

Since the end of the Second World War, things have taken a very different turn. Economic development has necessitated the utmost rationalization of applied technology, with a resulting tenfold increase in the size of equipment, even in the field of hydroelectric power. Furthermore, the steady proliferation of new technologies in public life and in the economy — giant aircraft, large nuclear power plants, oil refineries, high-capacity telecommunication satellites, and so on — has forced the citizen to take a more and more distant stand on the problems involved in their construction and operation, and to refrain from the value judgements that he really ought to make with regard to each.

In short, the more complicated science, technology and economy become, the greater the gap that separates the citizen from the political, scientific and economic authorities. The citizen feels more and more incapable of understanding or of contributing to the solution of problems created in the political, scientific and economic domains. It is difficult for him today to acquire the objective information needed to judge the value of the modern technologies, bearing in mind both the benefits that they bring and the risks that they involve. Moreover, he is seriously perplexed by the world problems that the evolution of mankind is creating. The reason for this state of affairs lies in the fact that for several decades, in numerous branches of science, technology and economy, there has been a lack of systematic information. This deficiency can be explained by the three following facts:

- a) The bodies responsible did not consider it advantageous to provide systematic information from the very beginning of a new field of activity;
- b) The citizen, for his part, did not ask for the systematic information;
- c) The mass media — the press, radio and television — have operated in a rather general and haphazard way, and though certainly capable of arousing public interest they have too often aimed at sensational effects.

For several years now, in Switzerland and in other countries, we have seen a revival of public interest in scientific and technical problems as a whole. In the specific field of energy, this development is based on three forms of awareness.

The first of these stems from the general concern of the population for **environmental protection** — a concern that has penetrated the energy field because of certain specific forms of damage, among which I should mention, first and foremost, an increasing deterioration in the healthiness of the atmosphere around towns and the accidental pollution of waters due to the use of liquid fuels. This concern has progressively and concurrently turned towards the problems created by nuclear energy, not so much because of any specific damage that may have occurred, but rather by virtue of the mystery that surrounds it. As always, it is the unknown that one is afraid of.

The second form of awareness relates to the **reliability of national energy supply**, which has fast deteriorated with the gradual predominance of mineral oils; the trickiness of this situation has been clearly demonstrated by the oil crisis resulting from the Israeli-Arab war in the autumn of 1973; in this respect, nuclear energy has clearly emerged as the only available means, for the next few decades, of largely overcoming the problem of this dependence.

The third level of awareness, more general in nature, stems from the world-wide concern of mankind, created by the Club of Rome, such as the **world limitations of the various energy resources**, more especially as applied to mineral oils. Furthermore, the **ecological limitations imposed by the growth of the energy economy**, or in other words the

limited capacity for absorption by nature of the effects of energy, is making the citizen realize more and more clearly that, in the next century, mankind will be fully utilizing all the possibilities that exist within those limitations.

It is quite clear that these general levels of awareness could not have come about, in Switzerland or in the world as a whole, had it not been for the ever growing efficiency of mass media and information, both in the scientific and technical world (in terms of the numerous scientific journals and frequent meetings) and among the general public (in terms of widely circulating newspapers, broadcasting and television, i.e. mass media with a world-wide range). It cannot be denied that information is of fundamental importance for the citizen who wishes to, and should, assert himself within the framework of a democracy.

It ensues from what I have said that we have reached a turning point in the history of the relationship between technology and democracy, where informing the citizen is to play a decisive role: the situation is in fact ripe for the re-integration of the citizen into the process of creation of a democratic will with a sound basis at his own level, enabling him to cope with the energy problems of the future, more particularly nuclear energy problems, with complete objectivity and reassurance. This chance of putting man back into the village context should not be missed. It requires the **complete candour of the "nuclear establishment"**, and as a consequence, an **active information policy**.

THE DEMOCRATIC COUNTEenance OF SWITZERLAND

Switzerland has, since it came into existence, conformed to the general rules of democracy – that form of government invented by the Athenians by which the people exercise sovereignty. Our democracy is of the federal type and is exercised at three levels:

- i) The Communes, of which there are about 3000;
- ii) The Cantons, of which there are 26; and
- iii) The Confederation.

