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ADVANCES IN THE APPLICATION OF NUCLEAR ENERGY FOR PEACEFUL PURPOSES

Information transmitted by New Zealand

Note by the Director General

On 4 September the Director General received from New Zealand material on the advances made in the year 1973-74 in applying nuclear energy for peaceful purposes. The material in question is reproduced below for the information of the General Conference.

NEW ZEALAND

NEW ZEALAND ATOMIC ENERGY COMMITTEE

1. The New Zealand Atomic Energy Commi tee (NZAEC) is directly responsible to the Minister of Science and has been entrusted by the Cabinet with the responsibility to advise on any aspects of research, development or application of nuclear science in New Zealand. It is also the liaison committee for co-ordination between organizations concerned with the introduction of nuclear power in New Zealand. It has the responsibility to advise the Minister on international aspects of nuclear science affecting New Zealand bearing in mind the responsibilities of the Minister of Foreign Affairs.

2. Contact is maintained with overseas nuclear authorities and international bodies and the secretariat acts as the technical and administrative liaison body for most nuclear matters.

3. Standing sub-committees have been established to study and report on reactor siting and safety criteria, licensing requirements and procedures, nuclear law, nuclear shipping, research reactor utilization, manpower, training and similar requirements for a national programme.

Constitution and terms of reference

4. In 1966 NZAEC was reconstituted as an advisory committee to the Minister of Science. The membership is made up as follows:

(a) Two independent persons appointed by the Minister - one of whom is appointed Chairman;

(b) Two persons from the New Zealand universities appointed by the Minister; and

(c) The Heads of the New Zealand Electricity Department, Ministry of Works and Development, Foreign Affairs, Department of Scientific and Industrial Research, and Health Department.

If an ex officio member is unable to attend any meeting of the Committee he may authorize any other officer of his Department, having the status of a deputy or an assistant Permanent Head, to attend the meeting in his stead.

5. NZAEC is empowered to co-opt specialists as required or to appoint sub-committees.

6. The terms of reference are as follows:

(a) To advise the Minister of Science on any aspects of research, development or application of nuclear science in New Zealand;

(b) To act as a liaison committee between organizations and departments concerned in planning for the introduction of nuclear power in New Zealand;

(c) To advise the Minister on international aspects of nuclear science affecting New Zealand, bearing in mind the responsibility of the Minister of Foreign Affairs for the administration of external and foreign affairs of New Zealand;

(d) To advise the Minister on any other matters concerning nuclear science which the Minister may refer to it; and

(e) To report annually to the Minister on its activities.

International relations

7. NZAEC has no formal agreements with national bodies overseas, but has the benefit of many informal arrangements with national bodies and other organizations which are most valuable.

8. It is anticipated that New Zealand's participation in the activities of the Agency will be extended through the recent establishment of a New Zealand Embassy in Vienna. Previously it had not been possible because of its geographical position to be as active as countries with local representation.

9. Co-operation in Agency projects in the region will continue to the extent possible, particularly where the applications do not exist within the framework of such bodies as the Colombo Plan Organisation.

10. Membership of the Organisation for Economic Co-operation and Development (OECD) began during the period under review but no direct action has yet been taken on membership of the Nuclear Energy Agency (NEA) of OECD. Discussions have taken place in Paris and Wellington and it has been agreed that the Executive Secretary of NZAEC should be the correspondent with NEA on legal and other matters of mutual interest.

11. NZAEC maintains a continuing survey on developments overseas in major nuclear policy fields and in recent months on changes in the licensing and regulation of nuclear energy and associatied fields of activity in various countries. Exchange and overseas training of personnel from the New Zealand national laboratories, Government Departments and universities continue and visitors from abroad are becoming more frequent.

NZAEC standing sub-committees, working groups and liaison activities

12. The Secretariat of NZAEC relies to a considerable extent on sub-committees whose specialist members are drawn from Government Departments, universities and the private sector. Assistance is drawn from the same sources to service sub-committees and to prepare documents and reports on progress.

Sub-committees

Siting and safety criteria

13. During the period covered by this review considerable effort has been expended in assessing seismic effects on various sites. More field investigations have been undertaken but a considerable amount of work yet remains to be done.

Nuclear law

14. Most recent studies can be divided into the following three major areas:

(a) The general institutional and organizational framework governing nuclear activities, nuclear installations and associate areas;

(b) Nuclear insurance and liability; and

(c) International obligations and procedures.

