integrity packaging for the sea dumping of radioactive wastes. Two papers were given on the operational experience and condition of three U.S. radioactive waste burial grounds. Bardet (France) reviewed seven years experience and operating procedures for burying radioactive waste at Cap la Hague.

The presentations at the symposium indicated that considerable progress has been made in the development of waste management technology. Furthermore, it appears that the technology exists for the safe management, handling and disposal of all nuclear wastes generated during the various operations involving the nuclear fuel cycle. However, much of the technology still remains in the developmental stage. A great deal remains to be done in working out the engineering and design details, and adapting the technology to actual operating conditions and controls.

One can conclude that expanding nuclear power programmes will have available, when and where required, demonstrated technology for managing the radioactive wastes from all sectors of the nuclear fuel cycle. However, the authorities of national nuclear programmes must provide increased attention and support during the next five years to those areas where the technology remains to be demonstrated on a practical basis.

REPORT ON AN INTERNATIONAL SYMPOSIUM,
VIENNA, 15–19 MARCH 1976
The symposium was attended by more than 130 participants from 29 countries and the FAO, WHO, ECE and UNEP.

Development of Nuclear-based Techniques for the Measurement, Detection and Control of Environmental Pollution

Rapid industrialization and urbanization have brought about drastic changes in the environment and often leave in their wake a host of new pollutants that may pose serious immediate or long-term health hazards. There is an urgent need to apply scientific knowledge to detect such harmful pollutants and to track their movement in the environment.

The main purpose of the meeting was to identify the role of nuclear techniques in the solution of pollution problems. Topics covered included analysis of air particulates, activation analysis of water pollutants, X-ray fluorescence techniques, and tracer technology. In comparison to a similar symposium on the use of nuclear techniques for environment pollution studies held in October 1970, which dealt mostly with the use of neutron activation analysis and radioactive tracer techniques, the present meeting reflected the advances of X-ray fluorescence, electron-capture gas chromatography, and charged-particle induced analytical methods in trace analysis. A more selective approach in the choice of tracer techniques for investigating a particular pollution problem became apparent during the meeting.

Since it is desirable to understand the origin and fate of the pollutants that pose immediate or long range influence on environmental quality, one common type of air pollution – that caused by the combustion of fossil fuels – was chosen to illustrate the state of the art. About 60% of the papers were related to the composition and movement of air pollutants from combustion processes. The influence of fuel-air mixing, combustion temperature and nitrogen content of fuel on the emission of noxious gases (nitrogen oxides, sulphur oxides, carbon monoxide and unburnt hydrocarbons) was reviewed. It was clear that pollution could be reduced at the expense of either paying addtional costs for processing fossil fuel before it is burned, or by sacrificing energy efficiency by lowering the temperature in combustion zone.

The analysis of air particulates, using neutron activation, charged-particle activation, photon activation or X-ray fluorescence, has become an active programme in many laboratories. Considerable progress has been made in using elemental ratios such as bromine/lead, vanadium/aluminium, lead/aluminium, etc., and in correlations between the distribution of selenium and mercury, or selenium and cadmium in air particulates samples to determine the cause, origin and retention of pollutants in the environment.

The formation and dispersion of noxious combustion gases from fossil fuels is another phase of air pollution studies. Tracer techniques have been applied to the dispersion of these gases in the atmosphere. The use of sulphur hexafluoride as a tracer has become more reliable due to the improved performance of electron-capture detectors. The fate of sulphur dioxide in the atmosphere was investigated with the aid of stable-isotope ratio measurement. The effect of gaseous pollutants, particularly nitrogen oxides from supersonic flights in the stratosphere, on the formation and depletion of the ozone layer was discussed.

The advance of tracer techniques in the investigation of pollution of reservoirs, underground aquifer systems, estuary waters, and the biochemical oxidation of organic pollutants in rivers was reviewed. The need for critical selection of a suitable tracer for a particular pollution problem was emphasized.

Highlights in the progress of analytical techniques include:
– two new versions of X-ray fluorescence analysis, one using X-ray total reflection, and the other polarized monochromatic X-ray beams;
– systematic characterization of fly ash particles using multiple methods, including neutron activation analysis, scanning electron microscopy, photoelectron spectroscopy, X-ray fluorescence, and X-ray diffraction;
– improved accuracy in determining trace concentration of chromium by electron-capture gas chromatography;
– the use of nuclear magnetic resonance spectroscopy for the characterization of the valency state of iron in air particulates found in the vicinity of steel plants;
– analysis of lead from automobiles by X-ray fluorescence, proton-induced X-ray emission, and proton activation analysis.

The meeting reviewed the use of nuclear techniques in the studies of combustion processes, petroleum refineries, automobile exhausts, emission from steel industries and the water supply systems. It was recognised that in the study of environmental pollution problems, nuclear techniques have played an important role in identifying the origin, composition and movement of pollutants in our surroundings.