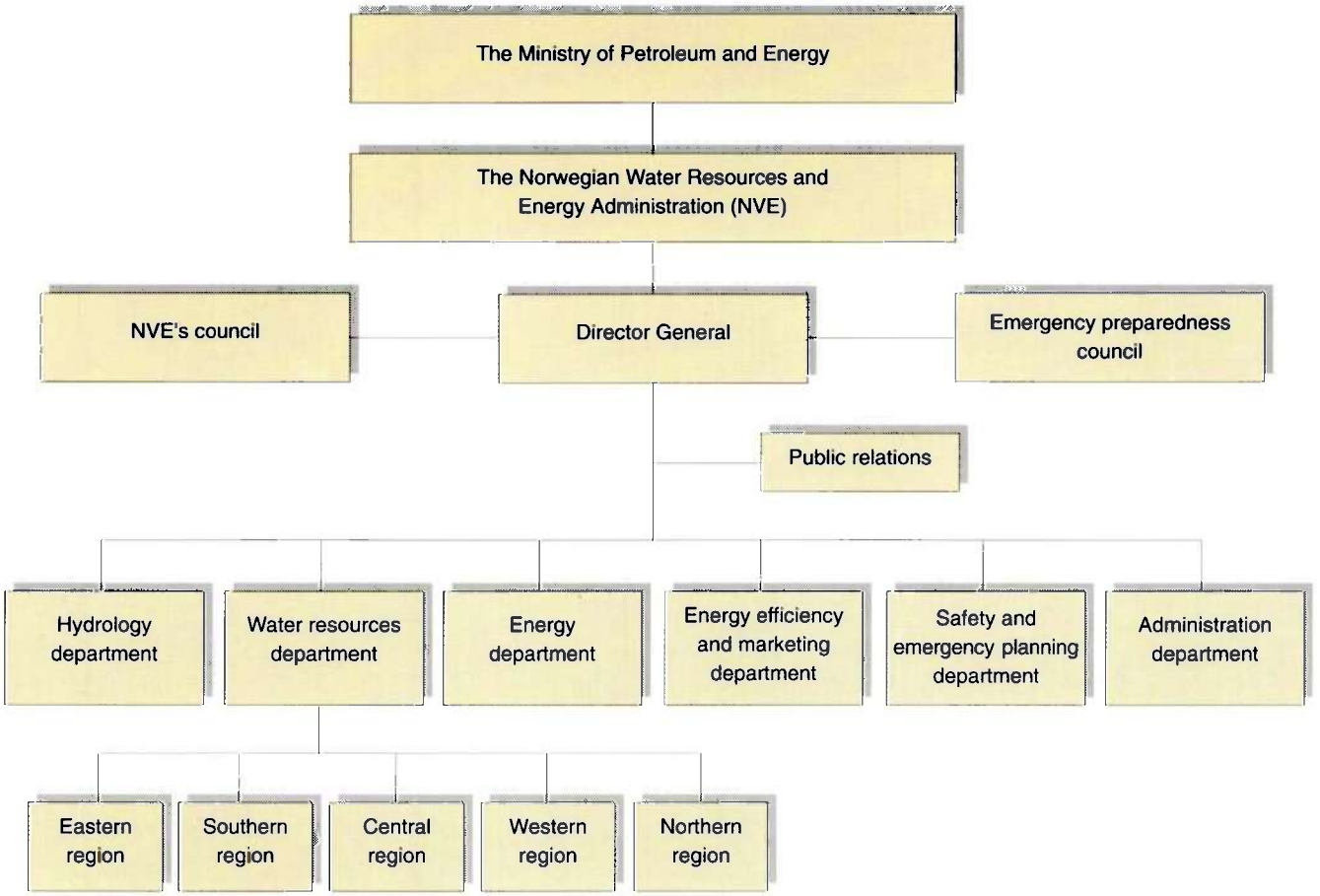
NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION



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From the Vigeland Park, Oslo
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The Norwegian Water Resources and Energy Administration, NVE, in the 1990's

NVE is responsible for managing Norway's water and energy resources for the benefit of the nation as a whole, and for ensuring that the country's energy requirements are met at the lowest possible cost to our natural environment.

NVE is an agency providing expertise for the whole country through its head office in Oslo and 5 regional offices.
It is organised as a directorate and comes under the authority of the Ministry of Petroleum and Energy.