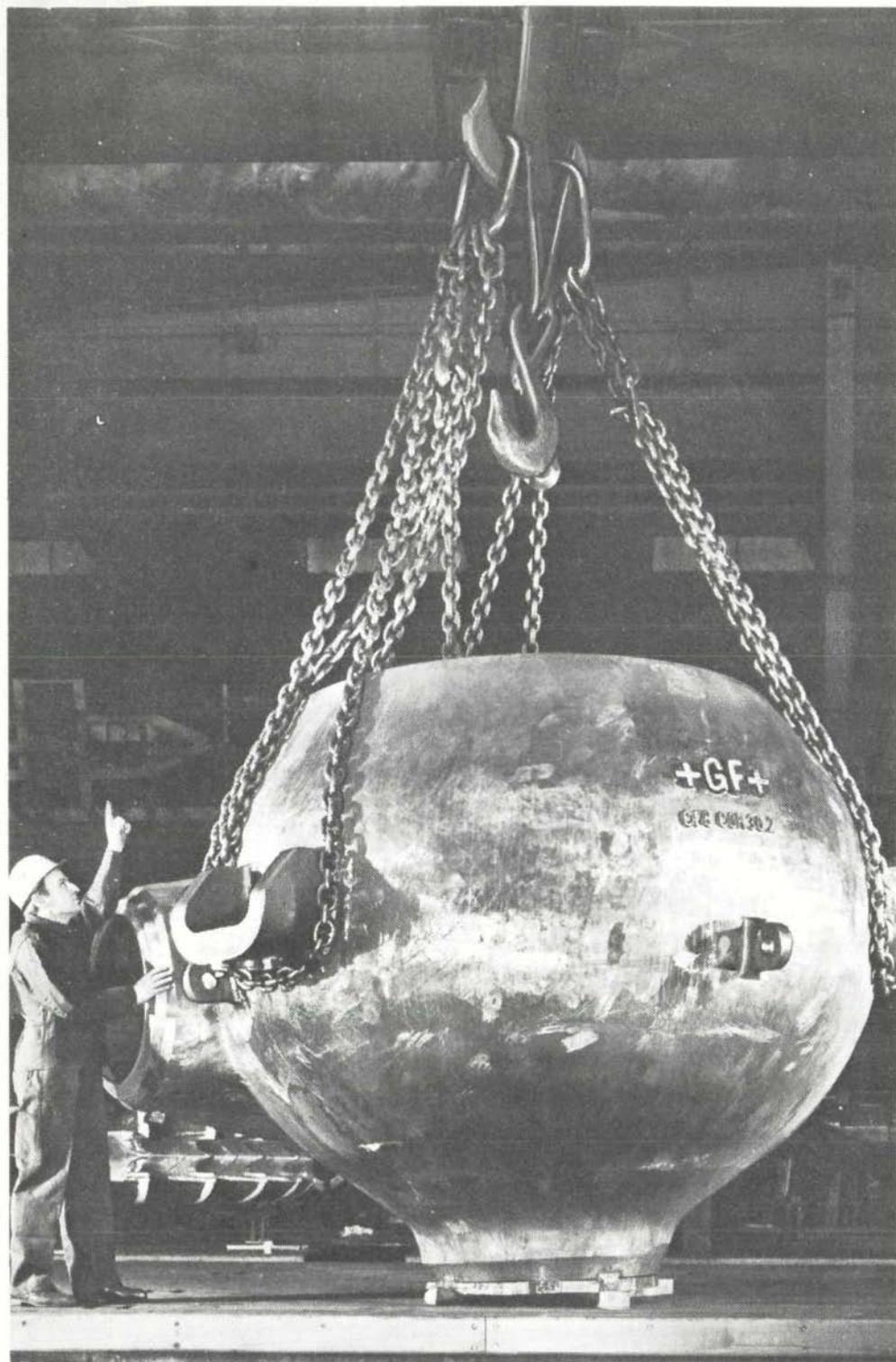
It is a parliamentary type of democracy at federal and cantonal level. There are, however, a few Cantons which still exercise direct democracy through the famous Landsgemeinden, and most of the Communes do as well.

