INTERNATIONALLY CO-ORDINATED RESEARCH IN RADIOECOLOGY AND ENVIRONMENTAL MONITORING

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1. INTRODUCTION

The projected growth of nuclear power in many Member States of the IAEA presents several questions of radiological protection which can best be resolved through international co-operation. In fulfillment of its statutory obligations the Agency tries to help in the development of soundly based radiation protection programmes relevant to the specific needs and circumstances of countries and regions. One approach is to co-ordinate investigations in individual Member States aimed at reliable assessment of radiation burden to the population from natural and man-made sources. The Agency's assistance, in addition to modest financial support of individual research groups, consists mainly of organizing meetings where the investigators and other experts can discuss research methods and evaluate and compare their data. In this way any undesirable overlapping of work can be avoided.

The basic principles of such co-ordinated research programmes are that a) the participation of a Member State is optional, b) the joint investigations must be based only on already existing relevant national programmes, c) the programme may possibly lead to technical, scientific or even legal agreements in which the recommendations of an international expert group will be reflected and incorporated into national regulations.

The present paper outlines briefly the main objectives and the ways of solving the problems in two current co-ordinated programmes "Studies on the Problems of Radioecology of the Danube River" and "Environmental Monitoring for Radiological Safety in South East Asia, the Far East and the Pacific".

2. THE DANUBE PROGRAMME

The protection of the water-related environment and the water quality is of common interest for the 8 states bordering the Danube, all of which are members of the IAEA. The main objectives of the programme are to investigate the radiological safety for the specific conditions of the Danube river, to harmonize measuring methods, and to evaluate the relationship between the possible releases of radioactive material into the catchment area and the radiation doses to the environment, the ecosystem and the human population both during normal operation of the existing or projected nuclear power stations and in cases of emergency (1). Figure 1 shows the Danube catchment area with the existing nuclear power stations and those projected for the next 6 years (1,2).

Joint investigations to date indicate that waste water from nuclear power stations of approximately 10,000 MWe capacity will enter the river. The distribution, however, of waste releases will be uneven, i.e. 60% and 75% respectively, will be released into the upper third and half of the river length. Taking into consideration international experience with BWR and PWR reactors (3), it can be foreseen that excluding H-3 95% of the total cumulative release value will enter the river in its upper third.

Some other findings of the programme are also of interest.

- Current measurements of the Danube water in various countries show 0.16 - 0.43 Bq/l (4.4 - 11.5 pCi/l) total beta activity (without K-40), 0.01 - 0.05 Bq/l (0.27 - 1.38 pCi/l) Sr-90, 0.002 - 0.05 Bq/l (0.05 - 1.46 pCi/l) Cs-137 and 11 - 33 Bq/l (300 - 790 pCi/l) H-3. Determination of the various radionuclides contributing to the gross radioactivity are now in progress.
- Rough estimates show that the cumulative concentration of mixed radionuclides forecast for the lower watercourse - even if absorbtion by the sediment is not taken into consideration - will be only 10 - 12% of the Maximum Permissible Concentration for members of the Public (MPCP of any mixture of radionuclides excluding Ra-226 and Ra-228 in drinking water is 10^{-7}Ci/m3). The cumulative concentration of H-3 will be approximately 4 orders of magnitude lower than its MPCP value (3 x 10^{-3}Ci/m3). These MPCP limits are defined in ref. 3.
- Concentration factors in various organisms have been determined, e.g. those for Co are in the range of 4000 - 12000 for algae, 1000 - 2000 for plants, 30 - 3000 for fishes. Extreme CF values for Co-60 however, in the order of 10^5 were measured in plankton. Great variations of the CF values in biota or in sediments are expected at various sectors of the river due to the differences of the flora and fauna whose composition is influenced by the hydroelectric stations. For example, there are clear indications that the construction of the Djerdap dam in Yugoslavia resulted in a more intensive accumulation of the radionuclides in the head-pond region than previously (1).

- A detailed bibliography of the relevant literature between 1957 and 1975 has been produced (4).

The future plans are based upon the recommendations of the programme advisory group (1) and may be modified on the basis of the results as they are obtained. Systematic measurements are now in progress for specific radionuclides in various inorganic and organic components of the river and its environment, and critical population groups and food-chains are being identified. A thorough intercomparison of the measured values will hopefully help an international monitoring network in the mutual interest of the riparian countries.

