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Standard Guide for the Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel¹

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1. Scope

1.1 This guide contains good practices for the selection, training, qualification, and professional development of personnel performing analysis, calibration, physical measurements, or data review using nondestructive assay equipment, methods, results, or techniques. The guide also covers NDA personnel involved with NDA equipment setup, selection, diagnosis, troubleshooting, or repair. General guidelines for the selection, training, and qualification of NDA auditors are included as well, but at a lower level of detail due to the variability of the personnel's responsibilities performing these functions. Selection, training, and qualification programs based on this guide are intended to provide assurance that NDA personnel are suitably qualified and experienced personnel (SQEP) to perform their jobs competently. This guide presents a series of options but does not recommend a specific course of action.

This standard guide does not address the qualifications per se of an NDA Manager. However, it is expected that the NDA Manager is familiar with NDA techniques, and can make informed decisions on the acceptability of the assay results. If an NDA Manager does not have adequate technical qualifications in the NDA field, they are recommended to undergo training to gain familiarity in this area.

An NDA Manager with no relevant NDA experience should have access to a Senior NDA Professional who will give guidance for all technical decisions such as applicability and limitation of methods, reasonableness of results, needed upgrades and advantageous development investments.

1.2 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This guide is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.10 on Non Destructive Assay.

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2. Referenced Documents

2.1 ASTM Standards:²

- C1030** Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry
- C1133** Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning
- C1207** Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting
- C1221** Test Method for Nondestructive Analysis of Special Nuclear Materials in Homogeneous Solutions by Gamma-Ray Spectrometry
- C1268** Test Method for Quantitative Determination of ²⁴¹Am in Plutonium by Gamma-Ray Spectrometry
- C1316** Test Method for Nondestructive Assay of Nuclear Material in Scrap and Waste by Passive-Active Neutron Counting Using ²⁵²Cf Shuffler
- C1455** Test Method for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods
- C1458** Test Method for Nondestructive Assay of Plutonium, Tritium and ²⁴¹Am by Calorimetric Assay
- C1493** Test Method for Non-Destructive Assay of Nuclear Material in Waste by Passive and Active Neutron Counting Using a Differential Die-Away System
- C1500** Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting
- C1514** Test Method for Measurement of ²³⁵U Fraction Using Enrichment Meter Principle
- C1592** Guide for Making Quality Nondestructive Assay Measurements
- C1673** Terminology of C26.10 Nondestructive Assay Methods
- C1718** Test Method for Nondestructive Assay of Radioactive Material by Tomographic Gamma Scanning
- C1726** Guide for Use of Modeling for Passive Gamma Measurements

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 Refer to Terminology **C1673** for definitions used in this test method.

4. Significance and Use

4.1 The process of selection, training and qualification of personnel involved with NDA measurements is one of the quality assurance elements for an overall quality NDA measurement program.

4.2 This guide describes an approach to selection, qualification, and training of personnel that is to be used in conjunction with other NDA Quality Assurance (QA) program elements. The selection, qualification and training processes can vary and this guide provides one such approach.

4.3 The qualification activities described in this guide assume that NDA personnel are already proficient in general facility operations and safety procedures. The training and activities that developed this proficiency are not covered in this guide.

4.4 This guide describes a basic approach and principles for the qualification of NDA professionals and technical specialists and operators. A different approach may be adopted by the management organization based on its particular organization and facility specifics. However, if a variation of the approach of this guide is applied, the resulting selection, training, and qualification programs must meet the requirements of the facility quality assurance program and should provide all the applicable functions of Section 5.

4.5 This guide may be used as an aid in the preparation of a Training Implementation Plan (TIP) for the Transuranic Waste Characterization Program (TWCP).

4.6 This guide describes education and expertise guidance for NDA auditors due to the importance and complexity of proper oversight of NDA activities.

5. NDA Roles, Responsibilities, and Duties

5.1 The application and use of NDA techniques includes such diverse activities as data review and analysis; measurement control activities; equipment operation, troubleshooting and repair; all require different levels of education, expertise, and training. Therefore the implementation and continued successful application of an NDA measurement program requires a complex mixture of theory, experience, and professional judgement. For NDA professionals, a wide variety of skills and knowledge areas is required. These knowledge areas include: physics, chemistry, statistics, NDA modeling methods, electronics, engineering, health physics, quality assurance, nuclear safety, and appropriate regulatory requirements. For technical specialists and operators, less emphasis can be put on formal education, but would be compensated for by higher levels of job specific training.

5.2 Based on roles and responsibilities, NDA personnel can be broken into the following categories. These are not necessarily job titles and some facilities may combine one or more levels. The activities exist in a broader organizational context.

5.2.1 Senior NDA Professional:

5.2.1.1 *Education*—Advanced degree (M.S. or Ph.D.) in physics, chemistry, or nuclear engineering and five years NDA experience; or fifteen equivalent years of experience in the NDA field.

5.2.1.2 *Expertise*—Expertise in most or all NDA techniques. Recognized nationally as an expert in one or more NDA fields through publications, peer reviewed by other subject matter experts (SMEs), active participation in national NDA conferences or conducting NDA training courses. Knowledge areas cover most of those listed in 5.1. Core expertise in one or more of the following areas, and familiarity with the others: Test Methods **C1030**, **C1133**, **C1207**, **C1221**, **C1268**, **C1316**, **C1455**, **C1458**, **C1493**, **C1500**, **C1514**, Guide **C1592**, Terminology **C1673**, Test Method **C1718**, and Guide **C1726** are applicable. The senior professional must adhere to t good practices for performing NDA measurements and data analysis to achieve quality results, as described in Guide **C1592** (Standard Guide for Making Quality Nond-Destructive Assay Measurements). The senior professional must possess relevant technical knowledge of the physical and chemical properties of the materials being assayed, when available. In-depth knowledge of analysis algorithm's applicability to the assay conditions (and limitations) for the NDA methods used is required. Knowledge of computational codes used for modeling, for example MCNP and MCNPX, may be necessary.

5.2.1.3 *Duties*—Designs NDA measurement programs, including method selection and instrument performance specification. Performs NDA technical oversight over the entire program. Performs initial calibrations, qualifications and certifications for instruments and methods. Provides expert technical data review. Provides consultation on NDA matters to various facility departments and organizations such as nuclear safety, safeguards, nuclear materials control and accountability, waste characterization, waste disposal and production operations. Provides mentoring to other job categories.

5.2.2 NDA Professional:

5.2.2.1 *Education*—Undergraduate degree in physical science or engineering and five years NDA experience; or ten equivalent years of experience in the NDA field.

5.2.2.2 *Expertise*—Expertise in one or more NDA techniques. Recognized in NDA field on a local or facility basis. Knowledge areas cover several of those listed in 5.1. Understanding of the NDA methods contained in one or more of the following: Test Methods **C1030**, **C1133**, **C1207**, **C1221**, **C1268**, **C1316**, **C1455**, **C1458**, **C1493**, **C1500**, **C1514**, Guide **C1592**, Terminology **C1673**, Test Method **C1718**, and Guide **C1726**, are essential. The professional must be a practitioner of good practices for performing NDA measurements and data analysis to achieve quality results, as described in Guide **C1592** (Standard Guide for Making Quality Nondestructive Assay Measurements).

5.2.2.3 *Duties*—Provides expert technical data review, and NDA measurement oversight. Performs routine instrument qualification, calibration, and validation. Reviews and approves measurement control data. Provides consulting on NDA matters within his or her area of expertise to various facility departments and organizations such as nuclear safety, safeguards, nuclear materials control and accountability, waste