public, as well as maximum permissible concentrations of radioactive isotopes in air and drinking water, are themselves based on recommendations of the International Commission on Radiological Protection.

Third Party Liability

An OEEC international Convention on Third Party Liability in the field of nuclear energy was signed on 29 July 1960. The Convention, elaborated by an ENEA Expert Group, establishes a uniform European legal regime governing liability and compensation for damage to persons or property resulting from nuclear incidents.

Security Control

An ENEA Convention on security control, to prevent the use of jointly developed nuclear facilities for military purposes, came into force on 22 July 1959. The control is based on accountancy and inspection of nuclear materials, and operates under the direction of a Control Bureau set up by ENEA in February 1961. An independent international court, the European Nuclear Energy Tribunal, set up under the Convention to hear appeals arising out of the operation of the security control, has been formally constituted. The Tribunal also has certain competencies under the Eurochemic and the Third Party Liability Conventions.

RELATIONS WITH IAEA

In July 1960 the OEEC Council approved an agreement for co-operation between ENEA and the IAEA and this agreement was unanimously approved by the IAEA General Conference on 30 September.

The agreement provides for reciprocal representation of the two Agencies in committees and working parties, for liaison between the two Secretariats on projects or activities of common interest, and for a regular exchange of documents and information.

TOWARDS OECD

During 1960 discussions took place on the reorganization of the OEEC and its replacement by an Organization for Economic Co-operation and Development which will include Canada and the United States among its members. Certain decisions of principle were taken at a ministerial meeting on 23 July, and a preparatory committee was instructed to prepare a draft convention and to consider which of the OEEC Acts should be retained. The new convention was signed on 14 December.

It is not contemplated that this reorganization will affect the status or activities of ENEA.

NORA PROJECT OFFERS UNIQUE REACTOR RESEARCH AND ADVANCED TRAINING OPPORTUNITIES

As reported in the April issue of the Bulletin, an international program for reactor research and advanced training for a period of three years has been established in connection with the Norwegian critical assembly NORA.

Objectives

The aim of the project is to determine, through integral experiments, the basic reactor physics data for lattices moderated with light-water, heavy-water or mixtures of heavy and light water, with fuels of different sizes and spacings, three different enrichments and compositions. These objectives could be summarized as follows:

Contribution towards a better understanding of the fundamental physics of heterogeneous water moderated lattices.

Accumulation of data on systems which have not been investigated previously, notably systems moderated with mixtures of H_2O and D_2O (spectral shift system).

Improvement of experimental techniques.

Higher accuracy of existing data on selected systems.

Investigation of power reactor effects to the extent that these can be simulated in a critical facility.

The International Team

The joint project will aim at a high technical standard of work and it is hoped that this can be achieved by bringing together a carefully selected international team of research workers. The Norwegian Institute for Atomic Energy will provide the necessary permanent staff of the NORA facility; the international research team is being recruited by the Agency. The final selection of candidates will be made by the joint committee composed of the Indian scientist, R. Ramanna, as the chairman appointed jointly by IAEA and Norway and two scientific representatives each from Norway and from the Agency.

The candidates for the international team should have an academic degree and two to three years experience in the field of theoretical or experimental reactor physics, preferably related to the experimental program, and should be available for this work for at least one year. They should be able to speak and write fluently one of the working languages of the Institute, i.e. English or Norwegian. The positions to be filled during the first stage of the program are:

- One or two experimental reactor physicists familiar with the techniques and interpretation of experiments on critical systems;
- One experimental physicist who could work specifically on temperature and void effects;
- One experimental physicist familiar with theory and experimental techniques to measure neutron flux spectra;
- One physicist or engineer familiar with reactor kinetics problems;
- One or two theoretical reactor physicists with a thorough knowledge of reactor theory.

The NORA project offers particularly interesting opportunities for research and advanced training and it is hoped that qualified scientists will submit their nominations for the participation in the international research team.

The applications should be directed to the Agency through the official governmental channels. It is expected that, as a rule, interested Member States will cover all the costs for their candidates who may be selected for participation in this program. However, in cases where Member States have difficulty in meeting such expenses the Agency may cover part of the total amount of the cost.

Program

The experiments planned with the NORA facility include criticality experiments, kinetic experiments and experiments with simulated power reactor effects. The details of the program, which started last May, are the following:

1. Pre-criticality tests of the installation with H_2O:
   - 1.1 Mechanical tests (pumps, valves, etc.);
   - 1.2 Control system (neutron source tests of channels, control rod tests, etc.);
   - 1.3 Insertion and removal tests with fuel and experimental equipment.
2. Cold runs of the installation with D_2O:

