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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Nuclear instrumentation – Data format for list mode digital data acquisition used in radiation detection and measurement

Instrumentation nucléaire – Format de données pour l'acquisition de données numériques en mode liste utilisées dans la détection et la mesure des rayonnements

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NUCLEAR INSTRUMENTATION – DATA FORMAT FOR LIST MODE DIGITAL DATA ACQUISITION USED IN RADIATION DETECTION AND MEASUREMENT

FOREWORD

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CDV	Report on voting
45/842/CDV	45/848/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

In this standard, the following print types are used:

- Names of data types, elements and definitions in ASN.1: in `Courier New`

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INTRODUCTION

In the context of this document, digital data acquisition devices are high-performance measuring instruments that sample signals from radiation detectors in order to store and process them in a digital manner. They offer advantages over conventional data acquisition systems: they are in general faster and cope better with high count rates, are more compact and less expensive per input channel. They allow easier integration of many radiation detectors in the same system, which results in benefits for nuclear physics. In addition, the real-time processing provided by digital data acquisition systems allows new applications in for example nuclear security and safeguards. They enable off-line processing and re-analysis of acquisition data which may improve the accuracy of radioactivity measurement, and enable computational analysis of individual detector or system response data.

The equipment to which this document applies is commonly known as "digitisers", and may offer signal processing with digital signal processors (DSP) or field-programmable gate arrays (FPGAs). To reduce the amount of data to be stored or transferred, these devices are programmed to extract only the properties of interest, such as the pulse height, pulse area, sub-areas, rise time or pulse shape, and the timestamp of the events associated with the interaction of radiation in a detector. Alternatively, they may also offer the partial or full recording of the digital signal for more advanced processing. This type of time-stamped data is often called "list-mode data" which may be stored for off-line processing and analysis by software.

Typically, digital data acquisition devices are controlled by a computer, which may be embedded in the device, and which runs proprietary or custom-made data acquisition software. Instrument drivers take care of the communication with the data acquisition device. This document specifies the format of the data presented by digital data acquisition devices, primarily used for accurate laboratory measurements, but also for new applications in nuclear safety, security and safeguards. The data may be stored on a local or remote computer, or may be streamed to a remote computer in a network.

This document relies on ASN.1 notation. ASN.1 is an internationally-standardised, vendor-, platform- and language-independent notation to specify data structures at a high level of abstraction. The ASN.1 notation standard is complemented with standardised encoding rules, which are independent of the notation, and again are platform- and language-independent. The encoding rules determine the precise bit-patterns in which values of these data structures are represented, when they are stored in a file or transferred to another computer over a network. Tools are available that facilitate the implementation of this document in software for data acquisition and analysis.

NUCLEAR INSTRUMENTATION – DATA FORMAT FOR LIST MODE DIGITAL DATA ACQUISITION USED IN RADIATION DETECTION AND MEASUREMENT

1 Scope

This international standard specifies the format of binary list-mode data at the output of digital data acquisition devices used for the detection and measurement of radiation. Such data acquisition devices may employ digital signal processors (DSPs) and field-programmable gate arrays (FPGAs) in combination with memory and a communication interface with a computer.

This document is applicable to those data acquisition devices which are able to record and present interaction data of radiation in detectors on an event-per-event basis, with data stored in an output file or streamed to a remote computer. Such list-mode data typically contains timestamp and energy information, but may also contain digital signals or properties like rise time or sub-areas of signals computed by the DSP or FPGA from the signal samples.

It is not the scope of this document to specify the communication protocol between data acquisition hardware and the instrument drivers. Instead, it specifies a standard format for the presentation of data acquired by one or more acquisition devices, to the user or user application.

This document only specifies the binary formatting of data. The formatted data may be sent or stored as specified by other protocols. Also, commands to control data acquisition devices are not included in this document.

This document does not put requirements on encryption or authentication of data. However, data is canonically encoded in the format of this document, which allows the application of data security algorithms.

This document does not replace IEC 62755. This document provides optional mechanisms to include IEC 62755 formatted data into list-mode data.

This document does not apply to data acquisition devices used as instrumentation and control systems in nuclear power plants, nor other safety-critical applications. It is also not intended for medical applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62755, *Radiation protection instrumentation – Data format for radiation instruments used in the detection of illicit trafficking of radioactive materials*

ISO/IEC 8824-1:2015, ITU-T X.680, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8825-7, ITU-T X.696, *Information technology – ASN.1 encoding rules: Specification of Octet Encoding Rules (OER)* and *Technical Corrigendum 1 and Technical Corrigendum 2*