors on energy matters to the French Socialist party, and a director for nuclear matters at the Common Market in Brussels.⁸ Among the interesting facts which emerged were the following:

The French have, in all their foreign reprocessing contracts, an absolute escape clause to the effect that, if for any reason they cannot reprocess foreign spent fuel, they will return the spent fuel rods to the country of origin with no obligation to repay the money paid in advance on the contract by that country. Much of the advance payment is intended to be used to finance a new, as-yet-unbuilt reprocessing plant, UP3, the one supposed to reprocess the Swedish spent fuel. It was also hinted, not very subtly, by the French AEC director that, in the long run, France's own reactor program would require all the reprocessing capacity they were building. The implication was that, despite use of foreign payments to finance construction of the reprocessing plant, there was no guarantee that the plant would be available for reprocessing foreign fuel.

The atomic workers union, furthermore, opposes the reprocessing of foreign spent fuel as a commercial

venture, contending in a three-month strike in 1976 and a continuing public relations campaign that reprocessing is too dangerous to be done for commercial purposes and should only be performed for France as a public service. It appears that if the Left wins in France, as nearly happened in June 1978, it may also take this position. Consequently, a country in Sweden's position has little basis for confidence that the contract, whatever it provides in detail, will actually be fulfilled.

Another problem with the contract is its lack of detail. There is no clear provision even as to what types of radioactive wastes may be returned to Sweden. Apparently the contract specifies that not only the vitrified high-level liquid wastes but also highly radioactive cladding hulls, high-volume low-level wastes, alpha-active wastes, and even parts of the decommissioned reprocessing plant can be returned to Sweden. (Under the Stipulation Law, although the disposal plan is only required to deal with "highly radioactive wastes," the contract is not limited to any category of waste but is required to be "adequate.")

Finally, the existing French COGEMA contracts with Sweden cover only wastes that will be generated during the 1980s, not over the thirty-year lifetime of the reactor. The argument was made to me by a member of the Nuclear Inspectorate that Sweden needs to be flexible and can obtain further reprocessing contracts later. However, according to figures published in Germany after its Karlsruhe contract with COGEMA was leaked to the German press, the price of reprocessing is skyrocketing. It was reported there that the Germans had contracted in April 1978 to pay \$700 per kilogram of heavy metal, or \$700,000 per metric ton, while the price in the Swedish contract signed just a month earlier had been \$370 per kilogram. The price of French reprocessing was reported to have risen by a factor of 21 since 1971. The current price of reprocessing is thus comparable to the price of fresh reactor fuel, and it is unlikely that reprocessing can be justified economically at such prices.⁹

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I wrote a letter outlining my findings to the chairman of EK-A, saying that it seemed clear that if EK-A's mandate was to examine the safety and environmental aspects of the KBS plan, they should consider the problem of the contract as well, since if the contract fell through, so would the whole KBS plan. I was later told by Birgitta Hambreus that my letter—which had been circulated with “Do Not Classify” stamped on the top!—was the only official document available even to her as a member of Parliament that cast any doubt on the adequacy of the reprocessing contract. I was invited to speak at an international conference organized by the environmental movement in Stockholm in June 1978, called the Critical Experts Conference on Nuclear Waste Management. I discovered there that even Sweden's foremost nuclear opponents had not been aware of the contract problems.

Swedish Politics

Most of the reviews of the KBS plan were complete by the beginning of summer 1978. The date for the decision of the government as to whether the utilities had fulfilled the Stipulation Law and could load fuel into the Ringhals 3 reactor was set for July, put off until August, and then moved to September, as the pressure on Prime Minister Fälldin increased.

The Stipulation Law is drafted in such a way that final interpretation of the law is to be made by the cabinet and the Prime Minister, not the courts. Several key terms in it are by no means clear. The only guidance provided by the Parliament for the interpretation of the key term, “absolute safety”—the standard against which the nuclear waste disposal plan is to be judged—is that it means a “very high level of safety” but is not intended to be “draconian.” There are no precedents for the application of this standard. No indication is given as to how complete a plan must be to satisfy the requirement that the applicant have “shown” a disposal

method. For example, have you shown a method when you say, as the KBS does, that you will store the vitrified wastes for thirty years after reprocessing while you try to develop a better technology for ultimate disposal?¹⁰

On September 29, 1978, the Prime Minister held a press conference, accompanied by his coalition partners, the leaders of the Conservative and Liberal parties, at which he announced this decision:

The application that Vattenfall and FKA have filed for permission to introduce nuclear fuel to reactors Ringhals 3 and Forsmark I is in accordance with the requirements of the Stipulation Law when it comes to a contract on reprocessing of spent nuclear fuel. On the other hand, the government has found, when examining the requirements for a safe final depositing of the highly radioactive waste, that certain additional geologic investigations are needed before the requirements of the law are completely met. Consequently the application cannot now be approved. . . .

