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ATOMIC ENERGY IN AFRICA

Note by the International Atomic Energy Agency (IAEA)

1. The International Atomic Energy Agency is the organization of the United Nations system responsible under its Statute for encouraging the utilization of atomic energy for peaceful purposes in its Member States and for performing any operation or service useful in research on atomic energy. This includes providing materials, services, equipment and facilities. It is also responsible for fostering the exchange of scientific and technical information on the peaceful uses of atomic energy and encouraging the exchange and training of scientists and experts in this field.

2. Seventeen African countries are members of the International Atomic Energy Agency (IAEA): South Africa, Algeria, Cameroun, Congo (Leopoldville), Ivory Coast, Ethiopia, the United Arab Republic, Gabon, Ghana, Liberia, Libya, Mali, Morocco, Nigeria, Senegal, Sudan and Tunisia. Kenya and Madagascar have been approved for membership.

3. The IAEA is concluding an agreement with the Organization of African Unity and expects to collaborate with the Scientific, Technical and Research Commission of that Organization in matters of mutual interest.

4. In practical terms applied to Africa this means relating IAEA's assistance to the implementation of national development plans and ensuring that the potential of the peaceful uses of atomic energy is taken into account in the preparation of future plans. Atomic Energy

plays a considerable role as an ancillary in agricultural research and development, ground water studies, preservation of agricultural products and food, and in medical diagnosis and therapy. Recognition of its potential in power production is acknowledged by economic planners even where abundant supplies of hydro-power exist. Some examples of the role of atomic energy in Africa and the part played by the IAEA are given below, together with some suggestions for future action.

Nuclear Power

5. Although there are vast hydro-power resources and substantial quantities of oil and natural gas in Africa there have recently been advances in applied nuclear energy which bring near the break-even point with conventional energy. This break-even point however will first be achieved by large stations operated at high load factors. The great majority of African electric power systems at present in existence are of a relatively small capacity and indeed some large hydro resources are in many cases untapped. Some time will be required therefore before nuclear units of a competitive size can be envisaged in Africa. There are possibilities of achieving an improved load factor in the areas where fresh water requirements will have to be met by plants for the joint production of desalted water and electricity. The IAEA is participating in studies being carried out on the feasibility of dual purpose power and fresh water producing nuclear plants by the United States, Israel and Mexico. In Tunisia detailed studies on the feasibility of such a plant for use in the southern area of the country have been made. The UAR proposes to embark on a nuclear power project calling for a nuclear power station of 150 M(e) which would be integrated into the grid system. At the request of the UAR the IAEA is studying a project for a sea water desalination plant to be used in connection with a pilot agricultural project of 10,000 acres, the aim being to study the feasibility and economics of the use of desalinated water for agriculture under arid conditions. The IAEA would be glad to investigate other cases of arid areas in Africa for which water desalting appears to be an important problem.

6. The report of the African Electric Power Meeting held in 1963 pointed out the desirability for the planning authorities in the Member countries of ECA to keep abreast of technical changes in the nuclear power field. A developing country planning a new power programme should not therefore consider the atomic energy alternative in isolation but together with investigations of conventional means. This should be in the nature of a continuing process particularly when it is borne in mind that at least four years should be allowed for the construction and commission of a nuclear power station and about 2-3 years for the initial surveys and studies. The development of the Iron and Steel Industry in West Africa and the conclusions of the Bamako meeting of October 1964 in so far as they refer to regional supplies of electricity are relevant to the production of future power. In preliminary investigations so far carried out by the IAEA in nine countries in Africa it has been suggested that the problem should be the subject of separate study during the next 3-5 years. Such studies might be made or be brought up-to-date in Cameroun, Liberia, Kenya, Senegal, Togo, etc.

Nuclear Raw Materials

7. In 1963 Africa produced about 20% of the world's uranium output mainly from South Africa, Madagascar and Gabon. In addition Madagascar produced about 700 tons of monazite containing about 100 tons of thorium oxide as well as small tonnages of beryl. This does not represent production potential since South African production has been deliberately cut down from its production capacity of 5,700 tons per year. $5 per pound of contained uranium oxide in concentrates is regarded as an economic price for uranium although many long-term contracts still exist in which the price is in the order of $8 to $10 per pound. Contracts for small tonnages have been made at prices as low as $3.65 per pound and the most recent contract for about 500 tons of uranium oxide at a price of about $3.42 per pound but it is unlikely that this would be representative of the prices which will prevail when the demand and supply position become more in balance. When in later years demand exceeds supply and assuming that reserves of what

are at present regarded as economic ores are not increased it will become economically possible to mine deposits which are at present regarded as sub-grade.

