Developing a national research centre

by N.W. Holm*

The historical development of the Risø National Laboratory differed from that of most other governmental nuclear research centres in that Risø had to diversify from nuclear research before it had the opportunity of fulfilling its original objective: to support the national introduction of nuclear power.

A Danish Atomic Energy Commission was enacted in 1955. Like other industrial countries Denmark was at that time concerned about diminishing future oil supplies, and it was considered desirable to prepare for an early introduction of nuclear power in Denmark. Funds were appropriated for the rapid build-up of a nuclear research laboratory, and the first facilities including a small research reactor were operational at Risø as early as 1957. The founding chairman of the Atomic Energy Commission, Professor Niels Bohr, left a profound imprint on future programmes by insisting that Risø be set up as a *scientific* laboratory allowed to deal with all avenues of research employing nuclear tools or methodology.

The political arguments for early introduction of nuclear energy in Denmark were soon eroded by the availability of plentiful and cheap oil from new fields in the Middle East. Furthermore, up to the early seventies, the Danish utilities were hesitant to gamble on what they considered to be unproven technology. The oil crisis in 1973–74 changed that. Preparations to go nuclear were accelerated by all parties involved, and parliamentary approval was expected in mid-1976. A heated public debate, reflecting the discussions in other western countries, made the government postpone the decision pending further clarification of the economic and waste disposal issues associated with nuclear energy. After the Three Mile Island accident, reactor safety became again a central issue. Several studies, including a substantial geological waste disposal project, have been carried out in the meantime, or are due to be reported in the next couple of years.

It is doubtful, however, whether these efforts by themselves will trigger a decision. Being singularly dependent on imported energy, Denmark has taken great strides to improve energy utilization and to develop its own limited energy resources. Since 1976 huge subsidies have been given to conservation efforts; a decision has been taken to build up from scratch a natural gas grid to be fed from the Danish sector of the North Sea; and it has been decided to expand district heating – mostly supplied from cogeneration plants. The aim is to meet up to 65% of all heating needs by piped energy in 1995: 25% by gas, and 35–40% by district heating. Finally, North Sea oil and gas concessions have been renegotiated with the objective of accelerating domestic prospecting and production.

The huge investment burdens associated with this ambitious programme and the stagnation experienced in Danish consumption of electricity – mostly generated by coal – seem to have removed the political urgency for a nuclear decision, which is not now expected for several years to come.

Changes at Risø

In its early years, Risø was allowed to build up a spectrum of useful research facilities and to develop a broad scientific programme ranging from basic physics, metallurgy, chemistry, etc. to meteorology, agriculture, and industrial utilization of ionizing radiation. While difficult to quantify precisely, the nuclear component never exceeded 40 to 50% of the budget. It comprised the staff and expertise necessary for the safe operation of Risø's own nuclear facilities, and for the support of Danish regulatory agencies in nuclear matters. Programmes directly concerned with nuclear power have decreased over the years and have been re-oriented towards safety-related research in fuel element technology, reactor physics, reactor dynamics, and reactor thermohydraulics.

A new law on Energy Policy Measures was enacted in 1976. The Danish Atomic Energy Commission was abolished and Risø was transferred to what is now the Ministry for Energy. The terms of reference for Risø were expanded to include energy research in general, and Risø was allowed to do contract research for outside customers.

These changes were reflected in a re-evaluation of Risø's research policy, an exercise originally triggered by accumulated cuts of some 15 to 20% in Risø's budget over the preceeding years. The first response to these cuts was to decrease budgets for investments and operating costs, but this approach soon became untenable. The major decisions resulting from the re-evaluation were to: cut personnel budgets; divert into research in new energy technologies; and seek new sources of funding. Also some further downwards adjustments were made in the nuclear energy research programme.

* Mr Holm is former Director of the Risø National Laboratory, DK-4000, Roskilde, Denmark, and is now General Manager of the Danish Steel Works Ltd, Frederiksvaerk, Denmark. This article is based on a speech Mr Holm gave at the Scientific Afternoon of the 1981 IAEA General Conference.