Nuclear shipping

15. Apart from keeping informed of the world trends in this field, no further work calling for recommendations has been undertaken during this period.

Research reactor

16. Three proposals have been studied, two relating to universities and one to the Institute of Nuclear Sciences.

Manpower

17. Only one report has been placed before the Government during the last two years; some of the recommendations for training are now being implemented and the remainder are under consideration. It is likely that a further report will be required within six months.

Liaison activities

18. The activities of the sub-committees and the composition of their membership has reduced the need for formal liaison in a number of areas, but where special liaison is required, e.g. with the Commissioner of Energy Resources, Commission for the Environment, New Zealand Committee for Energy and Development and similar bodies, this is undertaken by the NZAEC Secretariat.

NEW ZEALAND ELECTRICITY DEPARTMENT

Nuclear power

19. The Government's policy is to defer the introduction of nuclear power whilst indigenous fuel sources can still be allocated to electricity power production in sufficient quantities and in a reasonably economic and usable form.

20. In the light of the sources of fuels for electricity power production now known to be available, the Power Planning Committee has programmed the first nuclear power station for commissioning in 1988. If further large sources of indigenous fuel are discovered it may be further delayed, but in view of the time needed to establish preliminary procedures, and the long lead time of nuclear power stations, it is essential that the departments concerned make the necessary preparations to introduce nuclear power.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, INSTITUTE OF NUCLEAR SCIENCES

21. In pollution studies iodine-131 continues to be the most suitable tracer for "in situ" measurement of large-scale water movements under New Zealand conditions. Studies of effluent dispersal and sewage pollution have been made in collaboration with regional authorities and councils. Krypton-85 gas has been used in testing heat exchangers at Marsden Point. The Institute has received many enquiries concerning the elimination of static electrical charges in various stages of the manufacture of plastic goods. The work on determining radionuclides resulting from weapons testing continues. The radiation chemistry section is continuing work on radiation-induced oxidation reactions in solutions containing oxygen. Studies on wood-plastic materials using New Zealand woods are being continued. The principal fields of research in nuclear physics (accelerator group) are: proton capture studies in medium weight ($A = 46-56$) nuclei; the use of proton-induced and X-ray-induced fluorescence for elemental analysis; trace element detection using nuclear techniques and production of short-lived radioisotopes.

NATIONAL RADIATION LABORATORY

22. This Laboratory is the Division of the Department of Health which administers the radiation safety legislation in respect of all sources of ionizing radiation and radioactive materials and is the issuing and supervisory body for licences in this field.

Advisory services

23. The Laboratory provides advice and assistance in radiation protection for all users of ionizing radiation in New Zealand and codes of safe practice have been published.

Radiation monitoring service

24. This has been provided since 1951 and the Laboratory also provides a thermoluminescence dosimetry service; measurement of very low dose levels is being developed by thermally stimulated exoelectron emission.

Monitoring of environmental radioactivity

25. The Department of Health is responsible for monitoring environmental radioactive contamination in New Zealand and associated Pacific areas.

Nuclear reactor safety

26. The Laboratory's role is becoming increasingly important as the energy crisis has hastened the need for a definite assessment of the future of nuclear power in New Zealand. The specialized knowledge within the Laboratory is utilized by the sub-committees of NZAEC, particularly in relation to procedures and safety criteria.

Training

27. Groups of professional and technical workers are able to attend special courses. Students include overseas visitors who subsequently set up radiation protection services in their own countries; the work is thus allied to World Health Organization agreements.

URANIUM PROSPECTING

28. Some ten months ago an approach was made by a European mining organization to undertake prospecting in areas of interest within New Zealand. As yet no official decision has been made relating to this approach.

FORESTRY RESEARCH

29. The studies at the Forest Research Institute, involving the use of radioactive materials as tracers etc., are concerned with tree physiology, herbicide biochemistry, wood formation and structure, tree nutrition and pathology. Technicians are being trained in radiobiological instrumentation and methodology.

AGRICULTURAL RESEARCH

Ministry of Agriculture and Fisheries

30. At the Ministry's Research Centres the use of radioisotopes is becoming increasingly important in animal and soil studies.

31. At the Ruakura Animal Research Station research programmes on facial eczema, ruminant nutrition and metabolism continue together with studies on reproductive biology and physiology.

32. At the Ruakura Soil Research Station studies of phosphate fixation in soil, measurements of soil moisture and density and studies of methods of cadmium analysis are progressing.

