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FINAL TECHNICAL REPORT submitted by project leader Louis Costrell
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Project: Instrumentation for Nuclear Applications

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Sponsored by the Pollutant Characterization and Safety Research
Division of the Office of Health and Environmental Research.

OSM

The objective of this project was to develop and coordinate nuclear instrumentation standards with resulting economies for the nuclear and radiation fields. There was particular emphasis on coordination and management of the Nuclear Instrument Module (NIM) System, U.S. activity involving the CAMAC international standard dataway system, the FASTBUS modular high-speed data acquisition and control system and processing and management of national nuclear instrumentation and detector standards, as well as a modest amount of assistance and consultation services to the Pollutant Characterization and Safety Research Division of the Office of Health and Environmental Research.

The principal accomplishments were the development and maintenance of the NIM instrumentation system that is the predominant instrumentation system in the nuclear and radiation fields worldwide, the CAMAC digital interface system in coordination with the ESONE Committee of European Laboratories, the FASTBUS high-speed system and numerous national and international nuclear instrumentation standards.

This has included also coordination and direction of the Nuclear Instrumentation systems referred to above. As the technology advanced, continued direction and effort were expended in resolving problems and assuring continuance of compatibility. Maintenance, interpretation and continued review of the NIM and CAMAC systems were provided.

A clearing house for NIM and CAMAC information was provided as well as liaison and collaboration with the ESONE Committee of European Laboratories and national and international laboratories with regard to the instrumentation systems.

The project provided processing and management of nuclear instrumentation and detector standards for adoption as standards of the the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), and the International Electrotechnical Commission (IEC) as well as a modest amount of assistance and consultation services to the Pollutant Characterization and Safety Research Division of the Office of Health and Environmental Research in conjunction with miscellaneous instrumentation projects.

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The Nuclear Instrument Module (NIM) system has had a phenomenal acceptance in laboratories and industry throughout the world. There has been a continuous coordination requirement involving contact with numerous laboratories and manufacturers and the resolution of questions that arise. In order to allow and encourage exploitation of technological development without impairing compatibility and interchangeability, continued vigilance and direction was required and was provided.

An analysis of the huge savings resulting from the NIM and CAMAC standards is presented in Report RR-166, "Benefit Analysis of Selected Accomplishments of DOE's Office of Health and Environmental Research" dated November 29, 1982 and prepared by Ecosometrics, Incorporated under DOE Contract DE-AC01-82ER30031 of July 29, 1982. These savings and other benefits continue to accrue.

Journal publications regarding NIM and CAMAC systems and instruments, installations and experiments using these systems abound in the technical literature. Many such papers appear in the Nuclear Science Symposia issues of the IEEE Transactions on Nuclear Science and in Conference Proceedings of the Nuclear Science Symposia and the Conference on Real-Time Computer Applications in Nuclear, Particle and Plasma Physics.

The standards were published by The Department of Energy (DOE), the Institute of Electrical and Electronics Engineers (IEEE), the American National Standards Institute (ANSI) and the International Electrotechnical Commission (IEC), as listed below:

NIM Standards

DOE/ER-0457T: NIM Standard Modular Instrumentation System

IEC 482: Dimensions of electronic instrument modules (for nuclear electronic instruments)

IEC 547: Modular plug-in unit and standard 19-inch rack mounting based on NIM standard (for electronic nuclear instruments)

IEC 1301: Nuclear instrumentation -- Digital bus for NIM instruments

CAMAC Standards

ANSI/IEEE Std 583: Modular instrumentation and digital interface system (CAMAC)

ANSI/IEEE Std 595: Serial highway interface system (CAMAC)

ANSI/IEEE Std 596: Parallel highway interface system (CAMAC)

ANSI/IEEE Std 675: Multiple controllers in a CAMAC crate

ANSI/IEEE 683: Block transfers in CAMAC systems

ANSI/IEEE 726: Real-Time BASIC for CAMAC

ANSI/IEEE 758: Subroutines for CAMAC

IEC 516: A modular instrumentation system for data handling (CAMAC)

IEC 552: CAMAC - Organization of multi-crate systems, Specification of the branch-highway and CAMAC crate controller Type A 1.

IEC 640: CAMAC - Serial Highway Interface System

IEC 677: Block transfers in CAMAC systems

IEC 678: Definitions of CAMAC terms used in IEC publications

IEC 713: Subroutines for CAMAC

IEC 729: Multiple controllers in a CAMAC crate

IEC 755: Real-time BASIC for CAMAC

FASTBUS Standards

ANSI/IEEE Std 960: FASTBUS Modular High-Speed Data Acquisition and Control System.