In principle, the power is vested in whichever of the three levels is faced with a problem, i.e. according to whether the problem is of communal, cantonal or

federal importance. Thus an attempt is made to place the power of decision as close as possible to the citizens. This state of affairs is reflected in the fiscal structure, which provides for direct taxation at the three levels, in descending order of magnitude, as we go from the communal, through the cantonal, to the federal level.

The constitutional articles, both federal and cantonal, are drafted by the federal parliament or cantonal parliaments, and then always put to popular vote. The laws are likewise decided by the parliaments and a facultative referendum is held. The citizen may also exercise his right of initiative for the purpose of proposing the adoption of a constitutional article or a law. When the laws are enacted, he may appeal to the various legal instances, which protect his lawful rights; the cantonal court provides for the right of appeal to the federal court.

Pump housing with welded-in diffuser for the coolant circuit of the nuclear power station "Beznau II", Switzerland. It weighs 37 tons. Photo: Georg Fischer AG. ►



The machinery for selecting candidates for the elections ensures political distribution coupled with a cultural, denominational and regional balance.

Seen from afar, the democratic make-up of Switzerland takes on the appearance of a kaleidoscopic image composed of a thousand pieces. Seeing it from nearby, one is aware of the full complexity of the democratic machinery, but one can also measure the whole range of human participation that makes it work.

From the standpoint of the creation of the democratic will to control the construction and operation of nuclear facilities, it is interesting to note that it is expressed in terms of four federal laws that have been formulated independently at different stages of history in order to attain different ends, but which, put together, take into account all aspects of the protection of man, the environment and the countryside.

Two of these laws are based on exclusively federal power for their enactment:

1. The Federal Act of 23 December 1959, on the peaceful use of atomic energy and protection against radiation, which is especially intended to protect man against radioactivity and radiations;
2. The Federal Act of 1 July 1966, on the protection of nature and the countryside, aimed at preserving the characteristic appearance of the countryside and of localities.

These two laws form the subject of a single federal authorization procedure by which protection measures can be imposed or, if needs be, authorization can be refused. Both the procedures and the supervision of the construction and operation are based on the opinion and work of a number of specialized bodies.

The other two federal acts entrust the Confederation only with the task of strict supervision and the Cantons with the power of enactment. These are:

1. The Federal Act of 16 March 1955, revised 8 October 1971, on the protection of waters against pollution; this law prescribes the protection of waters against thermal inflows (for example in the case of direct cooling by river water) or chemical inflows (for example, indirect cooling through towers);

2. The Federal Act of 13 March 1964, on labour in industry, cottage industry and commerce, which regulates, among other things, the protection of the environs of industrial plants against injurious and disturbing effects, and which refers particularly to climatic effects and the noise created by cooling towers.

The last two laws relate to two different cantonal authorization procedures based on the recommendations and opinions of federal authorities.

Although we can therefore be glad that the democratic will to control the construction and operation of nuclear facilities has been fully realized through the four legal documents referred to, it is clearly less gratifying to note that this will is expressed in terms of three independent authorization procedures, each of which offers the possibility of appeal at several levels. As we shall presently see, these appeals, made by the citizens and communal authorities in the case of several projects, have led to a considerable delay in the implementation of the nuclear power programme in Switzerland.

Furthermore, aware of the weakness inherent in this distribution of authority, a number of political bodies are requesting a recombination procedure at federal level; with this purpose in mind, they are asking for a standard design for the sites of the Swiss nuclear power plants; this is in process of realization. The criteria considered in this study, some of which are contradictory and will require a compromise solution, are the following:

- (a) Minimal distances for the transport of the energy generated;
- (b) Conditions favourable for the use of heat, for example for long-distance district heating, or for the evacuation of heat releases;
- (c) Conformity with the provisions of the nuclear energy law (protection against radiation);
- (d) Consideration for the requirements for protecting nature and the countryside;
- (e) Consideration for the needs of national defence;
- (f) Consideration for requirements in planning the local, regional and national administration of the territory.