The additional geological investigation will therefore need to show that there exists a large enough rock formation at the required depth and with the properties that the KBS safety analysis was based on. . . .

If the applicants, after the additional investigation, file again for approval, the government will have a Nuclear Inspectorate hearing over the application. If the Inspectorate finds that the uncertainty that the government estimates now to exist in the stated area has been eliminated, then the government is of the opinion that the applicants have fulfilled the requirements stated in the second paragraph of the Stipulation Law. In such a case the government has the intention to allow the applicants to introduce nuclear fuel to Ringhals 3 and Forsmark 1.

Was it a “yes” or a “no”? The nuclear industry was delighted with Fälldin's decision, while the environmentalists denounced him for giving in to the nuclear industry. However, according to one close observer, the Prime Minister had imposed an extremely difficult condition upon the utilities, and the Swedish press erred in emphasizing the comments of his coalition partners at the press conference that this was only a minor requirement. This latter view was confirmed by the actions of a group of KBS geologists

who, within days of the decision, went public and announced that there had not been adequate data to justify the geological interpretations made by KBS. KBS declared them incompetent and began drilling more holes in search of a site.

The Center party was infuriated with Fälldin and demanded that he ask the Conservatives and Liberals to support a national referendum on the continuation of nuclear power in Sweden. When the other parties refused, Fälldin resigned, saying: “All parties in a coalition must be able to compromise, but no coalition party should demand of another to extinguish its soul.” Many Social Democrats were astounded. They had expected the “bourgeois” parties to stick together in the end. This had, after all, been their first chance to govern in 44 years.

Fälldin has been replaced as Prime Minister by Ola Ullsten, the new leader of the small Liberal party. Ullsten was elected with only 39 votes; 66 votes were cast against him, and the rest of the 349 members of Parliament, including the Social Democrats and Center party, abstained. (It is a rule of the Swedish Parliament that a Prime Minister can be elected unless a majority of votes are cast against him.) Ullsten promised to follow the policy announced by the old coalition, which narrowed the decision to the question of a site. Although the Nuclear Inspectorate apparently leans toward approval, the group of outside experts which it appointed to review KBS's new geological evidence were reportedly unconvinced.¹¹

The process has been disrupted by the accident at Three Mile Island, which has resulted in the immediate closing of one Swedish plant of similar design and the abrupt decision by Olaf Palme, the powerful Social Democratic leader, followed by all the party leaders, to call for a referendum on nuclear power. Neither the time nor the wording of the referendum has been decided upon as this article goes to press. If the Swedish people should vote against starting up any new reactors or in favor of a compromise limit on the total number of reactors, either of which is a possibility, it is unclear what would happen to the Stipulation Law.

No matter what happens, we have a lot to thank the Swedes for. The KBS plan, despite its shortcomings, may be the most detailed and successful effort to date to develop a safe method for nuclear waste disposal. Nuclear waste has been seen as a great moral issue by anti-nuclear people and as an insufficiently studied but probably trivial problem by nuclear proponents. Neither of these views has done much to help solve the waste problem. The KBS plan, together with the large number of independent critical reviews commissioned by the Swedish government has defined important technical issues which were not clearly seen before—for example, the limitations of physical barriers such as glass and metallic containers, and the importance of geologic retention. The Swedish experience has also shown how rapidly scientific and public understanding can be deepened with open and independent critical reviews, financed by the government, of major projects involving technological uncertainties.

