

Title: ADVANCES IN GAMMA-RAY FIELD INSTRUMENTATION AT LOS ALAMOS

Author(s): J. K. Halbig, S. F. Klosterbuer, P. A. Russo,
J. K. Sprinkle, Jr., and S. E. Smith

Submitted to: IAEA Symposium on International Safeguards
Vienna, Austria
March 14-18, 1994
(EXTENDED SYNOPSIS)

RECEIVED

MASTER

SEP 07 1993

OSTI



DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Los Alamos
NATIONAL LABORATORY

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the U.S. Department of Energy under contract W-7405-ENG-36. By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. The Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy.

Form No. 836 R5
ST 2629 10/91

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

ADVANCES IN GAMMA-RAY FIELD INSTRUMENTATION AT LOS ALAMOS*

J. K. Halbig, S. F. Klosterbuer, P. A. Russo, and J. K. Sprinkle, Jr., Safeguards Assay N-1, MS-E540, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 USA

S. E. Smith, Martin Marietta Energy Systems, Inc., Y-12 Plant, Oak Ridge, TN 37830 USA

We have developed a prototype miniature and modular multi-channel analyzer (M³CA). The prototype brings together hardware and software technologies in an instrument that can be effectively used in many safeguards, arms control, nuclear industry, and environmental applications. The design uses modular building blocks for both hardware and software. It is hardware bus independent and, because of its interface philosophy, it is very versatile and is much easier to interface to external controllers than previous instruments. The prototype instrument demonstrates that low-power instruments now have the capabilities and performance required in many applications where, previously, only mains-powered instruments have been used.

Notable features of the system include the following:

1. Small size: 10 cm by 20 cm by 9 cm, including battery, power, and bias supplies.
2. Maintains spectroscopy-grade performance at input counting rates exceeding 60 k/s.
3. Software and interface designed to be easy to use, versatile, and robust in operation and communication.
4. Modular construction of both hardware and software.
5. Low power consumption.

Reference 1 describes the architecture and philosophy of the design, and Refs. 2 and 3 describe the first application. This paper will summarize performance results of the prototype with regard to this application as well as the ultimate performance of such an instrument.

We will report on a NaI enrichment user function implemented using an HP-100 palmtop computer interfaced to the prototype.

We are aware that many applications do not require the performance that is possible with the original prototype. Once the foundation is in place, application-specific building blocks can be quickly, efficiently, and relatively inexpensively developed in the context of the interface philosophy and existing software. For example, the high-performance amplifier and analog to digital converter (ADC) boards of the original prototype may be replaced by a single amplifier/ADC board for use in lower-performance applications. However, the basic hardware and software foundation will remain in place. Except for specific applications, the lower-performance instrument will respond exactly as the high-performance instrument. An example of such an application is an HM-4 performance instrument with user programs.

Because of the increase in performance of small, low-powered instruments, one can now use them across the spectrum of safeguards applications. This benefits safeguards authorities because separate hardware, development, training, and logistical efforts for in-plant and portable applications are no longer required.

Effective use of the building-block and interface philosophy leads to timely and cost-efficient adaptation of technology to solve new problems because it minimizes hardware and software development or adaptation efforts. When such a system is implemented by a safeguards authority, training, support, and maintenance costs should be reduced.

*Work supported by US Department of Energy, Office of Arms Control and Nonproliferation and DOE/DOS, Program of Technical Support to IAEA Safeguards.

The basic M³CA has the versatility to support many types of detectors. A compressor-cooled germanium system is described that requires approximately 50 W of power to hold temperature. The basic M³CA software controls the on-off status of the compressor and monitors crystal temperature and leakage current. The reduction of microphonics has been addressed by the vendor of the cryostat and crystal. In addition, for this application, the size of the electronics is being significantly reduced. Delivery and testing of the completed measurement system, an MCA-plus compressor-cooled detector, is anticipated for second quarter of calendar year 1994. We will report on preliminary tests.

The basic M³CA design is highly adaptable to both attended and unattended use. It has features that make it attractive for unattended radiation monitoring applications.

REFERENCES

1. J. K. Halbig, S. F. Klosterbuer, P. A. Russo, J. K. Sprinkle, Jr., M. M. Stephens, L. G. Wiig, and K. D. Ianakiev, "Recent Miniature MCA Technology Developments at Los Alamos," to be published in the *Proceedings of the Fifteenth Annual ESARDA Symposium of Safeguards and Nuclear Material* (Rome, Italy); Los Alamos National Laboratory document LA-UR-93-1728.
2. J. K. Sprinkle, Jr., J. K. Halbig, S. F. Klosterbuer, P. A. Russo, and S. E. Smith, "A Miniature Modular MCA for Gamma-Ray Spectroscopy, Recent Miniature MCA Technology Developments at Los Alamos," to be published in the *Proceedings of the Fifteenth Annual ESARDA Symposium of Safeguards and Nuclear Material* (Rome, Italy); Los Alamos National Laboratory document LA-UR-93-1727.
3. S. E. Smith, J. S. Gibson, J. K. Halbig, S. F. Klosterbuer, P. A. Russo, and J. K. Sprinkle, Jr., "The Holdup Measurement System II (HMSII)," presented at the 34th Annual INMM meeting in Scottsdale, Arizona, July 18-21; Martin Marietta Energy Systems, Inc. document Y/MA-37-7212.