The main areas of operation of its 5 specialised departments are: hydrology, nature and environment, watercourse technology, energy and watercourse consessions, energy planning, the energy system, the electricity market, energy efficiency, safety and emergency planning.

The directorate participates in international cooperation relating to several of its areas of expertise.

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NVE's departments

Hydrology
The hydrology department consists of 5 sections.

Hydrometry
is responsible for all routine field work and primary data processing relating to surface hydrology, as well as for coordinating the division's field studies with the services providing instruments and equipment.

Water balance
is responsible for the administration of surface hydrology and geohydrology work, including the provision of forecasts, as well as for field work and primary data processing relating to geohydrology. The section provides flood forecasts and operates a flood warning service.

Glaciers and snow
is responsible for studies and administrative work relating to glacier and snow hydrology.

Environmental hydrology
conducts and coordinates hydrological studies and administrative work connected with environmental matters.

Data
is responsible for hydrological software development, data analysis and the maintenance and development of the division's data bases.

Water resources
The water resources division is divided into 3 sections in Oslo and has 5 regional offices in which other specialised divisions are also represented.

Concession
is responsible for dealing with concessions (licences) to exploit/regulate watercourses, permits granted under Norwegian water resources legislation, distribution of concession fees, facilities which have reverted to the state, changes in concession terms, and legal matters.

Nature and environment
is responsible for ecology and landscape management within NVE's field of competence, and for water use and conservation planning.

Watercourse technology
is responsible for administering and managing state funds for contingency measures aimed at reducing or preventing erosion and flood damage, at reducing pollution resulting from run-off to watercourses, and at facilitating the public's use of watercourses.

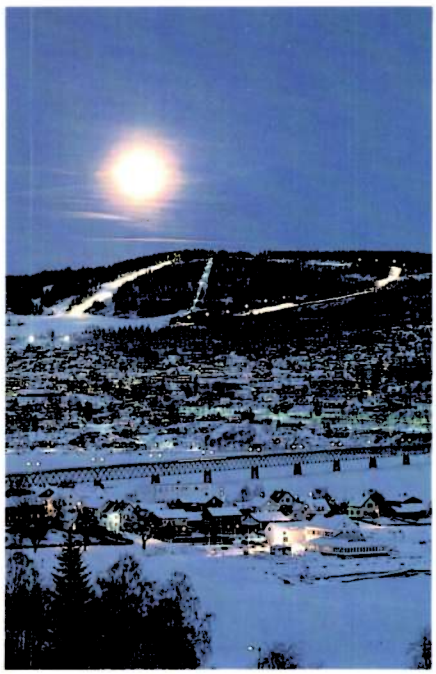
Energy
The energy division is comprised of 4 sections.

Energy balance
is responsible for making overall evaluations of national energy supply and consumption, including plans for new energy production facilities and economic analyses of the energy system's utilisation, including the balance of electricity supply/demand in the shorter and longer terms.

Resource
is responsible for maintaining an overview of technical and economic conditions relating to energy resources and sources of power, the uprating/refurbishing of existing power plants, and the programme for new, renewable energy sources.

System
is responsible for overall planning of the national energy transmission system, for coordinating regional plans for transmission and distribution systems, new energy transmission facilities and the technical/economic aspects of transmission facilities.

Concession
is responsible for dealing with preliminary notices of intent relating to construction of energy facilities and for applications for concessions to build and operate energy facilities.



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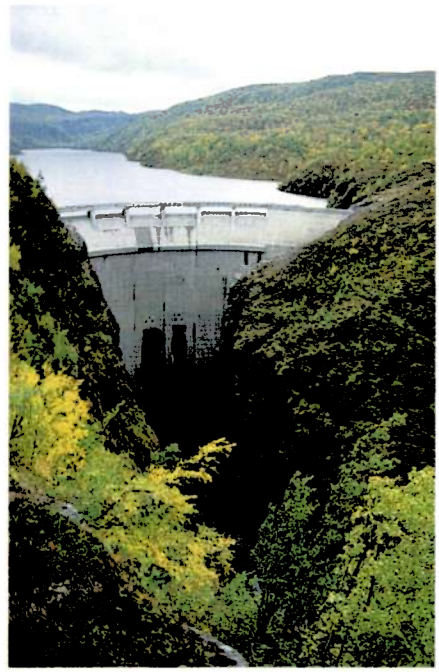

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Energy efficiency and marketing
There are 2 sections in the energy-efficiency and marketing division.