NOTES

1. Stipulation Law, Proposition, 1976/77: 53.
2. **Handling of Spent Nuclear Fuel and Final Storage of Vitrified High Level Reprocessing Waste, KBS Project, Volumes: I. General; II. Geology; III. Facilities; IV. Safety Analysis; V. Foreign Activities.** Available from KBS, Brahegatan 47, S-102 40 STOCKHOLM (English version must be requested specifically).
3. Nancy E. Abrams and R. Stephen Berry, "Mediation: A Better Alternative to Science Courts," *Bulletin of the Atomic Scientists*, April 1977, p. 50.
4. **Disposal of High Active Nuclear Waste: A Critical Review of the Nuclear Fuel Safety (KBS) Project on Final Disposal of Vitrified High Active Nuclear Fuel Waste, Energy Commission, Dept. of Industry, Government of Sweden, 1978, Ds I 1978: 17.**
 "Ds I" reports are published by the Swedish Dept. of Industry and copies may be obtained by request (for English version) to: Industridepartementet, Fack, S-103 10 STOCKHOLM.
 I became a consultant to EK-A in January 1978, when the review had already begun, and am the co-author (with Thomas B. Johansson) of the introductory chapter explaining the procedure used; I am also the author of a substantive appendix on legal issues.
5. Thomas B. Johansson and Peter Steen, **Radioactive Waste from Nuclear Power Plants: Facing the Ringhals 3 Decision, Industridepartementet, Stockholm, 1978, Ds I 1978: 36.** This is the best analysis available of the technical issues raised by the KBS Report and the range of opinions held on them in Scandinavia, Europe, and America. It provides not only a summary of the review comments

but a sensitivity analysis of the various numerical parameters which describe how radioactive material escaping from the repository would result in radiation doses to man.

6. In April, after completing his KBS review with Rydberg, Winchester presented a copy of the review to the Energy Minister Olof Johansson and pointed out explicitly that he thought the COGEMA contract secrecy was deplorable and had hindered their review. The Energy Minister then asked Winchester to prepare a separate review of one of the smaller COGEMA contracts for him (I am told that the general form is essentially the same in all of them). This review so far has not been released to the public by the Swedish government, nor have I seen it. According to Winchester, however, some information about the reprocessing contracts was leaked and published in Stockholm in late July 1978.

7. The atomic workers' union is part of the CFDT (Democratic Federation of Labor).

8. My husband, Joel Primack, who is a physicist and very knowledgeable about nuclear energy matters, accompanied me in these interviews, providing invaluable aid not only with his questions but with his inability to speak French, which encouraged our interviewees to speak English.

9. Japan recently agreed to pay COGEMA almost \$1 million per ton for reprocessing.—*In These Times*, April 11-17, p. 10.

10. Before these problems are automatically blamed on the inability of lawyers to draft legislation on technical matters, I would like to point out that, unlike the U.S. Congress, the Swedish Parliament is not dominated by lawyers. In fact, I was unable to locate any lawyer members. (However, the bill was reviewed, as are all bills, by a body of high-ranking judges.) The Swedish Parliament is composed essentially of workers, farmers, former housewives, and professional politicians. The French Parliament is dominated by academics, and the Russian government is run by engineers. These differences are telling when one attempts to understand how law is used and interpreted in different countries.

11. KBS has now put out a second report (called KBS II) which describes a method for disposal of unprocessed spent fuel (option "B" of the Stipulation Law). KBS II is being subjected to the remiss process in Sweden and will also undergo international review when the English version is released.

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The Pesticide Problem

(continued from page 16)

crop and livestock varieties, microbial agents, genetic manipulation, messenger chemicals, and yes, even pesticides become mutually augmentative instead of individually operative or even antagonistic, as is often the case under prevailing practice (e.g., insecticides versus natural enemies). An integrated control program entails six basic elements: (1) man, (2) knowledge/information, (3) monitoring, (4) the setting of action levels, (5) methods, and (6) materials.

Man conceives the program and makes it work. *Knowledge* and *information* are used to develop a system and are vital in its day-to-day operation. *Monitoring* is the continuous assessment of the pest-resource system. *Action levels* are the best densities at which control methods are invoked. *Methods* are the pathways of action taken to manipulate pest populations. *Materials* are the tools of manipulation.

Integrated control systems are dynamic, involving continuous information gathering and evaluation, which in turn permit flexibility in decision making, alteration of the pathways of action, and variation in the agents used. It is the pest-control adviser who gives integrated control its dynamism. By constantly "reading" the situation and invoking tactics and materials as conditions dictate, he acts as a surrogate insecticide, "killing" insects with knowledge and information as well as pesticides, pathogens, parasites, and predators. Integrated control's dynamism is a major factor that sets it off from conventional pest control. Thus, though the latter involves some of the same elements, it lacks dynamism in that it is essentially preprogrammed to the prophylactic or therapeutic use of pesticides. In other words, pesticides dominate the system and constitute its rigid backbone.

There are highly effective integrated pest control programs in many states and in a number of foreign countries, including Australia, Israel, India, Sri Lanka, Malaysia, Peru, England, the