Quaternary geology studies and archaeological dating; and uranium disequilibrium geochemistry.

The seminar programme included presentations of case studies in various Latin American countries, as well as lectures on a variety of techniques and methods. Topics included stable isotope fractionations in natural processes; production and distribution in the environment of radioactive isotopes of natural origin and/or released by thermonuclear explosions (like tritium and carbon-14); field studies with environmental isotopes (for example, investigations on groundwater origin, movement and dating; aquifer interconnection; lake balance and dynamics; and geothermal water.)

Examples also were given of the use of artificial isotopes and radiation sources in hydrological systems and in hydraulic engineering. Applications in this field help determine river discharges, identify leakage from dams, and track groundwater flow-rates and direction.

A field trip to La Plata and La Magdalena, about 70 kilometres southeast of Buenos Aires, showed participants the site of extensive groundwater investigations. Salt concentration is increasing there, and environmental isotope variations are being used to study the salinization's origin.

Participants additionally visited the Ezeiza Atomic Research Centre to tour plants for sterilization and isotope production. The Centre also houses equipment for sediment transport determination using isotope techniques, since this has been an active area of interest for years of the Comisión Nacional de Energía Atómica in Argentina.

Advancing standards for nuclear instrumentation

by J. Weill and M. Gandhi

International co-operation to forge worldwide agreement on nuclear standards is at the core of the technology's development, not only fostering improvements in quality, performance, and information exchange, but also facilitating international trade.

Toward these objectives, IAEA has long been active in developing basic nuclear safety standards, codes, and guides, often working closely with other international organizations and national regulatory bodies.* One such leading group in the field is the International Electrotechnical Commission (IEC), which was formed in 1906 and today stands as the oldest independent international standards organization in the world. IEC formed Technical Committee No.45 (TC 45) in 1960 to prepare standards related to nuclear instrumentation systems and equipment. Following is a progress report on the work of that committee.

To date, TC 45 has published about 95 standards for nuclear instrumentation, more than one-third of which concern nuclear power plants and radiation protection. All standards cover various aspects of instrumentation, terminology, general principles, manufacturing specifications, characteristics and test methods. However,

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* See, for example, articles in the *IAEA Bulletin* of September 1983, Vol.25, No.3, reporting on the Agency's Nuclear Safety Standards programme, as well as activities of several other organizations.

they are limited to instrumentation using electronic and electrical tools and sensors, which are subject to nuclear radiation.

Future Actions Proposed

As proposed in early 1984, items of future work cover various instruments and systems, as detailed in the accompanying table. Although each item will be presented to TC 45 and its sub-committees, it cannot generally be predicted that each topic will lead to a standard.

Typically, the process of standards preparation covers various phases and requires an average time of about 52 months to reach the final stage of IEC publication, although action recently was taken to reduce this timeframe. Of course, simple standards that do not need elaborate discussions require less time. Others, however, may entail difficult problems due to different technological and safety points of view, as well as widely diverging general policies and financial shortages, and thus the agreement time can be comparatively longer.

TC 45 currently is composed of about 75 experts in the nuclear field from about 20 industrial countries. Plenary meetings have been hosted by 16 countries annually since 1961. The next plenary is scheduled for April 1985 in Madrid, Spain.

Revised Scope

As recently defined and approved, the committee's revised scope is "to prepare international standards relating to electrical and electronic equipment and systems for instrumentation specific to nuclear applications."

Additionally, the revised scope of TC 45's two sub-committees – Reactor Instrumentation (sub-committee 45A) and Radiation Protection Instrumentation (sub-committee 45B) – was defined in 1982:

- *Reactor Instrumentation:* To prepare international standards regarding electrical and electronic equipment and systems used for safety-related instrumentation and control systems and safety systems for nuclear power plants excluding the instrumentation for radiation monitoring unless used directly for plant control or safety actuation.

Typical standards might recover requirements for design, construction, manufacture, quality assurance, and testing of electrical and electronic equipment for safety-related instrumentation and control systems and safety systems as well as the calibration of sensors and the associated measuring equipment.

Nuclear power plant process instrumentation, e.g., for the measurement of temperature, pressure, flow rate, etc. is not normally within the scope. However, when the instruments are part of electrical and electronic systems and form part of safety-related instrumetation and control systems or safety systems, the particular requirements for these instruments shall be within the scope.

The foregoing is in accordance with IAEA terminology and therefore includes power supplies.

- *Radiation Protection Instrumentation:* To prepare international standards regarding the specification, functional performance and methods of test for electrical and electronic equipment for the detection and measurement of ionizing radiation and radioactivity for radiation protection purposes.

Overview of IEC Structure, Role

Founded under co-operation of various national electrotechnical associations in 1906, the IEC today deals with almost all branches of electrotechnology in the electrical and electronic field, covering all modern applications such as telecommunications, data-processing, microprocessors, fibre optics, and nuclear energy. Presently 44 countries, including all industrialized countries, are IEC members.

TC 45 currently is one of 81 active technical committees that carry out IEC standardization work in a precise field. Each IEC technical committee is composed of experts appointed by their national committees.

To date, the IEC has issued approximately 2000 publications. Standards and reports are published in the three official IEC languages – English, French, and Russian.

Impact and Liaisons

Although achievements in international standardization are often slow and disappointing, this hard and often thankless task is fortunately accompanied by a very fruitful exchange of views among experts. International human contacts and bonds of friendship are being set up that can influence the views and realizations of countries participating in the task. This aspect cannot be ignored nor underestimated because it often creates harmonious exchanges in commercial, technical, and scientific fields, which is always the basis and aim of international standardization.

