

ATOMIC ENERGY IN ITALY

EVEN a casual observer cannot help being struck by the remarkable interest evinced by Italy as a nation in the development of the use of atomic energy for peaceful purposes. The June 1957 issue of the *Atom Industry* contains an illustrated supplement on the industrial nuclear programme in Italy which makes interesting reading in this direction. This is as it should be when one remembers that one of the most important pioneers in nuclear physics was Enrico Fermi. Italian interest in this field and the progress already achieved is something to be emulated particularly by Asian countries. Atomic energy has come to stay and is destined to have a considerable influence on the life of the common man in the not too distant future.

While it is true that Italians have lagged behind others in industrial application of atomic energy, it is nevertheless possible that the high level of their theoretical studies, the efficiency of their industrial concerns and the ample possibilities of the collaboration of allied countries will permit rapid progress. Bold, yet careful, programmes are being launched in order to secure new and highly important sources of energy. By 1965, it will become necessary to derive the benefits of some of the new sources such as atomic energy. It is particularly so in underdeveloped Southern Italy with its insufficient sources of water power. A spurt in this direction has been received due to the attention of concerned authorities being drawn by the Geneva Conference of August 1955. Enterprises for the construction of atomic plants have taken note of the special needs of Southern Italy where some of the earliest plants will be located. American specialists expect that within a few years the cost of atomic energy will be brought down to the level of energy produced by conventional methods. When this happens the southern regions of Italy will no longer be in an inferior condition to more fortunate areas. They will also be able to look forward to a future of economic development. In spite of lack of practical experience, the plunge has been taken in preference to waiting for a few years for the possibility of being able to build cheaper atomic plants than at present. Since Italy is a land where the cost of energy is high with a tendency to go higher, it is possible even without exact calculations to forecast that the cost of atomic energy production will be competitive with that of conventional energy. The Suez crisis has demonstrated the danger of insufficiency of energy sources and has accele-

rated the pace of development of atomic programmes.

Geological prospecting for Uranium has been progressing soon after the Second World War yielding very satisfactory results. As a result the most important find is the one at Rio Freddo where about 1,500 metres of underground workings have developed. The activities so far carried out have not only led to the extraction of a certain quantity of the ore but also pointed out the existence of ore deposits of value.

From a study of the performance of power reactors in U.K., U.S.A. and elsewhere, it is concluded that it is preferable not to limit atomic plants to one type only and so it is proposed to set up both natural and enriched Uranium plants. Legislation now under way, concerning atomic energy, rejects nationalisation and consequent government monopoly of atomic energy plants. Government will own all atomic fuels and will permit their industrial use by concessions. There will be government participation in addition to private enterprise for atomic energy production on conditions of equality while the sale price of energy will be regulated by government.

Industrial activity in the field of atomic energy will result in the formation of "human capital" due to the training of adequate technical and professional personnel for which Universities are insufficient by themselves. It is estimated that in five years about 2,500 technicians and about 1,200 qualified graduates will be required. Three schools have been opened for this purpose and two others will be started shortly. In these, training will be of six months' duration for graduates qualified in Physics, Chemistry and Engineering. In addition to practical training in Nuclear Physics and Electronics, there will be courses of study in Nuclear Physics, Reactor Engineering, Reactor Theory, Reactor Physics, Health Physics, Metallurgy and Chemical Engineering. Acquisition of a water boiler reactor for one school and a swimming pool reactor for another are contemplated, while the use of similar reactors for a third school is being considered.

A National Committee for Nuclear Research (CNRN) has been set up which initiates, controls, co-ordinates and allocates funds for nuclear research in Italy. The CNRN has also promoted a reorganisation of the Centre of Information, Study and Experiment (CISE) where a Reactor Group has been organised for construction and installation of a reactor at Ispra. This was

planned to be of the high neutron flux heavy water moderated natural uranium type. Initial details of its design were made available in time for the Geneva Conference. Due to difficulty in getting Uranium and heavy water and due to bilateral agreement with U.S.A. for the supply of U^{235} , it was later decided to enter into an agreement with U.S.A. for the construction of the reactor. The CP-5 heavy water moderated enriched Uranium reactor was the one selected for this purpose and the work was entrusted to the American Car and Foundry of New York who specialise in this type of reactor. This firm has also had the co-operation of CISE experts in working out the design. Researchers of the Reactor Group of CISE are now in New York and Washington to work in collaboration with the firm on the project. The power of the reactor will be 5,000 kw. with a neutron flux of 10^{14} cm.⁻² sec.⁻¹ Detailed planning of the Ispra centre where it will be installed in the spring of 1958 is also under way.

The Electrical Industry has also taken a lead in studies and projects for the building of nuclear plants. The Edison group of power companies in Italy has signed an agreement with the Westinghouse Corporation of America for the purchase of a plant of 134 million watt capacity. This will be a pressurised water reactor using enriched Uranium as fuel. The possibility of increasing its output to 240 MW with a superheater fired by conventional fuel has also been contemplated. The Societa Elettro-nucleare Italiana (SELNI) set up by the main

electricity companies is about to begin its activities. SELNI has already assembled a limited number of personnel, produced a draft project and begun the study of locations suitable for installing a nuclear power plant in Southern Italy. Negotiations with overseas firms for the design and operation of this plant are well under way.

In July 1956, the Fiat and Montecatani concerns entered into an agreement for the establishment of a Society for Research on Nuclear Installations (SORIN). SORIN has now reached an advanced planning stage for installing its first reactor of the swimming pool type with its connected laboratories. This is intended for industrial research and for the production of radioactive isotopes. Later, SORIN will instal a 150 MW. nuclear power plant and a second plant in addition. SORIN will also train nuclear technicians, the first group of whom are already at its disposal. A number of these are in U.S.A., U.K. and other countries completing their training and arranging purchase of plants and equipment.

Largely due to the efforts of the CNRN, a consciousness for the necessity of exploiting this new source of energy has grown in industrial circles as also in government circles with the result that Italy will not stand by, as a mere spectator during the industrial revolution of the atomic age involving every country in the world.

S. RAMA SWAMY.

ELECTRIC POWER DIRECT FROM FISSION

IN a recent number of Nucleonics, a novel type of reactor has been proposed which converts fission energy directly into electricity by causing ionised U^{235} gas to interact with a magnetic field.

The proposed reactor is cylindrical in shape and would contain the fissionable material in gaseous form. The temperature of the gas is high enough, so that part of it is ionised. Direct conversion is accomplished by driving the ionised (and therefore electrically conducting) fissionable gas do work against a magnetic field. The work done against the field appears as electrical energy in an external circuit. The dynamical motion of the plasma (hot gas) is so arranged that after each interaction with the magnetic field, the plasma configuration is reshaped by solid walls so that magneto-hydrodynamic instabilities cannot grow from cycle to cycle.

That electrical power is generated as a result of the interaction of the moving plasma

with the coil-condenser oscillation can be understood in terms of the forced oscillation of a tuned electrical circuit. In this case, the coil and condenser in parallel, form a tuned resonant tank circuit. The oscillation is forced by the interaction of the induced eddy currents in the conducting plasma with the currents in the main coil. Eddy currents are induced in the moving plasma because the plasma is a conductor moving in a magnetic field. Since the induced current in the plasma is in such a direction as to give a net retarding force on it, the electrical oscillations in the coil condenser tank circuit are 'forced' to a greater amplitude at the expense of the mechanical energy of the plasma motion. The consequent conversion of the mechanical energy to electrical energy of resonant oscillation is the basis of electrical power generation.

Several advantages have been claimed for the proposed design.