At this stage in our reflections on democracy there is a need for an important comment of a practical nature. Whenever the citizen is called upon to accept or to reject by vote a constitutional article, or whenever he is called upon to resort to a referendum to oppose a law passed by parliament, he does not take into account the ins and outs of articles expressed in general terms.

Let us take as an example the Article of the Federal Constitution relating to atomic energy that was adopted in 1957; it states: "The legislation concerning atomic energy belongs to the domain of the Confederation. The latter stipulates the provisions relating to protection against the hazards of ionizing radiation." Let us now look at the relevant law adopted in 1959; it states in particular that "the project for a nuclear facility should envisage all measures that one can reasonably demand for the protection of persons,

property and important rights" and, further on, that "respect for Switzerland's international commitments is guaranteed." No citizen could have thought at the end of the 'fifties, when approving these constitutional and legal provisions that appear clearly indispensable, that he would be directly concerned at some time by a nuclear facility project. It is only at the time when a law becomes a fact that the citizen, if involved in a project of that kind, perceives its impact. As the proverb puts it, the devil is in the detail!

Such behaviour is becoming more and more typical of numerous sectors in a society that is constantly growing more complex. The installations or establishments of national interest, such as airports, hydro-electric dams, nuclear power plants, highways, refineries, military buildings and so on, are certainly regarded as such by the man in the street. But as soon as a project specifically touches on certain private interests, he is up in arms; while acknowledging in his heart of hearts the need for the project in the general interest, he prefers to see it carried out elsewhere. Such reasoning is, moreover, part of man's logic: one cannot ask him as such to make a voluntary sacrifice for the collective — that is asking too much. It therefore devolves upon the State to find the best solution in the public interest. In terms of overall national achievements, this limitation of the freedom of a good number of citizens, implicit in the adoption of a wide variety of projects of national interest, seems to be an indispensable contribution to the collective interest.

THE DEVELOPMENT OF SWITZERLAND'S POWER STATION PROJECTS

From the beginning of electrical power development in Switzerland until the end of the 1960s, our electrical economy was based essentially on water power. At the beginning of the 1960s, however, the residual

possibilities offered by water were dwindling rapidly, and the power companies began at the time to plan a certain number of large conventional oil-fired thermal power stations. The surrounding