Construction work at the pilot plant for uranium extraction at the Risø laboratory. (Ambroos pressefoto)

Importance of outside funding

The decision to seek new sources of funding was the key to further developments. More than 97% of Risø's total funding had hitherto been received as a direct government budget allocation. New sources of funding were seen not only as a hedge against future budget reductions (which did indeed occur), or as allowing staff to be retained who might otherwise have had to be laid off, but as vital to the new board and the new management in clearly demonstrating the usefulness of Risø's competence and research potential to Danish society. In other words to remove Risø's "ivory-tower" image, be it deserved or not. It was felt that selling our know-how to industry and government agencies at home and abroad would be the most concrete demonstration of our usefulness.

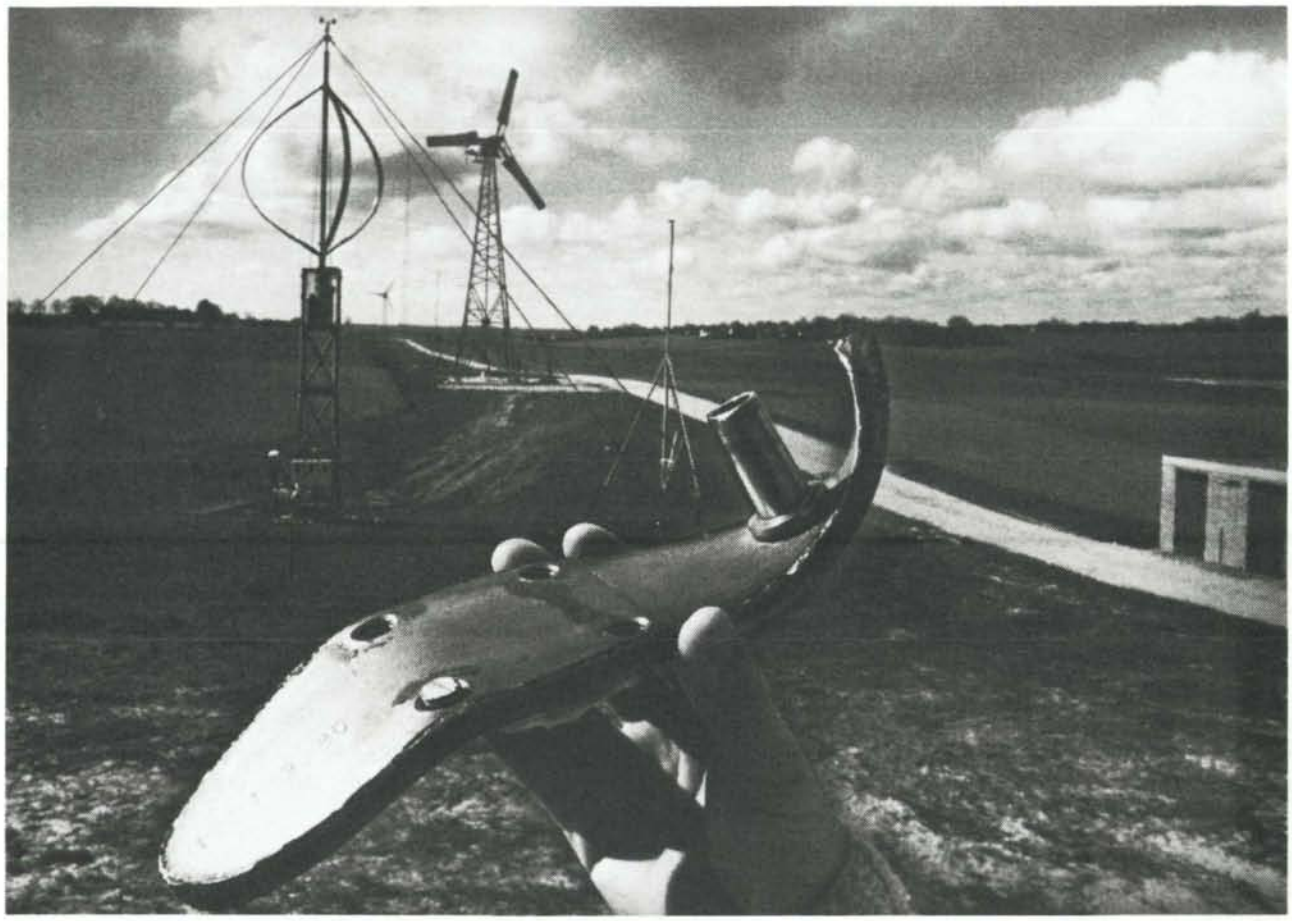
The efforts have met with success. Contract income increased from 2.5 million Dkr in 1976 to about 50 million Dkr in 1981* (covering more than 170 individual projects), and total employment has been *increased* by 5% instead of the 5% reduction originally planned. The table shows budget and staff figures for 1981.