ANSI/IEEE Std 1177 FASTBUS Standard Routines.

IEC 935: FASTBUS - Modular High Speed Data Acquisition

IEC 1052: FASTBUS standad routines -Standardroutinres for use with FASTBUS data acquisition systems

Other Standards

ANSI/IEEE Std 301: Test Procedures for Amplifiers and Preamplifiers used with Detectors of Ionizing Radiation.

ANSI/IEEE Std 300: Test Procedures for Semiconductor Charged-Particle Detectors.

ANSI/IEEE Std 309: Test Procedures for GM Counters.

ANSI/IEEE Std 325: Test Procedures for Germanium Gamma-Ray Detectors.

ANSI/IEEE 1131: Cryostat End-Cap Dimensions for Semiconductor Gamma-Ray Spectrometers.

ANSI N42.13: Calibration and Usage of "Dose Calibrator" Ionization Chambers for the Assay of Radionuclides.

ANSI N42.12: Calibration and Usage of NaI(Tl) Detector Systems for Assay of Radionuclides.

ANSI N42.14: Calibration and Use of Germanium Detectors for the Measurement of Gamma-Ray Emission of Radionuclides.

ANSI N42.15: Performance Verification of Liquid-Scintillation Counting Systems.

ANSI N42.16: Specifications for Sealed Radioactive Check Sources used in Liquid-Scintillation Counters.

ANSI PN42.17B: Performance Specifications for Health Physics Instrumentation - Occupational Airborne Radio activity Monitoring Instrumentation.

ANSI N42.17C: Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Extreme Environmental Conditions.

ANSI N42.18: Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents.

ANSI N317: Performance Criteria for Instrumentation for Inplant Plutonium Monitoring.

ANSI N320: Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation.

ANSI N323: Radiation Protection Instrumentation Test and Calibration.

ANSI/IEEE P1160: Test Procedures for High Purity Germanium Crystals for Production of Gamma-Ray Detectors.

ANSI/IEEE P1200: Quality Criteria for Software Analysis of Gamma Spectra for Germanium Crystals for Radiation Detectors.

ANSI/IEEE P1214: Multichannel Pulse-Height Data Format

IEC International Standards in process include:

45(Central Office)228: Performance Verification of Liquid-Scintillation Counting Systems.

45(Central Office)223: Microprocessor-Based Nuclear Radiation Measuring Devices.

45(Central Office)219: Portable Gamma Radiation Meters and Spectrometers used for Prospecting. Revision of IEC Publication 460.

45(Central Office)216: Test Procedures for Semiconductor Charged-Particle Detectors. Based on ANSI/IEEE 300.

45(Central Office)215: General Aspects of Electrical Measuring Systems and Instruments Utilizing Radioactive

45(Central Office)208: Multichannel Pulse-Height Analyzers, Types, Main Characteristics, Technical Requirements and Test Methods.

45(Central Office)204: Nuclear Instrumentation and Instruments used in Nuclear Applications - Definitions, etc.

45(Central Office)201: Calibration and Usage of Sodium Iodide Detector Systems. Based on ANSI In preparation.

45(Secretariat)321: Basis Weight Measurement Systems Utilizing Ionizing Radiation, Definitions and Test

45(Secretariat)317: High Purity Germanium Crystals for Radiation Detectors.

45(Secretariat)314: Calibration and Usage of Germanium Detectors for Measurement of Gamma-Ray Emission of Radionuclides. Based on ANSI N42.14.

45B(Central Office)114: Direct Reading Dose Equivalent and/or Dose Equivalent Rate Monitors for Neutron Radiation.

45B(Central Office)107: Installed Rate Equivalent Rate Meters, Warning Assemblies and Monitors for Neutron Radiation from Thermal to 15 MeV.

45B(Central Office)94: Direct Reading Personal Equivalent and/or Dose Equivalent Rate Monitors for X, Gamma and High Range Beta Activity.

45B(Central Office)94: Direct Reading Personal Dose Equivalent and/or Dose Equivalent Rate Monitors for X, Gamma and High Energy Beta Radiation.

45B(Secretariat)117: Personal Warning Devices for X and Gamma Radiations.

IEC Publication 912: Front Panel Interconnection for Emitter Coupled Logic (ECL).

IEC Publication 1151: Nuclear Instrumentation - Amplifiers and Preamplifiers used with Detectors of Ionizing Radiation - Test Procedures.

IEC International Standards in process at the conclusion of this project. Nearly all of these have been completed at the time of preparation of this report

45(Central Office)228: Performance Verification of Liquid-Scintillation Counting Systems.

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