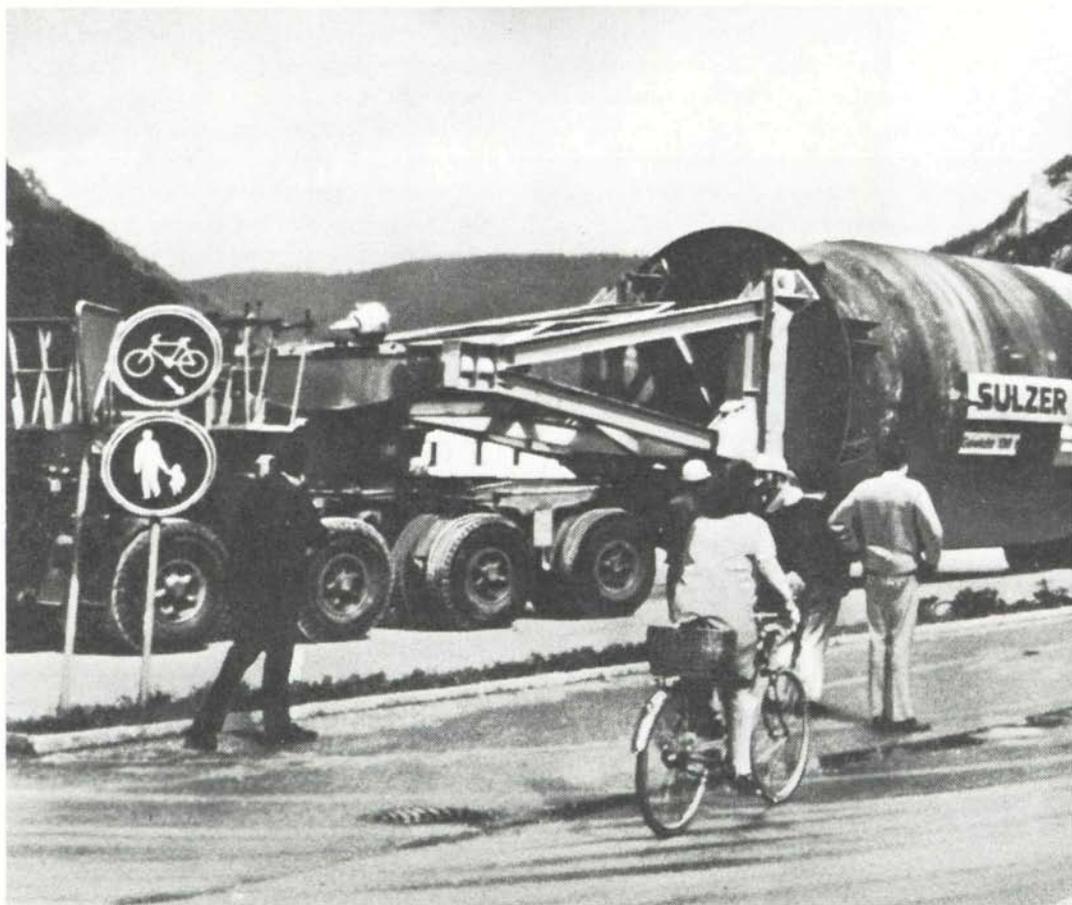
populations, firmly opposed to any pollution of the air by the combustion products from such stations, rose in violent opposition to each of these projects. Some citizens, realising that nuclear combustion did not directly involve the atmosphere, in fact insisted that Switzerland should go over to nuclear power stations straight away, pointing out that they were cleaner and claiming that they were close to being economically competitive.

The Federal authorities, too, for their part, were loath to see the country become substantially more dependent on the supply of fossil fuels, and shared the view that

nuclear power stations would be more favourable from the standpoint of the environment. Around 1963 and 1964, general policy and the public mood thus took a turn in favour of nuclear power stations. Of all the conventional power station projects, only one, with a capacity of 280 MW(e), located at Chavallon sur Colombey near one of the two refineries in Switzerland, survived the test of public acceptance.

The years 1964-1969 are what I shall call the "honeymoon" period. The Beznau I and II projects, each rated at 350 MW(e), were commissioned and put into service,

In the Swiss mountains, a heavy duty tractor trailer hauls a steam generator over narrow roads, at the end of a long journey from South Philadelphia U.S.A., to the Beznau II nuclear power plant site in Switzerland. Photo: Westinghouse.