An inquiry carried out during 1977 in most representative countries engaged in nuclear energy applications showed that about half of these countries exclusively used IEC standards concerning nuclear power plants. The other half simultaneously and often prefered to apply national standards, although they apparently often take their inspiration from IEC standards. Also true is that IEC standards, in turn, are mainly inspired by a number of national

standards or usual practices in various countries whenever possible and are based on sufficient world-wide consensus.

In carrying out its functions, TC 45, as well as its sub-committees, co-operate closely with several other international organizations including IAEA, the International Commission on Radiological Protection (ICRP), the International Commission on Radiation Units and Measurements (ICRU), the International Organization for Standardization (ISO), the Organisation Internationale de Métrologie Légale (OIML), and the World Health Organization (WHO).

Working programmes of TC 45

Current Items

- Front Panel Interconnection for Emitter Coupled Logic
- Fastbus – Modular High Speed Data Acquisition System
- Updating of CAMAC Documents
- Erratum to IEC Publication 547: Modular Plug-In Unit & Standard 19-Inch Rack Mounting Unit Based on NIM Standard (for nuclear electronic instruments)
- Airborne Instrumentation for Measurement of Terrestrial Gamma Radiation
- Test Methods for Multichannel Analysers as Multichannel Scalers
- Revision of Publication 659: Test Method of Multichannel Analysers
- Recommended Practices for Seismic Qualification of Electrical Equipment Important to Safety for Nuclear Power Generating Station
- Software for Computers in the Safety System of Nuclear Power Stations
- Electromagnetic Interference in Nuclear Instrumentation – Characteristics & Test Methods
- Loose Parts Monitoring in the Primary Loop – Characteristics & Test Methods
- SPDS – Computer-based System of Displays for the Safety Parameters of Nuclear Power Stations
- Temperature Sensor Response Time Testing
- Programmed Digital Computers Important to Safety in Nuclear Power Stations
- Radiation Monitoring Equipment for Accident Conditions in LWR – General Principles
- High-range Area Gamma Dose-Rate Monitoring Equipment for Accident Conditions
- Gaseous Effluent Radiation Monitoring Equipment for Accident Conditions
- Classification of Instrumentation & Control Systems
- Air Radiation Monitoring System for Normal & Accident Conditions
- Design, Location, & Application for Installed Gamma Area Radiation Dose-Rate Monitoring Equipment in Nuclear Power Plants Under Normal Conditions
- Measurement to Ensure Adequate Coolant Within the Core of Pressurized-Water Reactors
- Reactor Shutdown Out of Control Room
- Portable Neutron Dose-Equivalent Ratemeters for Use in Radiation Protection
- Beta, X, and Gamma Radiation Dose-Equivalent & Dose-Equivalent Ratemeters for Use in Radiation Protection
- Dose-Equivalent & Dose-Equivalent Ratemeters for Radiation Protection & for X, Beta, & Gamma Radiation Containing an X or Gamma Energy Component Greater than 4 MeV
- Portable Potential Alpha Energy Meter for Rapid Measurements in Mines
- Equipment for Continuously Monitoring for Beta & Gamma Emitting Radionuclides in Liquid Effluents
- Equipment for Monitoring of Radioactivity in Gaseous Effluents in Emergency & Post-emergency Conditions
- Portable or Installed X or Gamma Radiation Absorbed Dose Ratemeters for Measuring Environmental Dose-Rates in Air (Parts I & II)
- Warning Equipment for Criticality Accidents
- High-range Beta & Gamma Dose and Dose-Rate Portable Instrument for Emergency Radiation Protection Purposes
- Equipment for Monitoring Radioactive Halogen in the Atmosphere
- Equipment for Monitoring Radioactive Particulates in the Environment
- Thermoluminescence Readers for Personal & Environmental Dosemeters
- Equipment for Monitoring of External Contamination on the Body, Extremeties & Clothing of Personnel
- Equipment for Measuring & Monitoring of Airborne Transuranic Particles in Stacks Under Normal Conditions

Future items

- Revision of IEC Publication 181: Index of Electrical Measuring Apparatus Used in Connection with Ionizing Radiation
- Revision of Chapters 391: Detection & Measurement of Ionizing Radiation by Electric Means, and 392: Nuclear Instrumentation – Supplement to Chapter 391 of the International Electrotechnical Vocabulary IEV (50)
- Digital Bus for Modular Plug-in Unit Based on NIM Standard of IEC Publication 547
- Airborne Instrumentation for Measurement of Terrestrial Gamma Radiation
- Level Measuring Systems Utilizing Ionizing Radiation with Continuous or Switching Output (Revision & updating of IEC Publication 346)
- Electrical Measuring Instruments Utilizing Radioactive Sources (Revision & updating of IEC Publication 476)
- Revision & Combining of IEC Publications 430: Test Procedures for Germanium Gamma-ray detectors, 656: Test Procedures for High Purity Germanium Detectors for X & Gamma Radiation, and 697: Germanium Semiconductor Gamma-ray Efficiency Determination Using a Standard Re-entrant Beaker Geometry
- Test Procedures for Amplifiers & Preamplifiers for Semiconductor Detectors for Ionizing Radiation (Revision & updating of IEC Publication 340)
- Gamma-ray Spectroscopy Vials
- Characteristics of & Test Procedures for Semiconductor Materials for Radiation Detectors
- Definition of Quality Criteria for Computer Programmes Used in Gamma-ray Spectroscopy
- Definition of New Method to Test Channel Profile for Multichannel Analysers (MCA)
- Microprocessor Ratemeters
- Pocket Active Electronic Direct Reading & Warning Dose-Equivalent & Dose-Equivalent Rate Monitors for Use with Photon & Neutron Radiations