* In February 1982 1 Dkr was worth approximately US $0.13.

The budget and staffing of Risø National Laboratory 1981

Source of funds	Million D.Kr.	Staff paid by	Graduates	Others	Total
Government fiscal budget	175	Fiscal budget	205	521	721
Contracts		Contract activities	77	42	119
Government energy research programmes	23				
Grants (EEC)	9				845
Commercial activities	13				

In addition there were some 40 to 60 visiting scientists, post-graduate students, etc.



Alternative energy at Risø: this component broke off a small windmill during tests. (Ambroos pressefoto)

Our first accommodation to the enlarged mandate was to set up an energy systems analysis group with staff transferred from reactor and solid-state physics. These people, highly trained in physical modelling, were requested: to build up energy systems analysis competence; to give professional assistance to government energy planning; and, through contract work, to support part of their operating costs. The group has developed into an important asset for Risø.

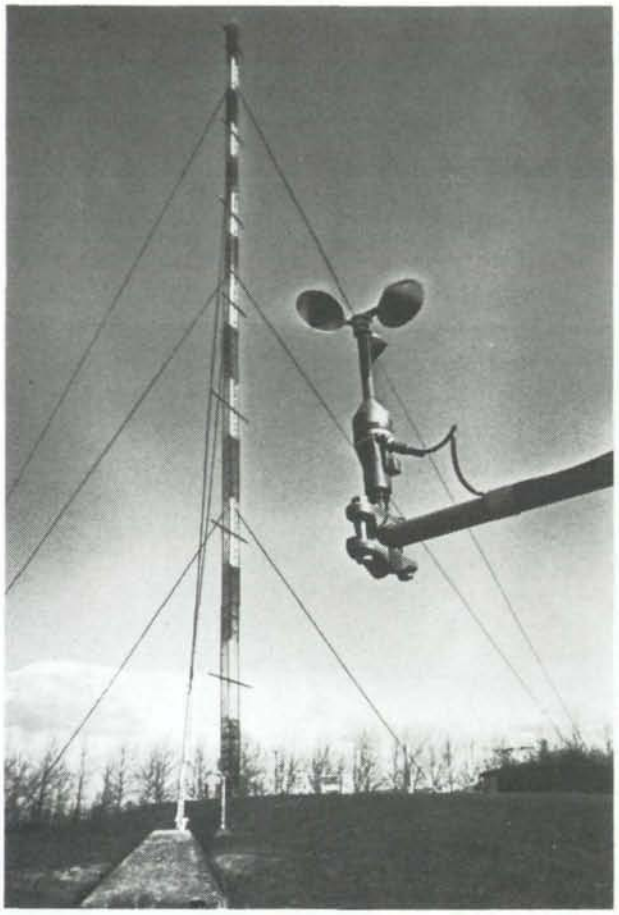
An expert committee was established to review all Risø projects and identify competence useful for research into new energy technologies. Discussions were held with the Ministry for Energy about possible Risø participation in the new series of energy research programmes to be funded by the ministry. Finally, substantial attention was given to increasing Risø's public profile by new and more informative annual reports, newsletters, exhibitions, and information meetings and symposia at Risø.