3. THE ENVIRONMENTAL MONITORING PROGRAMME IN ASIA

The Environmental monitoring serves as a verification system to demonstrate that controls on the releases of radioactive substances to the environment under normal conditions are functioning as intended and it also provides information on accidental release. One of the IAEA's important tasks is to give guidance on this subject to those Member States who are preparing nuclear power programmes (5). The aim of the South-East Asia programme is to promote investigations directed toward the identification of critical radionuclides and their transfer mechanisms through the characteristic local food-chains of the region. In addition, an assessment of the natural background radiation will also permit the evaluation of the radiation dose received by the local population. The work in which 7 countries (Bangladesh, India, Indonesia, Republic of Korea, Pakistan, Philippines and Thailand) are participating, is planned as a preparation for the growth of nuclear power generation in the region. The participation of the Federal Republic of Germany in this programme on the basis of a research agreement has made available to the other participants from South East Asia, the

Far East and the Pacific regions, wider experience in the planning and technical implementation of environmental monitoring programmes for nuclear facilities.

This international collaboration, besides providing a good forum for the exchange of experience in methodology and organizational questions, has already revealed some interesting features and data.

- Despite various levels of laboratory facilities and measuring methods comparable data could be obtained from several laboratories for total beta and gamma, Sr-90 and Cs-137 radioactivity measurements. 52 types of local food materials (vegetables, cereals, fruits, fish, meat) were analysed. Differences of radioactivity concentration in various varieties of certain items were identified (e.g. spinach and rice with a factor of 2 - 3 in gross beta and Cs-137 activity). Differences in gross beta and Cs-137 activities in rice samples were correlated with the different ash content in different varieties.
- Food consumption data were collected. After analyses and comparison of various food items the critical pathway to man for radionuclides proved to be cereals and sea-food in India for fishermen and farmers as critical groups near already existing nuclear centres as well as for the Philippine population.
- Where all necessary data were already available, the assessment of radiation dose from the incorporated radioisotopes through the food-chain indicated a yearly contribution of a few millirems to the annual total dose from the present level of radioactivity in a nuclear facility-free area.
- Further high background areas of natural external irradiation were identified in Bangladesh beach and Indonesian volcanic areas with maximum values of 1.14mC/kg/yr and 0.13mC/kg/yr (4400mR/yr and 500mR/yr), respectively.

4. CONCLUSION

Future plans include the intercomparison of measured values in the region, and extended analysis of critical pathways and critical groups. These two examples point out the value of having such programmes coordinated by an international organization. The investigators are enabled to meet periodically to discuss the planning and implementation of the programmes, unintentional duplication of work is avoided, and more efficient use of resources can be assured. The provision of a discussion forum is not only valuable as a research-associated activity but also has significance in training and education. Many developing countries benefit too from the financial support, particularly for purchasing the proper equipment and materials. Finally, one of the most important characteristics of such collaboration is that a much wider international expertise from outside the region can be made available to the regional laboratories through the Agency's technical assistance programme. We believe that such co-ordinated programmes help to solve not only certain technical and scientific problems of environmental protection but also some national organizational and administrative problems of concern for multinational or regional cooperation.

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THE DANUBE CATCHMENT AREA

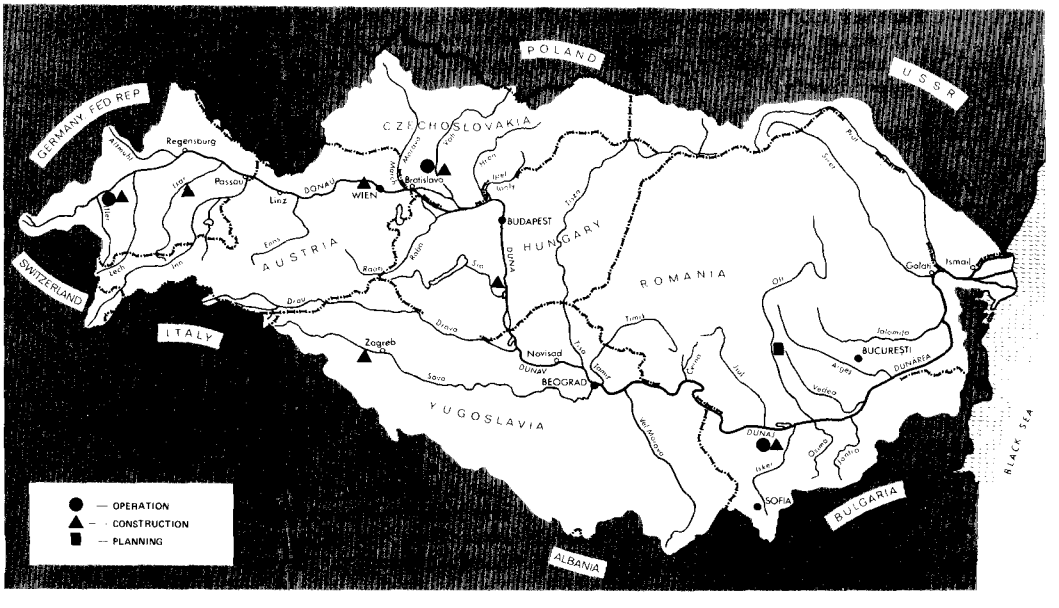

Figure 1.