WORLD INTEREST IN NUCLEAR DESALINATION

Nuclear power will be used in a desalination plant for the first time in a USSR plant now nearing completion. Studies are in progress to expand the concept of linking the power to chemical industries. These and other developing ideas were subjects of keen discussion by world experts at an Agency conference on nuclear desalination in Madrid.

Problems of fresh water requirements vary with localities but it is evident that rapid growth in populations will call for ever-increasing supplies. Much can still be done to make the most effective use of water from rainfall, underground sources, rivers and lakes, and there is also scope for research into the relationship between electricity demands, water needs and the potential for new industries.

It became clear during the symposium on nuclear desalination held in Madrid during November that international attention is being focussed on the problems to a greater degree than in the past. It is only five years since the Agency sponsored the first international meeting on the subject. In that time knowledge of how to use nuclear energy to provide fresh water from sea water has progressed rapidly, to the extent that in Madrid there was general agreement that large-scale plants for turning sea water into fresh water, probably in combination with other industrial work, may be built in the comparatively near future. Several might become operational in the 1980's.

Nuclear power plants are available today which are competitive with those using fossil fuel and even more economical reactors are being developed. Research is proceeding on large size desalting plants to go with the nuclear reactors, and on the economic implications of a reliable and pure water supply for agriculture.

Work is in progress to use nuclear power with desalting in USSR, where a big scheme at Shevchenko on the Caspian Sea is in an advanced stage. It will use one of the most advanced reactors (a fast reactor producing 150 megawatts of electricity and 250 000 tons of fresh water a day).

Among the many ideas put forward during the week were centres where power could be linked both to desalination plants and to fertilizer and other chemical factories to exploit raw materials; under-soil irrigation direct from desalting plants which could economise on the use of water; the use of comparatively small plants to maintain the level of reservoirs during periodical dry periods; and the importance of developing breeder reactors to reduce costs.

HELPING TO ALLEVIATE POLITICAL TENSIONS

The possibility that nuclear desalination to provide fresh water on a large scale could help to alleviate political tensions was referred to by Dr. Sigvard Eklund, the Director General, at the opening of the symposium. He expressed the hope that world banking and financial institutions would concern themselves increasingly with the overall advantages of large-scale long-term developments in this field.

Developed and developing countries share the need for large quantities of water at low costs, Dr. Eklund said. He hoped that the advanced countries can develop a technology which could quickly be applied in developing countries. For wide-scale use in agriculture the cost of the water has to be reduced drastically. It should, however, be recognized that fresh water produced in this way contains practically no salt and that it is available independently of meteorological conditions. Thus some previously uncontrollable variables would be removed and this might result in an earlier application to agriculture than is now generally expected.

Dr. Eklund also referred to the concept of large agro-industrial complexes where nuclear plants could provide fresh water as well as electricity for fertilizer and chemical processing industries. This idea promised a rational and economical plant for developing countries. It was of especial importance to nations which were major importers of products resulting from energy processes, which had raw materials which could be processed or whose climates favoured all the year round agriculture in fertile soil needing water. Study and analyses of such schemes would require specialists in many branches of technology and co-operative efforts between international organizations. Large investments would be needed, usually in areas lacking capital. One important contribution of international organizations like IAEA would be to provide engineering, development and experience which could reduce the financial risk and so encourage investment.

Mr. Lopez Bravo, Minister for Industry in the Spanish Government, said that Spain had followed all developments with the greatest interest. Two plants were converting salt water into fresh water by use of conventional power and there would soon be a third. These were to meet emergency situations, but there were much more ambitious and extensive plans. A study was being made of the possibility of a large agricultural and industrial complex in the south east of Spain. Another project being examined was to deal with water shortages in the industrial city of Barcelona and its surroundings by building a dual-purpose plant to produce electricity as well as fresh water.

DRASTIC IMPACT

"Joining the most abundant of the world's energy resources – nuclear power – with the unlimited waters of the seas to produce fresh water will have a drastic impact on this planet" declared U.S. Atomic Energy Commis-

sioner James T. Ramey. The combination of nuclear power with desalting in large plants had, he said, led to estimates which should give the green light for properly conceived projects in selected locations around the world. He considered it significant that the costs of developing conventional water resources were constantly increasing, while desalting costs showed a downward trend.

At Oak Ridge they were examining prospects for a large energy centre in the Near East. They were also looking into a more limited centre in Puerto Rico. Demonstration projects should, he urged, be started without delay so that the success story of nuclear power could be repeated with large-scale desalting.