33. At the Wallaceville Animal Research Centre animal nutrition investigations relating to selenium/protein binding continue and research is being conducted into the metabolism of magnesium-deficient and normal ruminants, insecticide residues, reproductive biology and immunology.

34. Invermay Agricultural Research Centre is carrying out investigations relating to sulphate-ion movement into the soil, using S-labelled superphosphate, and soil sulphur chemistry. The Fisheries Research Division is studying algal activity in New Zealand lakes.

Department of Scientific and Industrial Research

35. In much of the agricultural research the facilities of the Institute of Nuclear Sciences are used, and programmes are conducted in co-operation with university departments and research associations.

Plant Diseases Division

36. Radioisotopes are used in investigations of problems of plant nutrition and metabolism. A significant part of the work involves developing methods of studying plant metabolites by chromatography and electrophoresis. Studies on phosphorus nutrition and carbohydrate metabolism are proceeding.

Entomology Division

37. Codling moth larvae externally tagged with ^{58}Co were used in estimating over-wintering capacity as part of a life table study of the moth on apples and also in studies of competition for cocooning sites and invertebrate predators.

Grasslands Division

38. Studies of irradiation-induced mutations are part of genetic investigations in Nicotiana and work is proceeding on root morphology and phosphorus uptake.

Soil Bureau

39. Soil moisture measurements are being continued and algal growth investigations in lake waters are providing information on ^{14}C incorporation.

Applied Biochemistry Division (Lincoln Station)

40. Emphasis is being placed on increasing crop productivity by studying problems such as moisture stress and photosynthesis in some leguminous crops.

Plant Physiology Division

41. Isotopes are used almost exclusively in metabolic process studies in plant tissues, ^{14}C being widely used in biochemical work and enzyme assays.

Applied Biochemistry Division

42. Carbon-14 is used in studies of biochemical pathways, photosynthesis, enzymic reactions and protein synthesis. Sulphur-35 is used in determining microbial protein in sheep rumen and in protein synthesis. Arsenic-74 provides a method of determining arsenic uptake in seedlings.

UNIVERSITIES

Lincoln College

43. Senior degree students are using labelled nutrients to study mineral and sugar pathways in plants and work has been done on thyroid metabolism in sheep and fat metabolism in adipose tissue. A joint project on soil dating and ^{14}C incorporation is being conducted with the Institute of Nuclear Sciences.

Victoria University

44. Plant physiology students use $^{14}CO_2$ in demonstrating the path of carbon in photosynthesis and translocation. Work is also conducted on nutrient uptake and ^{3}H-thymidine is used in following the mitotic cycle in cell division. Research into the biosynthesis of proteins and nucleic acids involves the use of autoradiography and scintillation spectrometry, and projects on aspects of plant metabolism are conducted.

University of Otago

45. The Department of Zoology is currently working on the assimilation of carbon by fresh-water algae and studies of feeding and assimilation in fresh-water invertebrates.

46. The Department of Biochemistry has active programmes in which isotopically-labelled substances are extensively used. Studies of the mechanism of transcription and replication of desoxyribonucleic acid in micro-organisms and in bacteriophages, metabolic pathways and carbohydrate and amino acid metabolism are conducted.

47. All the universities conduct courses to train their students in the safe handling of radioactive materials and also in measurement and instrumentation techniques.

UNIVERSITY RESEARCH

Chemistry

48. At Victoria University a special course on radiochemistry is offered which includes radiochemical methods of analysis. Several aspects of the application of the Mössbauer effect in chemistry have been developed. All third-year chemistry students at the University of Otago attend a course on radioisotopes designed to demonstrate their uses in dealing with subjects such as chemical reactivity and structure. University of Canterbury teaching staff are investigating the chemistry of the complexes of technetium (II) in addition to biosynthetic studies of diterpenes in native trees.

49. The Urey Radiochemical Laboratory is part of the Chemistry Department of Auckland University and has extensive facilities for undergraduate instruction in radiochemistry. Current programmes include tritium labelling, kinetic isotope effects and radiotracer studies of gaseous pollutants.

Veterinary pathology and veterinary science

50. At Massey University lymphocyte transformation is being studied and iodine-125 is used in the labelling of antibodies. Lincoln College has been investigating the production, distribution and degradation of thyroxine and tri-iodothyronine in sheep. An ovine luteinizing hormone assay has been developed and is being used by the Ministry of Agriculture and Fisheries for fertility production experiments in sheep.