Market and electricity supply
participates in the task of organising energy supply in efficient units, and plays its part in ensuring that the conditions in which an efficient electricity market can function are studied, facilitated and supervised. The section is responsible for handling state subsidy funds.

Energy saving and local energy planning
is responsible for initiating and stimulating measures to achieve the potential for energy saving, and for assisting energy utilities in planning to meet the demand for energy as efficiently as possible.

Safety and emergency plannining
The division consists of 2 sections.

Safety
is reponsible for keeping up to date the regulations relating to plants and installations in lakes and rivers, for inspection and information/training relating to the safety of such facilities, for the registration of dams, for inspection, and for ordering the owners of installations in lakes and rivers to comply with regulations.

Emergency planning
is responsible for contingency planning in the electricity supply sector, and for drawing up regulations regarding technical safety measures.

Administration
Administrative support functions and services for the specialised divisions are provided by the administration division, which is responsible for joint services, financial matters, planning of activities, organisation, electronic data processing, international cooperation and R & D coordination, personnel, and the health service for personnel.

Erling Diesen:

New Energy Act, new power market

The new Energy Act does not entail any change in the fundamental aims of Norwegian energy management:

- reliable supply
- efficient use of resources
- strong emphasis on the environment
- smoothing out price differences

On the other hand, it does herald a marked revision of the means to achieve these aims. Where the business aspects of energy supply are concerned - planning and building, organisation and administration, operation and maintenance, sale and purchase - market-based solutions will be adopted to a far greater degree than has been the case to date.

By the terms it lays down in the concessions which it grants for the construction of energy installations, the central government will continue to ensure that these installations are of the right size to meet the total requirements of the communities they serve, while at the same time taking into account environmental considerations and local and general interests.

In addition, the state authorities will protect the safety of life and property through regulations covering electrical plant and dams, and contingency plans to prevent these facilities from being damaged by saboteurs.

Competition versus monopoly
Maintaining the clearest possible boundary between those parts of the sector in which competition is possible, and those parts which are natural monopolies, will be a crucial requirement for fulfilling the intention of the Act. For example, the transmission of power at different voltage levels - the operation of the main grid, the main transformer stations, and the distribution network - are all, by nature, monopoly activities.

Competition will first and foremost be possible within the field of electricity generation and sale. A number of generating companies offer their power and a number of distributing utilities and large individual users seek to buy it, in a wholesale market where contracts are concluded between independent business operators on negotiated terms regarding volumes, prices, duration, certainty of supply, etc. The new Energy Act recommends an organisational boundary between competitive activities and monopoly activities as the ideal arrangement. But it also accepts the establishment of independent profit centres within one and the same organisation.

Competitive activities will, naturally enough, operate with a view to achieving the best possible economic result. Monopoly activities, on the other hand, will aim at breaking even, after taking account of development and operation costs, and a normal return on capital.

Energy plans become mandatory
As a consequence of the new Energy Act, both NVE and the power companies have been allocated a number of new tasks. A new condition laid down in area concessions relates to energy-saving and the preparation of plans to promote efficient energy supply systems in the individual areas.

This condition requires each distributing utility to draw up an energy plan for its supply area. This plan is to be revised every fourth year and sent to NVE, which also draws up guidelines for planning work. The aim of the energy plan is to promote cost-efficient energy services within each individual area.

The costs of energy-saving measures in customers' premises and in the utilities' own plants are to be judged on the same basis as the costs of building additional capacity, and of buying power on the market. In particular, the scope for utilising local sources of energy, such as bio energy, should be studied. The same applies to the environmental impact of different methods of meeting demand. This is called planning in accordance with the "balance principle".

The developer must take the risk
The transition to market-based trading in electricity means that the economic risks attached to development are going to be borne by the developer. The central authorities will no longer give so much consideration to costs when judging a development project for which a concession has been sought. That is first and foremost a matter for the developer. The bodies which process concessions are, however, still expected to undertake a broad, macro-economic cost/use evaluation.