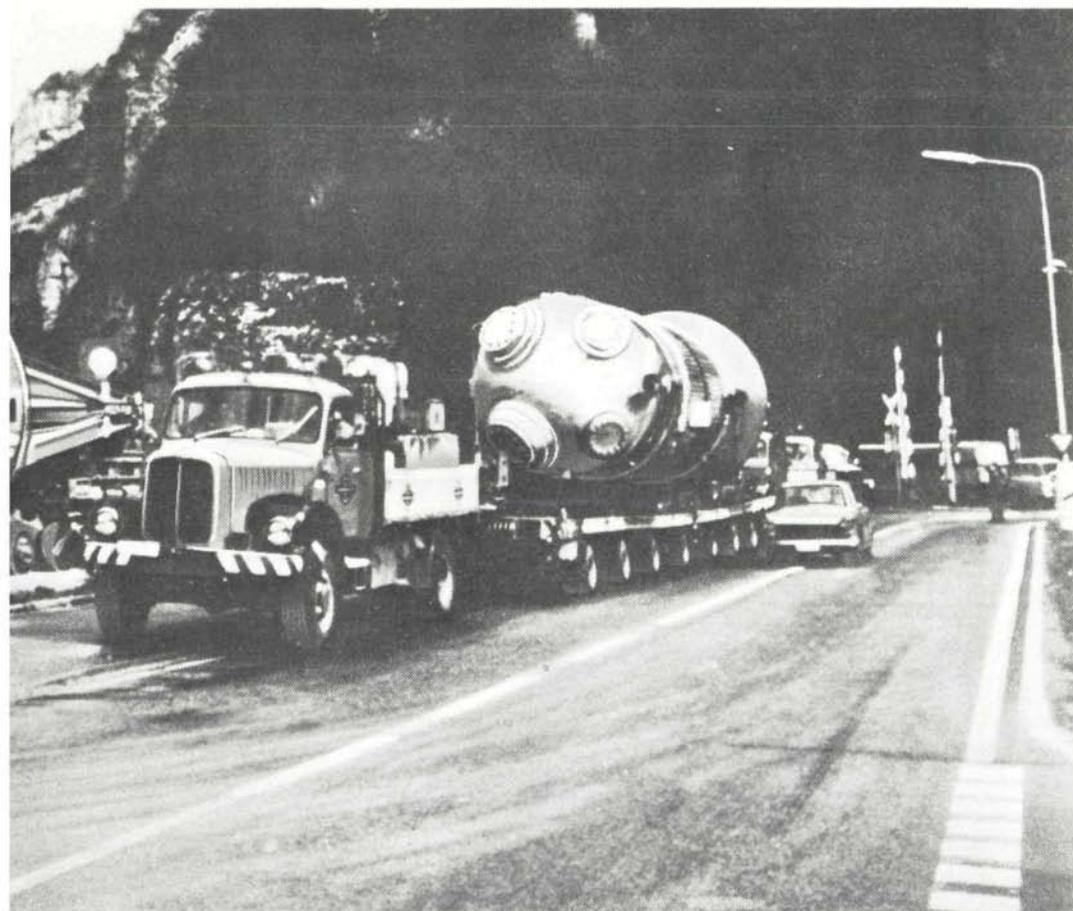


the first in 1969 and the second in 1971, virtually without opposition and without any delay. Located a kilometre or so away from the Federal Institute for Reactor Research, these projects undoubtedly benefitted, as far as information was concerned, from the presence of some hundreds of scientists belonging to the Institute who lived in the surrounding communities. The third project, 306 MW(e), located at Mühleberg, went into service in 1972, having run the gauntlet of public acceptance without any major difficulties as a result of a well-conceived publicity campaign conducted by the firm concerned. Mühleberg is in a typically agricultural region, and the traditional goodwill and confidence of the farmers in technology

and science (to which they owe a great deal in fact) greatly favoured the project.

Beznau I and II and Mühleberg are the three nuclear power stations operating in Switzerland today. They supply about 20% of the country's electric power requirements, which means that Swiss citizens are today the largest consumers of nuclear power in the world.

The years 1969-1974, on the other hand, brought what I shall call a period of "domestic strife." The beginning of this period in fact coincides with the awakening of public concern over the environment, and opposition to nuclear power stations was led by an increasing number of critical citizens; the efforts of these groups bore



fruit largely on a regional plane, however, particularly in the areas surrounding the sites of the various projects. I shall list these in an order which roughly reflects a decreasing degree of difficulty due to regional strife: Kaiseraugst, Verbois, Goesgen, Leibstadt, Inwil, Graben and Rüthi.

The opposition to these projects gained momentum when in April 1971 the Federal authorities, anxious to protect the quality of water against the effects of thermal releases, prohibited direct cooling of any new plant by waters drawn from the rivers of the Aare-Rhine basin. The designers were thus obliged to incorporate very large wet cooling towers in their plans and to apply for new communal or cantonal building permits after serious efforts had been made to evaluate the effects of the towers on the climate at each site and those consequences had been found acceptable.