8. Recent information presented to the Third International Conference on the peaceful uses of atomic energy (in September 1964) on the future supply and demand of uranium indicates that on present evidence and at present prices the Western world resources of uranium in 1970 are likely to be of the order of 330,000 tons. In the period 1971/80 consumption is expected to reach at least 270,000 tons and subsequent annual demand will rise to 55,000 tons. Deposits of uranium already known and developed in Africa represent the results of limited search and there seems little doubt that a more intensive prospecting, particularly in areas not as yet surveyed, will result in discoveries of new deposits of uranium ores as well as deposits of other minerals of potential atomic energy significance such as beryllium and thorium. Investigations of such areas are currently being carried out in Senegal, Tunisia, United Arab Republic, Upper Volta, etc. In addition the possibility of economic recovery of uranium as a by-product in fertilizer production from phosphate rock is being studied in Senegal and Tunisia and has previously received some attention in Morocco and UAR. Although the cost of production is not attractive on current prices of uranium this situation would change with the development of new reactor systems such as breeder reactors and any change in the supply and demand position which will surely arise within the next two decades.

9. The above facts are important for Africa since the development of nuclear power is likely to reach significant proportions only in the latter part of the century when the maximum world demand will face rapidly diminishing resources unless new deposits of ore are found or new reactor systems are developed which would permit utilization of higher cost uranium produced from low-grade deposits. The vast potential of mineral wealth in Africa might well be organized to take advantage of this anticipated new demand which could be an important source of foreign exchange.

Application of Radioisotopes in Agricultural Development Plans

10. Atomic energy in the form of radioisotopes and radiation plays an important part in the investigations essential to increase agricultural production. Endeavours to increase production require an understanding of the factors which affect yields. For example fertilizers that are rendered radioactive are extremely useful in determining the best methods of fertilizing a crop in different soils, e.g. how to get the greatest yield for a given amount of fertilizer through the correct placement. The IAEA is actively organizing world-wide projects designed to increase yields of rice and maize, mainly by developing methods of fertilizer application. Madagascar and the UAR are carrying out research in the rice project and similar research could be undertaken in Ghana and Sierra Leone. At present no African country is participating in the maize project but interest has been expressed by Ghana and projects could be developed in the main maize-producing countries such as Southern Rhodesia, Congo (Leopoldville), UAR, etc. The use of portable instruments (neutron moisture probes for soil moisture determination) is invaluable in studies on the wise conservation and use of water in crop production. These methods have been in use for some time in Algeria, Ghana, Ivory Coast, Kenya, Madagascar, Tunisia, UAR and Morocco.

11. Nuclear techniques are being used in plant production and protection studies particularly in cocoa, peanut and rubber research in Ghana, in ground-nuts and sorghum in Senegal and on olives in Tunisia. It is hoped to expand the use of these techniques to rubber in Ghana and Nigeria and in coffee in other countries in West Africa. In 1965 the IAEA proposes to organize a world-wide co-ordinated programme for tree-crops such as cocoa, coconut, oil-palm and rubber, to determine the most efficient means of fertilizer application leading to increased yields. It is hoped that several African countries will participate.

12. Entomological research is being undertaken on a considerable scale and much attention is being given to the possibilities of eradication of the Mediterranean fruitfly in studies in Tunisia and Morocco and

research into the eradication of Tsetse is being actively supported by the IAEA in Southern Rhodesia, and more intensive research is contemplated utilizing all the Tsetse fly research facilities in Africa. The UAR is also studying the eradication of locust by the sterile male technique which requires the application of nuclear methods.

13. In the campaign to increase agricultural production both by increasing the yields and by avoidance of losses from insect pests etc. the use of radioisotope techniques is considered by research workers as an additional useful tool in their hands. For this reason the IAEA has been actively encouraging the establishment of small radioisotope units within the existing agricultural research units or where none exist in the faculties of agriculture of the national universities. It is not intended that the laboratory should be continuously in use but should be available if and when the need arises to solve particular problems. Many such laboratories exist and more recently, in co-operation with the IAEA, new ones will be established in Sudan, Nigeria, and Uganda. They could with advantage be introduced into for example Mali and Cameroun.