Agricultural engineering

51. Lincoln College has used a neutron moisture probe in determining evapotranspiration rates from lucerne under irrigation.

Physics

52. Victoria University is working in the fields of deuterium implantation, nuclear lifetimes using the "associated particle" technique, and is also investigating environmental radioactivity. At the University of Canterbury, Mössbauer spectroscopy is used to investigate nuclear spin relaxation in conjunction with the accelerator belonging to the Christchurch Hospital Board.

53. The Department of Physics at the University of Otago is studying ciliary action in paramecium caudatum; cosmic ray studies are in progress. In addition, a 150-kV heavy-ion accelerator is being built for beam foil spectroscopy.

54. The Nuclear Physics Group at the University of Auckland has rebuilt its polarized ion source as a positive ion machine, and preparation for an extensive experimental programme, based on available polarized neutrons, is well advanced.

Geology

55. Victoria University is involved in studying the chemistry of the larvae of the Taupo Volcanic Zone, using X-ray fluorescence. Spectrometry developments have been made in fission-track dating which bridges the gap between ^{14}C and krypton/argon techniques. A research contract with the Department of Scientific and Industrial Research is in progress.

Nutrition

56. At the School of Home Science, Department of Nutrition, Otago University the importance of selenium in nutrition is being studied in collaboration with the Department of Medicine.

Medical

57. The Department of Pathology at Otago University is conducting a research project on tumour immunology supported by the Medical Research Council of New Zealand. At Otago University's Department of Surgery work is being conducted on the distribution of cells labelled with ^{51}Cr, lymphocyte homing capacity and the effects of antibodies on these.

Civil engineering

58. The gamma-ray transmission technique is used at the University of Auckland to measure density and moisture distribution in porous media, such as compacted aggregate samples.

MEDICAL RESEARCH

59. The major hospitals now have separate departments of nuclear medicine. There has been marked growth over the last few years as nuclear medicine plays an increasingly important role in diagnosis.

Wellington Hospital

60. Organ imaging involving the use of labelled compounds is now accepted as an important routine investigation in many clinical conditions. Placental scanning has contributed to better knowledge of the patient's condition before delivery, in that it identifies placenta praevia. In vitro radioimmunoassay tests continue to play an important and increasing part in diagnosis providing information otherwise unobtainable.

Auckland Hospital

61. The Nuclear Medicine Department has expanded over the two years covered in this report. In vitro investigations have maintained steady growth, and a more rapid increase has taken place in scanning. A very important part of radioassay work continues to be thyroid function tests.

Waikato Hospital

62. The hospital has a joint department of radiotherapy and nuclear medicine. An increasing number of patients is being treated with intermittent multiple chemotherapeutic agents either alone or with radiation therapy.

NEW ZEALAND CANCER SOCIETY

63. The Radiation Biology Section of the cancer research unit is no longer operating.

INDUSTRY

64. The Tasman Vaccine Laboratory continues to be an essential part of the New Zealand Hospital System. The Laboratory built the first irradiator in the world for customer service and has sterilized a very large proportion of surgical packs and laboratory articles. A further addition to the source in July 1974 gives a source of strength of 280 000 curies. The publication - Code of Good Manufacturing Process - by the Pharmaceutical Manufacturers Association includes a section on radiation sterilization and provides a local standard on which the unit may operate.

65. W.R. Grace (N.Z.) Ltd. continues its work in producing crosslinked polyolefin packaging films.

66. The uranium prospecting work mentioned in the previous report[1/] has not made significant progress.

67. Alex Harvey Engineering Company has recently completed the engineering part of a nucleonic scanning system for the control of zinc coating for an Australian firm.

1/ See document GC(XIV)/INF/124/Add.2, statement by New Zealand, para. 6.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PHYSICS AND ENGINEERING LABORATORY

68. The principal research field in radiation physics is the study of paramagnetic centres by electron spin resonance spectroscopy and ultrasonic modulation electron resonance of radiation damage in inorganic salts. Radiation biology studies include elucidation of the nature of the colour centres produced in fibrous proteins by high-energy radiation (^{60}Co-rays) and by ultra-violet light. The Laboratory has also been working on carbon isotope fractionation and carbon translocation.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, CHRISTCHURCH INDUSTRIAL DEVELOPMENT DIVISION

69. The Division is continuing work on plastic impregnated wood with a view to using it in the manufacture of various products. The material is exposed to a radioactive source at the Institute of Nuclear Sciences which hardens the plastic and reduces its moisture absorption ability.