Build on existing expertise

In times of diminishing support for research in general, it is particularly important to collaborate rather than compete. By taking up new activities a laboratory can hardly avoid moving in on somebody else's present (or planned) turf, and it is not wise for a government institution to engage in what others might consider unfair competition or unneeded overlapping of competence. Given qualified special expertise there should always be room for joint ventures, even where other parties are already established in a field.

The decision to base our efforts on existing know-how and technology has undoubtedly been the most important one. A few case-stories can serve as illustration.

Risø had well-established nuclear programmes on structural mechanics, on reliability and accident analysis, and on instrumentation, man-machine problems, and human engineering. Realizing that these programmes were essentially nothing but training in and application of basic scientific disciplines on one particular complicated process system, namely nuclear reactors, it was obvious that the expertise would be applicable for analysing other kinds of industrial plant as well. With increasing demands by society on plant safety and on protection of the environment, market opportunities looked and have proved good. By pooling Risø's expertise, on several occasions with private industry, we have performed reliability and accident analyses on e.g. a chlorine factory, a pharmaceutical plant, a fertilizer factory, and part of an electricity generating plant. We have also analysed the design of several off-shore



Facilities at Risø for studying meteorology and climatology for the purpose of environmental protection. (Ambroos pressefoto)

installations, and of the natural gas system now under construction.

Another example relates to the nuclear expertise built up in site investigation and monitoring. Fundamental work on meteorology and dispersion modelling, combined with practical experience in the construction and operation of monitoring stations, have been applied to solve a variety of conventional pollution problems for outside customers and also adapted to solve design problems for building structures sensitive to wind or weather damage.

Similarly, we have pooled our experience in meteorology, materials sciences, and structural mechanics to assist in the national wind power programmes, both in the design of important parts of large wind turbines and in the design and operation of performance-testing equipment. A Danish wind atlas has also been prepared and the methodology is presently being marketed abroad. Other parts of Risø are engaged in energy storage including hot-water storage in aquifers, gas and hydrogen storage, and battery research. Our experience in managing large engineering projects is currently used in the construction and operation of a pilot uranium extraction plant based on the carbonate pressure-leaching process. The ore to be processed in the pilot plant is from Greenland. It is hoped that the plant can later be a test-bed for other chemical extraction processes.

We remain on the look-out for new possibilities to adapt existing – particularly nuclear – expertise to problems of current interest. One final example is our efforts to utilize the thermohydraulic expertise gained in the nuclear work for coal combustion research and for oil and gas reservoir modelling. Our approach so far has been cautious as we are aware that in these ventures we will be stretching our existing capabilities thin in a professional sense.

More generally, we are trying to define what kind of business we are in, and which kind of priorities we should have. It is evident that our strength is not limited to nuclear. It is in fact "high technology", and it is well supported by a broad scientific competence gained as a result of the ground rules set by the founding fathers. That nuclear research was our training ground is becoming increasingly immaterial. We give priority to high-technology projects, and particularly to such projects which – while helping to solve a current problem – further enhance the technological and scientific competence of the laboratory.

Continuing to diversify

The re-orientation process went perhaps more smoothly than expected at the start. This is not to say that it was painless. The process took place in a difficult political climate with strong psychological pressures on staff and management stemming from the emotional and sometimes even intolerant public debates on nuclear power, on the dangers of new technologies in general, on the role of experts, on science policy, etc. Employees who in the early seventies were widely encouraged to inform the public on nuclear energy, suddenly had their competence, integrity and motives strongly attacked; and they were discouraged by what they felt was a general deterioration in respect for scientific truth. Risø as an institution decided early that it should refrain from taking part in the nuclear debate; a decision which was unpopular with some staff. It is natural perhaps, that some Risø-people also considered that the programme re-orientation contained an element of opportunism. That made it even more important to ensure that new energy research programmes were of sufficient quality and relevance.

The most difficult question in the process, which to both management and staff remains a problem of conscience, is how to retain or re-establish in time, a sufficient degree of preparedness, if and when the country decides to go nuclear. As mentioned earlier, a nuclear decision is not expected soon in Denmark. That means Risø must continue to diversify in the interim. We are presently engaged in such discussions, and they are no less difficult this time around.