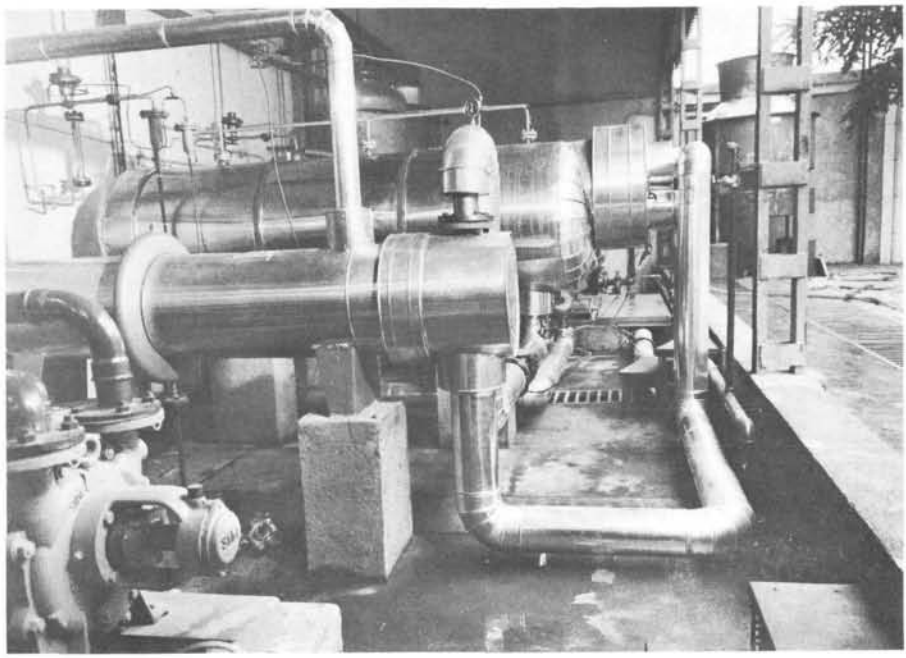
In the United Kingdom, said Dr. H. Kronberger, the second three-year programme of investigation had been authorized by the Government as a result of indications of the likely benefits. One reason was for export purposes, but it had also been acknowledged that desalination would be needed for supplementary water resources in the UK. The fact that it would be cheaper to guarantee water supplies in "dry" years in the UK by adding low-cost desalination plants rather than extending conventional schemes meant that desalination might be introduced earlier than previously thought.

Both the French Government and private industry attached great importance to desalination investigations, reported Dr. P. Balligand. This was demonstrated by a number of separate programmes in progress, including some at universities, to study and develop the technology of desalination.

WORLD-WIDE SURVEY OF OPERATING EXPERIENCE

For the United Nations P. A. Mawer gave details of a survey conducted of operating experiences with many desalting plants. Although it showed that there was a surprisingly low plant operating factor of 60 per cent, discussion brought out that actual plant availability is more like 85 per cent. The data resulting from this first world-wide survey will be important in evaluating future nuclear and fossil fired desalting facilities.

Undoubtedly the most ambitious study made to date, in terms of plant size and scope, has been that conducted by the IAEA, Mexico and USA for a nuclear power and desalting plant to serve a large area of southwest USA and northwest Mexico. J. A. Hunter (USA) reviewed the study, which has a wide interest partly because several plants of a billion gallons a day are envisaged and partly because the water will be used to develop new agricultural lands. The research covered the period until 1995; the first plant could be on-stream in approximately 1980, using light water reactors and multi-stage flash desalting. For later years the development of fast breeder reactors will contribute to cost reduction. Dr. Hunter considered that the desalted water might be of much greater economic value than water from natural sources because of its purity, its reliability of supply and the fact that supplies could be increased to meet demand. In any case, new supplies would have to be imported if not available by desalination.



A desalination test rig operated by the Spanish Atomic Energy Commission. (Photo: Spanish AEC)

THE BOLSA ISLAND PLAN

One set-back which advocates of nuclear desalination have had to face was the cancellation of the Bolsa Island project for Los Angeles, California, owing to substantially increased costs. R. W. Durante detailed reasons for the increase and pointed out the complexity of managing a project with multiple owners, each with their own legal restraints. Six organizations had agreed to co-operate in what the speaker described as "one of the most daring projects ever to be considered for the purposes of providing new water". Two light water reactors each with an electrical rating of 3000 megawatts would be part of a dual-purpose plant producing 150 million gallons of water a day. In 1965 the estimated cost was $444 million. The fact that by 1968 this had gone up to $765.5 million was due largely to escalation of labour and material prices (partly because the time scale was lengthened), increases in taxes, a scaling up of output, higher costs for reactors, changes in design, licensing requirements, decisions concerning management and operation by the six owners, new interest rates and higher costs for electricity transmission and water conveyance. Durante considered that the cancellation could not in any way be regarded as an indictment of desalting or dual-purpose plants, and was convinced that desalting would

eventually play a major role in areas similar to Southern California. He pointed out that cost estimates for other methods of providing water had also risen, greatly, especially costs related to aqueducts, dams or other projects with high labour ratios. For water brought from greater and greater distances costs would go up and quality down.

Y. Barrada (FAO) pointed out that the economics of agro-industrial complexes were strongly dependent on crop yields and water requirements. He showed that there have been striking advances in yields during the past decade. Work at Oak Ridge (USA) on such complexes was reviewed by J.W. Michel in a paper which will undoubtedly be used as a reference for some time. R.P. Hammond (USA) showed the relative sensitivity of profit from an agricultural desalted water installation to changes in cost of the water and other changes such as reactor development and crop storage improvements. He also indicated lines for identifying components of an agro-industrial complex affording the greatest chance for economic improvement.