New impetus to energy-saving
The electricity utilities must provide energy users in their supply areas with information and counselling on ways of saving energy. They must acquire enough knowledge to be able to evaluate, and contribute towards, energy-saving measures as an alternative to other options for meeting energy requirements. Each utility must draw up a plan for its energy-saving activities, and this plan must be sent to NVE. The plan must define the potential for energy-saving in the area and the ways in which customers can be persuaded to make more efficient use of energy. It must also describe how the utilities' energy-saving activities are organised, and include targets, strategy and the budget allocated to this purpose, thereby ensuring that it is fulfilling its concession obligations in this regard.

New concession rules
The rule making the right to trade in electricity subject to concession is new. The aim of this new kind of concession is to protect the customers' interests by ensuring that electrical energy is traded in an efficient power market, and by regulating the operation of the grid, as a natural monopoly.

All those who are engaged in trade in electrical energy, and who may be in some kind of monopoly situation, must have a concession to trade. These concessions will be granted by NVE. In line with the move towards market-based trade in electricity, the old system of power lease concessions has been terminated.

Asbjørn Vinjar:

"Energy-Norway" in the new Europe

The movement towards a European community actually started in the energy sector, with the establishment, in 1952, of the Coal and Steel Union. Crossing borders is growing steadily simpler - for people, information, goods and services. The different nations will continue to exist, while the feeling of community among them will be strengthened, and resources will be exploited as efficiently as possible.

The 1958 Treaty of Rome aims at the freest possible movement, between nations, of goods, people, services and capital. Norway is a member of EFTA, and through agreements between EFTA and the EC, the links between Norway and the European Community will also be strengthened.

The EC has proclaimed its intention to integrate the energy systems of its member nations, insofar as this is feasible. We are looking here at large - in some cases national - players, and national regulations. National arrangements must now be adapted to rules laid down by the Community. A characteristic of electricity systems is that they form a physically connected whole within each country, even though parts of the system may be owned and operated by independent undertakings. Consequently, in order to achieve the best possible utilisation of national supply systems, voluntary cooperation has evolved among the different utilities in each country. In many cases, too, trade in electricity with neighbouring countries is handled by national monopolies. In this respect, the situation in the Nordic countries is about the same as in the rest of western Europe, although cooperation in the electricity supply sector is somewhat more advanced in the Nordic area.

The electricity supply systems within each country in Europe are based on the concept of self-sufficiency, while production of electricity in many of these countries is wholly or partly dependent on imported fuel. This applies to most of the Nordic countries, as well. Only Norway and Iceland are self-sufficient, thanks to hydroelectricity. Against this background, we may now look at Norway's place in the picture.

Opportunities for energy-rich Norway

Norway has significant potential for playing an important role in three energy areas. We have large oil resources. We have large reserves of natural gas, and we have large resources of hydroenergy in a well-developed system which offers wide scope for regulation and is also robust and environment-friendly.

Power exchange

Norway is probably the only nation in the world which relies entirely on hydropower for its electricity supply. Only four countries - Canada, the US, the USSR and Brazil - have more hydropower than Norway. In the 1950's and the early 1960's Norway concluded contracts for the export of firm (non-interruptible) power to buyers in Sweden. As these have expired, plans are now being made for new long-term power sales agreements with Sweden.

The sheer size of the Norwegian hydropower system - totalling 27,000 MW of installed capacity - means that with relatively small investments we can replace costly peak load installations in large thermal power systems - for instance, in the countries around the North Sea. Laying cables across the North Sea, plus the necessary upgrading of the Norwegian system, would cost about the same as peak load plants located in these countries, but the latter would be less environment-friendly. It is worth noting that the economic advantage to be gained here would arise not from power exports, but from the daily exchange of energy volumes. The affect on our watercourses would be minimal. The potential for Norway and countries relying on thermal power to achieve mutual economic and environmental gains means that specific projects should be studied, in cooperation with interested partners in nations around the North Sea. The scope for such exchanges with Denmark and Sweden has already largely been exploited, through existing lines. The Netherlands and Germany are perhaps the most interesting potential partners. Cable links to Scotland, via oil and gas platforms on the Norwegian and British shelf, are another interesting possibility.