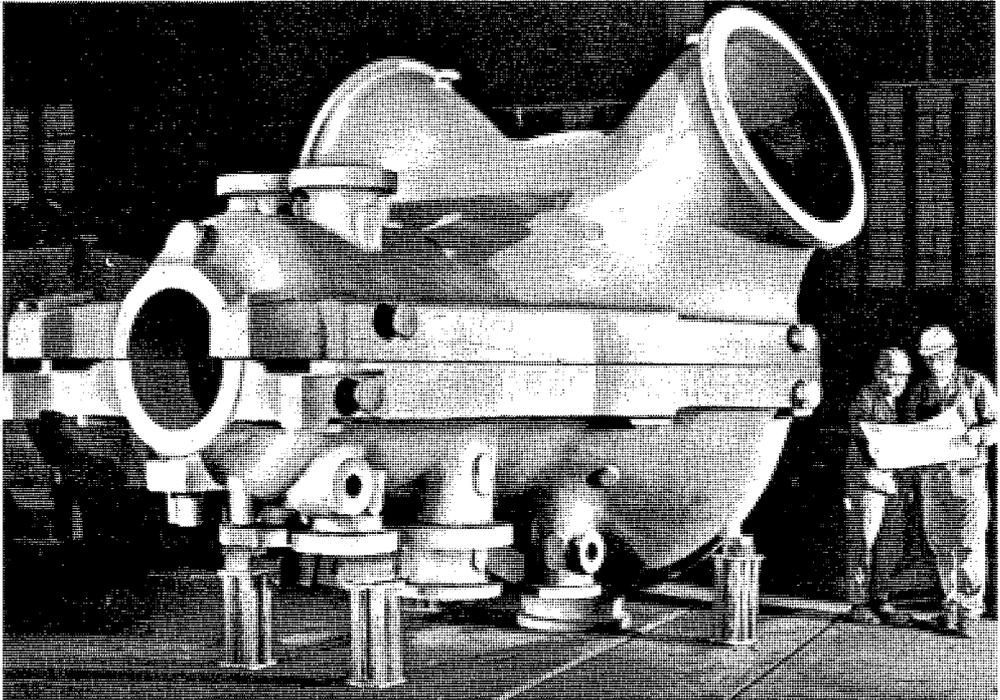
Without going into details, I may say that this wave of opposition led to appeals against practically all the projects, some of which were taken to the Federal Tribunal. It was only in mid-1973 that three of the projects were finally released — Goesgen, Leibstadt and Kaiseraugst — and all three are at present subject to Federal authorization procedures for nuclear construction.

Goesgen will go into operation in 1977, Leibstadt in 1979 and Kaiseraugst in 1980. The fact that no nuclear power station will have gone into service between 1972 (Mühleberg) and 1977 (Goesgen) shows that Switzerland is going through a de facto moratorium covering about three years and caused by legal appeals. This means that up to 1980 electric power supply in Switzerland will be barely adequate. The other projects are still at the site approval stage — only Goesgen and Verbois having received approval so far — and Verbois is in fact at present the object of two appeals at the Federal level.

With regard to public information, representatives of the public safety authorities were taxed to the utmost between 1969 and 1972, particularly as a result of having to take part in innumerable public meetings organized here, there and everywhere. In order to economize their strength, the Federal authorities have since 1972 been obliged to send representatives to public information meetings only on invitation and under the aegis of the Cantonal and Communal authorities, in Cantons and Communities where specific nuclear power projects are in preparation. In the Federal and Cantonal Parliaments as well as on radio and television, information has naturally been offered without restriction.

Although during the last few years there have been numerous questions on the subject of nuclear power stations in the Federal Parliament, none has led to prolonged or impassioned debate. Even a question calling for a moratorium on new stations "until outstanding questions of safety have been elucidated" found no response; but I should add that this question was put in on 6 June 1973 and dealt with only in December 1973, after the petrol crisis consequent on the Israeli-Arab conflict had arisen.

Generally speaking it is fair to say that no Swiss political party has come out officially on the Federal plane either for or against nuclear power stations. This suggests that party opinion is not uniform on the subject, that each has fringes leaning in both directions, and that the legislator must leave it up to the country to demonstrate its will by the democratic means available. On the other hand, within the context of nuclear energy problems and concerns related to oil, Federal legislators have on several occasions urged that the Federal authorities should prepare an overall energy plan, considering at the same time the wisdom of adopting a constitutional



The high pressure steam turbine cylinder being installed in the Swiss nuclear power station "Beznau".
Photo: Georg Fischer AG.

article which would grant general powers to the Confederation to legislate in matters of energy.