From P. Terlizzi (UNIDO) came the suggestion that there could be economic benefits in exploiting chemicals derived from the brine left by a desalting operation. This was carried further by L. Ehara (Japan) who described plans for a triple-purpose plant producing electricity, fresh water and industrial salt.

In the field of small and medium power P. Maldagne (Belgium) regarded the VULCAIN reactor as an energy source for a dual-purpose plant of 50 to 60 megawatts of electricity and 25 - 30 million gallons of water a day. In Italy, said L. Biondi, they felt quite prepared to begin construction of a demonstration ROVI plant without further development work.

The use of desalting plants on an occasional basis to maintain reservoir capacities was made by M. Burley (UK). He indicated savings that could be made in comparison with other methods.

J. Halzl (Hungary) considered that steam and electricity from nuclear reactors could be economically utilized in alumina plants and might be even more attractive in combined alumina and aluminium plants.

A need was indicated for more data on the yields and water-requirements of crops to help evaluate the agro-industrial complex. Another interesting idea was the possibility of a mobile desalting plant for use by countries during emergency; it may now be possible to establish reasonable economics for such a plant.

At the end of the symposium some of the important points which had been made were reviewed by several of the leading experts, including James K. Carr (USA), Hans Kronberger (UK), Pierre Balligand (France) and Ivan S. Zheludev, Deputy Director General of the IAEA for Technical Operations.

At the opening of the Madrid Symposium on Nuclear Desalination Spanish representatives present included the Minister of Industry, Mr. Lopez Bravo, who spoke of the benefits possible from this "new and revolutionary technology", and the President of the Atomic Energy Commission, Professor José María Otero Navascués, who also acted as chairman at meetings during the week. This photo shows (left to right) J. Wilson and J. Spitalnik (IAEA Scientific Secretaries), Professor I. Zheludev, the Minister of Industry, Dr. Sigvard Eklund and Professor Otero Navascués. (Photo: ESCOBAR, Madrid)

NUCLEAR DESALINATION A REALITY

José Maria Otero Navascués, President of the Spanish Atomic Energy Commission, said the first conclusion they could draw was that nuclear desalination could be considered as a reality from the technical and economic standpoint.

The fact that the efforts of the IAEA in promoting co-operation had already produced improvements in many aspects of desalination work as well as much greater knowledge of the nuclear potential was emphasized by Kronberger.

Balligand predicted that in a very short while the costs involved in production of fresh water would be reduced by half, taking as an indication that the same thing had happended with nuclear power. The symposium had reinforced confidence that desalination could provide a pure source of water; with it the farmer need no longer pray for rain.

Professor Zheludev referred to special IAEA missions to determine the technical and economic practicability of nuclear desaltination in particular locations at the request of the Member States. These had gone to the United Arab Republic to study the Borg el Arab project; to Chile to determine the feasibility of dual-purpose plants for the Antofagasta region; to Peru for studying the possibilities of nuclear desalination in the Pacific Ocean coastal area; and to Tunisia for determining the potential use of nuclear energy for the industrialization of the southern region. An observer actively participated in the power-water desalting plant study for Israel and more recently joined a group to study the desalting prospects for Athens in Greece. The Agency participated in the joint study for northwest Mexico and southwest U.S.

At the same time, the IAEA had convened panels of experts to define and produce the required information. As a result they had published reports on nuclear energy for water desalination and on costing methods. They would soon issue a report on the value of high-quality water in agriculture.

Under its research programme the Agency had published a study on the feasibility of nuclear reactors for sea-water distillation and a guide to evaluating nuclear desalination costs. Organized co-ordinated studies of nuclear desalting plants suitable for load applications are now underway.

The concept of multi-purpose energy centre projects had, he said captured a great deal of interest. Since shipping nuclear fuel was not a major cost item, nuclear power had a higher degree of freedom because the location of such projects did not depend on indigenous hydro-power sources or fossil fuel deposits. Hence it would be possible to establish large industrial complexes in regions where these natural resources did not exist. The concept might hold an important promise to those countries which have raw materials and the benefit of a climate suitable for year-round agriculture.

Altogether about 60 papers were presented and were keenly discussed by close on 300 participants from 28 countries and eight organizations. Subjects included results of research into agro-industrial complexes, experience in large and small desalination plants, a survey of techniques, the adaptability of various reactor types for the purpose, economic prospects, and experience gained in operating and preparing national programmes. The reports came from France, Federal Republic of Germany, Hungary, Israel, Italy, Japan, Singapore, Spain, United Arab Republic, UK and USA, as well as from the United Nations, the Food and Agriculture Organization (FAO) and the United Nations Industrial Development Organization (UNIDO).

Wearing a typical regional dress in which she has travelled to the Alexandra Hospital, Athens, for treatment, a Greek woman receives radiation treatment for a thyroid condition. The Hospital is part of the University of Athens School of Medicine and has received IAEA grants for research. (Photo: IAEA/Moir)