The Norwegian system can be operated in this way, without creating significant problems for supplies to domestic users, because of the large scope for water storage in hydro plants which already have generating installations large enough to utilise water flows during periods of heavy melting or rainfall. The question then arises; can this method of coordinating hydropower with thermal power systems be utilised on a larger scale?

Natural gas and the CO_2 problem

The debate about the use of natural gas in Norway is influenced by the Norwegian authorities' commitment to stabilise CO_2 emissions at the1989 level before the year 2000. If this goal is to be achieved, our gas resources cannot be used for production in Norway involving traditional combustion processes - unless we can reduce CO_2 emissions from other existing processes.

Norway could attempt to conclude environmental agreements with other countries involving the supply of gas - as a replacement for other, more polluting, fuels - in exchange for permits to increase emissions in Norway. The same kind of arrangement might be possible in connection with the production of energy-intensive goods in Norway, to be offset by the reduction of less environment-friendly production in other countries.

Significant potential

Our existing hydropower system, with its very large potential for daily and seasonal regulation, is in itself a highly valuable resource. To exploit it as efficiently as possible, the potential must be judged on the basis of the whole, coordinated Norwegian hydropower system. Future arrangements for power trade with foreign countries must be made with this in mind.

The new Energy Act aims to create a free and efficiently operating domestic power market. Norway should strive to bring about a correspondingly free cross-border energy market, in which our energy resources can be utilised in a way that makes environmental and economic sense.

Energy supply in a European perspective offers wide and attractive opportunities for Norwegian energy authorities and the players in the energy supply sector.

Mike Kennett:

NVE in the Antarctic

Members of the Norwegian Antarctic expedition ready for action.
© Mike Kennett

NVE conducts glacier research from pole to pole - more precisely, from the Svalbard archipelago to the Antarctic. During the 1989/90 season NVE participated in the Norwegian Antarctic Expedition (NARE). It numbered 34 scientists, covered 16 different projects and lasted for 10 weeks. We used 2 helicopters and the coast guard vessel "Andenes".

Climate aspects

NARE 89/90 was mainly concerned with climate-related environmental studies: glaciology, biology, oceanography, meteorology, geology and archeology, from reindeer research on South Georgia to the geology of Queen Maud's Land. The main purpose of NVE's project was the use of glacier radar for climate monitoring. Glacier radar is a tool with which NVE has acquired considerable experience during the past few years. It is normally used to measure ice thickness, but by analysing the reflections from the bottom of the ice one can also ascertain something about the conditions beneath the ice. Such information is valuable in predicting how the Antarctic will react to climate changes, and in analysing this reaction by repeating the measurements in a few years.

Studying ice currents

Most of the ice on the Antarctic continent is virtually stationary, moving a few metres per year. But at some points around the edge of the Antarctic, the ice moves in streams at the rate of as much as several kilometres per year. These ice streams can be several tens of kilometres wide and a couple of kilometres deep, and account for almost the whole of the ice drainage from the Antarctic - some 1,500 km^3 per year. At the same time, however, they appear to be unstable, since the speed at which the ice moves can vary considerably within the course of some few years.

Global heat pump

The ice streams off the continent and creates "ice shelves", which float on the sea and are melted from beneath by ocean currents. The circulation of the sea is very difficult to measure, beneath several hundred metres of ice, but this is an important phenomenon, since enormous volumes of chilled water stream northwards again and spread themselves out over the sea bed of the whole world, thereby affecting the temperature of the world's oceans. The ice shelves also act as a kind of dam structure in front of the ice streams.

Radar mapping of Fimbulis ice shelf

The Jutulstraum is one of the largest ice streams in the Antarctic and drains an area of 124,000 km^2 in Queen Maud's Land. An important task was to map the size of the Jutulstraum, using radar, and to look at conditions beneath the ice stream. The ice shelf in front of the Jutulstraum is called Fimbulis, and is 300-600 m. thick and 150 km wide.

2,500 km. of radar profiles

To ascertain the answers to these questions, 2,500 km of radar profiles were measured from a helicopter over the Jutulstraum and the Fimbulis. These data are now being analysed to yield information about the thickness of the ice and the conditions beneath it. The data will be important in the future for evaluating changes which may take place in response to climate changes.