Some aspects of the problem presented by the relationship between democracy and nuclear energy in Switzerland have now been reviewed. It can be seen that in Switzerland these questions bear almost entirely on one part of the nuclear energy field, namely nuclear power stations. We hope that during what I have called the "domestic strife" stage we have succeeded in showing a large part of the Swiss population that absolute guarantees of safety cannot be given in any area of human activity, and we hope that we have also succeeded in convincing the population that the risk involved in operating nuclear power stations is acceptable when compared with the numerous other risks, collective or individual, which are consciously or unconsciously accepted by the average citizen.

Since nuclear energy is obviously a question of international moment, critical citizens are today orienting the attention of the Swiss public more and more towards the international problems presented by the fuel cycle — problems about which a small country like Switzerland can do nothing without international co-operation and information. I shall mention those which seem to me at present to be the most important from the standpoint of the information which Swiss citizens ought to receive and about which I should like to make a few proposals. These are:

- The problem of ultimate disposal of the high-level radioactive waste produced in irradiated fuel reprocessing plants; and
- The problem of diversion of plutonium by criminals.

As regards the first problem, it strikes me that today we are still optimizing the irradiated fuel reprocessing operation with a view to recovering plutonium at the

lowest possible cost, which means weight concentrations of plutonium of the order of 10^{-3} to 10^{-4} in the high-level waste. On the other hand, it would be technically possible even today, without any further research and development effort, to bring this separation factor to figures of 10^{-7} to 10^{-8} in perfectly acceptable economic conditions — that is with an incremental cost well below the total cost of producing a unit of electric power. Nowadays, a strategy aimed at ensuring the commercial competitiveness of nuclear stations with conventional thermal power stations by scratching a few measly per cent off the unit cost of electric power no longer makes sense, since the cost of oil has risen so enormously. Our new strategy should be to establish a source of energy which will be ecologically acceptable in the very long term and of unlimited capacity, since it may be that no other source of energy — fusion, solar and terrestrial heat, and so on — will materialize as a satisfactory long-term substitute.

The financial sacrifice involved in the high rates of plutonium separation I have mentioned seems tolerable, and even in a world economy based on breeder reactors with an aggregate capacity of one million MW(e) the residual plutonium content of the radioactive waste seems likely to be ecologically acceptable. In these circumstances the temporal dimension of the radioactive waste disposal problem would no longer be millions of years, but would be reduced to the order of a century, governed by strontium-90 and caesium-137.

Moreover, if further research and development made it possible to separate these two isotopes and transmute them into isotopes with a shorter half-life, by bombardment with neutrons or high-intensity charged particles, then the temporal dimension of the problem could perhaps even be reduced to a few dozen years.

In any event, it seems that a concerted effort among the large countries concerned, under the auspices of the International Atomic Energy Agency, will be essential to establish standards and conditions for the disposal of high-level radioactive waste; to a very large extent, it will be necessary to put aside the idea of balancing present economic advantage against very long-term hazards.

This same consideration applies equally to the need for co-ordinating the selection of underground storage sites for high-level radioactive waste at the international and regional level.

These problems are important enough so that in Europe for example, the idea of defraying the cost of the efforts I have mentioned by a special fund supplied from a small tax on electricity is worth considering. I do not think that the Swiss consumer would have any objection to such a plan.

With regard to the technical problems of plutonium storage and transport in relation to the possibility of criminal diversion, it likewise seems more and more important to promote strict international rules governing physical protection — even if, comparing this with other sectors, there may seem to be many easier ways of causing massive damage to a population than the production of home-made atomic bombs.

In conclusion, the last points I have made show quite clearly that the problems raised by the relationship between nuclear energy and democracy in Switzerland are going to be, more and more, problems connected with security and international solidarity. In this connection I think I can act as the spokesman of my fellow citizens in requesting the Member States of the International Atomic Energy Agency to put the Agency in a position where it can discharge effectively its tasks of standardization and information related to all sensitive stages of the nuclear fuel cycle.