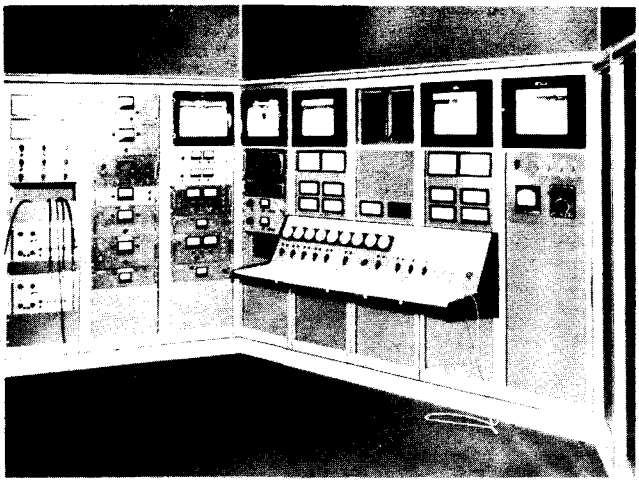
   As in items 1 in general, but with accurate calibration of pumps, valves, heaters and flow system.
3. Experiments with the natural uranium charge and D_2O:
   - 3.1 Approach to criticality;
   - 3.2 Calibration (control rods, nuclear instrumentation, absolute power levels, etc.);
   - 3.3 Criticality experiments with macroscopic and microscopic flux measurements, U-238/U-235 fission ratio, water level reactivity coefficients;
   - 3.4 Kinetic measurements transfer functions.
4. Experiments with the 1.5 per cent and 1.7 per cent enriched charges and D_2O:
   - 4.1 Approach to criticality;
   - 4.2 Control rod calibration;
   - 4.3 Criticality experiments with different fuel/moderator volume ratios, comprising:
     macroscopic and microscopic flux distributions
     water level reactivity coefficients
     neutron spectra
     U-238/U-235 fission ratios
     temperature effects
     epi-Cd U-238/sub-Cd U-238 absorption ratios
     reflector effects;
   - 4.4 Kinetic measurements:
     transfer functions
     delayed neutron fraction (beta)
     sub-critical multiplication;
   - 4.5 Simulated power reactor effects:
     void experiment.
5. Experiments with the 3.07 per cent enriched charge and D_2O:
   - 5.1 Approach to criticality;
   - 5.2 Calibration of control rods;
   - 5.3 Criticality experiments with different moderator/fuel volume ratios with emphasis on undermoderated lattices, comprising:
     macroscopic and microscopic flux distributions water level
     reactivity coefficients
     neutron spectra
     temperature effects
     U-238/U-235 fission ratios
     epi-Cd U-238/sub-Cd U-238 absorption ratios
     reflector effects
     control rod effectiveness;
   - 5.4 Kinetic experiments:
     transfer functions
     delayed neutron fraction (beta)
     sub-critical multiplication;
   - 5.5 Power reactor effects:
     void effects;
   - 5.6 Miscellaneous experiments:
     Pile-oscillator measurements of resonance absorption in various neutron spectra.

Upon the completion of the measurements with the D_2O-moderated 3.07 per cent enriched charge, the NORA facility will be modified for experiments with close-packed lattices using mixtures of D_2O and H_2O. Some re-calibration of the non-critical system (flow rates, temperature distributions, etc.) will be necessary.

The program for H_2O-D_2O moderated cores with the 3.07 per cent enriched charge will be similar to the D_2O program described above, except possibly for a wider range of moderator/fuel volume ratios. This program will be elaborated in due course.

Facilities

The NORA reactor facility is located on the main site of the Institute for Atomic Energy at Kjeller,



NORA control room

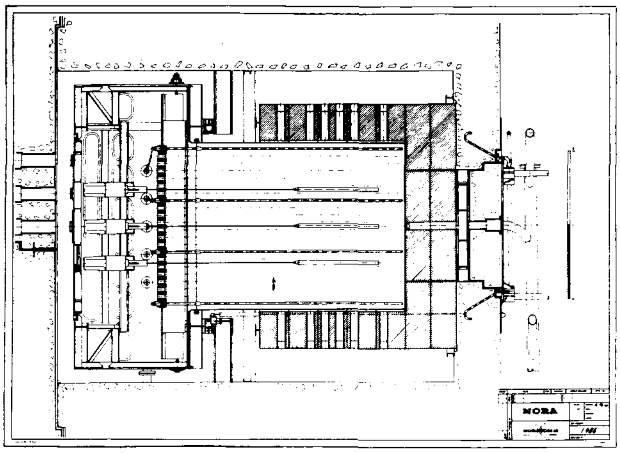


Diagram of the vertical section of the critical assembly

20 km from Oslo. The Institute for Atomic Energy is a government-sponsored research institute devoted to research within all fields of nuclear energy. The personnel numbers approximately 450 persons, a substantial part of which is academically trained. The Institute was founded in 1948 and got its first major research instrument, the 450 kw research reactor JEEP, in 1951. The second reactor, the Halden Boiling Heavy Water Reactor, which is a 20 MW boiling heavy water reactor located 120 km south of the main IFA site, went critical in the summer of 1959. Thus NORA will be the third reactor built and put into operation by the Institute. A fourth reactor (neutron source) is under construction.

The Institute is divided in various divisions or departments, covering Physics, Chemistry, Metallurgy, Reactor Development and Isotope Production. The NORA project will be operated in close cooperation with the Physics Division.

NORA has been built solely for the purpose of conducting reactor physics research. Therefore a guiding principle in the design has been to obtain a high degree of flexibility with due regard to the demands set by nuclear and radiological safety principles.

As shown in the Figure 3, the reactor consists of an aluminum tank, diameter 2.25 m, height 3 m and a header box containing shim - safety rods and fuel element suspension system. The reactor tank is surrounded by a 50 cm thick graphite reflector and by a 120 m thick contrete shield, several parts of which are removable.

A cylindrical part of the bottom reflector and shield is removable. The reflector composition in this part can thus be varied, enabling a study of the effectiveness of various reflectors.

In the first phase of operation heavy water will be used as moderator. Therefore a flexible suspension system for the fuel elements has been constructed, permitting variation in the lattice pitch in steps of 0.5 cm upwards from a pitch of 10 cm. Later when mixed H_2O-D_2O and H_2O is used as moderator, a fuel positioning system of grid plates will be installed.

A heat exchanger and electrical heaters are installed in the moderator circulation system, permitting measurements to be performed at moderator temperatures up to 80-90°C.

The control system incorporates six permanent nuclear channels and an automatic on-off power controller capable of keeping the reactor power constant to $< \pm$ 0.5 per cent over a period of one hour or more.

A precision water height measuring device determining relative moderator level to $\pm$ 0.1 mm is available.

The control room contains, apart from the normal reactor instrumentation, a number of panels for experimental equipment.