Nils Roar Sælthun:

Climate changes

The hydrology division, with support from other specialist groups within and outside NVE, has analysed the impact of climate changes on Norwegian watercourses and water resources. The enquiry takes as its point of departure climate scenarios which assume an increase in "greenhouse gases" corresponding to a doubling of CO_2 levels in the atmosphere by around the year 2030. The climate changes described are based on two possible scenarios, with temperature and precipitation specified in each. The most likely scenario assumes a temperature rise of 1.5 to 3.5° C, mainly during the winter and in inland areas, and a mean increase in precipitation of between 7% and 8%.

With the help of hydrological models, among other things, estimates have been made of how such climate changes will alter water flows in our watercourses. Calculations have been made of the impact on seven Norwegian watercourses, over a period of 30 years, and three height levels are specified. The most important results are:

An end to the spring floods?
The most probable scenario would lead to a moderate rise in the total run-off in the high mountains and in areas of high rainfall; a reduction (owing to increased evaporation) in lowland areas and in inland forest areas. The seasonal pattern of run-off is greatly changed, particularly at mean levels. The spring flood will in some places be greatly reduced; waterflows during winter will increase many times over, while summer waterflows will be reduced. Autumn and winter floods will become much more frequent. Flood damage will increase in coastal districts and small watercourses. Increased resources will have to be devoted to safety measures.

Shorter ski-ing season
The season during which fields are covered with snow will shrink significantly, by from one to three months. The groundwater deficit in the summer will increase, thereby also increasing the need for crop watering in most parts of the country, apart from outer coastal areas. The increased need for watering, and reduced run-off during the summer, may lead to water shortages in small watercourses used for irrigation.

Glacier melt will increase
Glaciers will melt more rapidly, particularly those in eastern Norway. In western Norway net melting will be smaller, and glaciers near the coast, in regions where precipitation is heavy, may remain in balance, according to the most probable scenario.

Higher water temperatures
Water temperatures in the summer will generally increase at the same pace as air temperatures; in addition, the earlier end of the snow- melting season will mean that water temperatures will rise from around zero Centigrade to nearly that of air temperatures about a month earlier than at present. The ice formation period will shorten, and it must be expected that many of the larger lakes in south Norway will remain ice-free, during most winters. In inland watercourses where winter conditions are now stable, winter flooding may occur when the ice melts. Erosion and sediment transport will increase significantly during the winter period, particularly if farmers do not revise present practices that leave fields without plant cover during the winter. Soil loss could become a serious problem.

Increased power production and flood loss
Power production will rise slightly, in the most probable scenario (2-3% is indicated, on a national basis), partly owing to increased run-off, and partly because of reduced flood loss. The seasonal variation in run-off will be better adapted to consumption, giving an increased level of firm power output. In the high scenario (16-17% rise in precipitation) the rise in run-off and production will be much larger, but flood loss will also rise, unless the production system is adapted to the changed conditions.

The most likely effect on water supplies will be changes in water quality, but water utilities with small reservoirs and marginal run-off may experience shortages in dry summers.

Bjørn Wold:

Polar hydrology

The Norwegian Hydrological Committee has started up its own polar hydrology programme. In cooperation with, among others, NVE, it has built two run-off stations on Svalbard during the past few years. The larger of the two has been built in the glacier watercourse of Bayelva, near Ny-Ålesund, on the north west coast of Spitsbergen island. The permafrost creates both building problems, and problems related to monitoring technology, which are not found on the mainland. These problems, coupled with record-size floods during the two past years, have resulted in some damage to equipment and breaks in registration. Nevertheless, satisfactory data was collected in 1990. The station was extensively repaired during 1990, and should now be ready for a new monitoring season. The monitoring programme will for the time being cover run-off, material transport in the river bed, and water temperature.

The other station has been built at Sassenfjord, in the lower part of the DeGeer valley, beside a mountain formation which cuts right across the valley. This place, called Hyperittfossen, is an excellent natural monitoring site. The monitoring programme will initially cover run-off and water temperature, but it is also hoped to begin measuring material transport in the river bed.

The building and operation of the stations has, during this initial period, been mainly financed by NHK's polar hydrology programme, but NVE's hydrology division has also contributed support. Plans for further studies of Svalbard's hydrology are not clear. There is a great need for periodic measurements, continued over a long time, of a number of parameters. The institution which should logically be responsible for this is NVE. Budget responsibility has not, however, been clarified.