Food Preservation

14. The application of atomic radiation for the preservation and disinfestation of food is under serious consideration in some of the technically advanced countries and would seem to offer distinct possibilities of interest to several African countries. Destruction of insect pests in grain by irradiation appears to be biologically and technologically possible and the same may be true for the application of radiation for the prevention of losses of dried fish due to insects. However its application in tropical climates will be partly dependant upon improvements in the handling and packaging of the preserved commodity. Some studies are being undertaken at the Mpoti Research Station in Mali on Niger fish and it would seem advisable that similar studies might be carried out in Tanzania and Uganda where there are high losses of dried fish and a consequent reduction in protein available for populations who

live inland. Delay of ripening of some tropical fruits, particularly bananas and mangoes, can be achieved by atomic radiation as can control of harmful organisms transmitted by food and food products. Radiation decontamination of commodities such as fish, meat, bone and blood meals, would substantially increase the market for such products in Europe and elsewhere. Food irradiation is a complex subject and the IAEA, whilst actively co-operating in the necessary research before it is warranted to introduce the technique in a wider scale into developing countries is actively co-operating with projects in Algeria and Tunisia concerned with the necessary installations for the radiation of agricultural products and other food.

Applications of Atomic Energy in Hydrology

15. Recent studies have proved that data of great economic significance with regard to the availability of ground water in arid zones and for the investigations of water resources can be obtained with comparatively small effort and at a lower cost through the use of radioisotopes. Isotope techniques may be used to trace water to find where it comes from and to determine the age of ground water and provide other information of importance in the effective utilization of the available water resources. These techniques are currently used in Southern Rhodesia, Tunisia, and in hydrological investigations in the Taveta area in southern Kenya. In arid and semi-arid regions groundwater must be developed to maintain viable pastoral and nomadic economics. Isotope techniques can be used to good advantage in the evaluation of long-term potential for sustained groundwater production. These techniques could be applied particularly in the Savannah and Sahel regions of for example Chad, Niger, Algeria, etc.

Industrial Applications of Atomic Energy

16. Industrialization projects are prominent features in many development plans of African countries. In a modern industry the use of radioisotope techniques (nucleonic gauging, radiography, tracing) is an integral part of direct importance to many African countries.

It is the standard practice to utilize these techniques in prospecting for oil and mineral deposits in which the information is given in a manner not obtainable by any other method. Recent work performed in the UAR with IAEA assistance has demonstrated clearly the range of useful applications of radioisotopes in different industries. Tracer experiments were performed in oil fields, steel plants, the glass industry and fertilizer factories. Non-destructive testing of ingots by means of gamma radiography wqs also successfully introduced. Tracer applications are of common usage in moisture measurements in construction of highroads and in ore dressing. Consideration of the use of these techniques in industrial development schemes now being planned or undertaken in various regions of Africa should be given by planners as well as industrialists and contractors.

Medical Applications of Atomic Energy

17. Improvements in health services and facilities have been assisted in recent years by advances in nuclear medicine in particular in the diagnostic and therapeutic fields. National development plans provide for considerable hospital building programmes as well as national health schemes. Radioisotope laboratories for diagnostic purposes are already in operation, for example in the Congo (Leopoldville), Kenya, Nigeria, South Africa, Tunisia, the UAR and Uganda. They have recently been introduced into Morocco and Senegal with IAEA assistance and will be available soon in Sudan. Medical research utilizing radioisotopes into the causes of tropical diseases such as liver cancer, sickle cell anaemia and various types of malnutrition is being undertaken in all countries with the necessary facilities. Some of this work is being supported by the IAEA in Ghana and Nigeria and through research contracts in Congo (Leopoldville), Kenya, South Africa and the UAR.

18. This work requires trained personnel and specialized equipment and adequate health and safety measures have to be observed. The increased availability of radioisotope facilities in Africa to tackle medical and biological problems must allow time for training and personnel and the introduction of appropriate legislation.

Research Reactors and Training

19. In 1964 there were 2 research reactors operating in Africa, in Congo (Leopoldville), and the UAR. Another in South Africa is expected to become operational in 1965; one is under construction in Ghana and Senegal plans to introduce one. In collaboration with the IAEA a regional radioisotope training centre is maintained in UAR and another centre has been agreed in principle for establishment in Congo (Leopoldville). These centres are primarily used for training and reactor studies. To implement the programmes mentioned above nuclear scientists and technicians from African countries will need to be trained. A limited number of personnel can be trained in the basic nuclear sciences in the universities and institutes of higher learning in various African countries but more specialized training in the handling and maintenance of specialized equipment may have to be undertaken overseas in established nuclear centres. Training awards, fellowships, scholarships, grants etc. in the more specialized atomic energy fields are available under the programme operated by the IAEA which also embraces, where necessary, the provision of university lecturers and grants for study tours. Regional training courses with IAEA assistance have been held in Congo (Leopoldville), the UAR and Uganda. In addition a mobile laboratory can be made available for teaching and demonstration of counting techniques, etc.

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