To review further research into Svalbard's hydrology, NVE, the Norwegian Polar Institute and the Norwegian Hydrological Committee have begun drawing up a special study programme devoted to this subject.

Egil Skofteland:

NVE gains trust in the developing world

NVE's cooperation with NORAD (the Norwegian Agency for Development Cooperation) continued in 1990 in accordance with well-established routines, within the areas of energy and water resources, including water supply and sanitation.

Policy Questions
A condition for the success of an electrification programme is that the area involved has reached an economic level which enables its inhabitants to make use of the new energy. We must limit ourselves to centres where enough purchasing power exists to create a real economic demand for electricity. When we analyse the energy requirements of a developing country, we distinguish between the energy needed to survive, and the energy which is a precondition for sustainable development. Firewood today accounts for virtually all energy consumption in African villages. By supplying electricity, we provide a necessary precondition for development. NVE wishes to increase its involvement in the energy sector by giving assistance in building up institutions, in evolving strategy and in preparing legislation.

It is, moreover, one of the NVE's definite goals to seek to influence development of the vast water resources that exist in many developing countries, so that development takes place at a sustainable rate, with due consideration of the environmental consequences.

In all aid organisations there has been a major revision of water supply policy as a result of the international water decade, 1981-90. Now NORAD also gives higher priority to simple technology, participation by the local population, the building up of institutions and the integration of water supply with sanitation and health training. In water supply planning, too, greater importance is now given to environmental aspects. During the run up to the UN's big environment and development conference in Brazil, in 1992, the Nordic countries will focus particular attention on water as a resource. NVE wishes to play a part in preparations for this conference.

Projects
In 1990, as in previous years, it was mainly in Africa, and particularly in the SADCC region (Southern African Development Coordination Conference) that NVE was active in development aid programmes. The SADCC's energy secretariat is in Luanda, Angola, and its operation is financed by NORAD. NVE has assisted the secretariat with advice concerning planning of its further operation, and the organisation of cooperation among the SADCC countries, in accordance with a modified Nordic model.

Mozambique
Cooperation with EDM (Electricidade de Mocambique), which started many years ago, continued in 1990, including evaluation of the economic aspects of a controversial new small power plant.

Lesotho
NVE is involved in training of personnel to operate the two small power plants which were completed in 1989. The experience gained during the construction of these plants will be described in an NVE report in 1991. In 1990, also, NVE provided advice to the DWA (Department of Water Affairs) in connection with the construction of hydrometric stations in the Quthing river.

Tanzania
NVE personnel continued to participate in planning and revision of the extensive water programme, which has now been reorganised. At the same time, plans were laid for the continuation of the electrification programme for Zanzibar and Pemba, and some assistance was given in connection with the planning of a new power plant on the Pangani river.

Zambia
NVE's involvement here focussed mainly on the water supply sector, and follow up of the programme financed by NORAD. Plans for the Nyancombe micro hydropower plant were also evaluated by NVE.

Zimbabwe
In Zimbabwe, NVE participated, as technical adviser, in the water programme financed by NORAD.

Angola
Planning of future cooperation between NVE and the energy authorities in Angola started in 1990 - and could pave the way for great challenges.

Namibia
Cooperation began with NORAD in 1990. Energy will be one of the main areas to receive Norwegian assistance. NVE is helping to plan an electrification project in Ovamboland, in the far north of Namibia.

Kenya
NVE was particularly involved in water sector activities, as well as an evaluation of the import of transformers from Tanzania, but following the break in diplomatic relations between Kenya and Norway, Norwegian assistance ended.

Nepal
Construction of Jhimruk hydropower plant has now begun, and NVE is acting as a technical adviser on the project, which is being carried out by private organisations.

Pakistan
Planning of an extensive electrification programme continued in 1990, and everything was made ready for the project to begin.

Thailand
NVE evaluated the environmental consequences of the Pak Mun hydropower plant in the north eastern part of Thailand, and gave a conditional recommendation that Norway should participate by financing part of the project.

Central America
After a lengthy planning phase, proposals were tabled at a seminar in San Salvador for a number of study and training projects which are suitable for regional cooperation in the electricity sector. It is hoped that several of the projects will be started in 1991, and the intention is that NVE should coordinate the necessary Nordic consultancy assistance.