



Designation: C 1490 – 014

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

This standard is issued under the fixed designation C 1490; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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. Selection, training, and qualification programs based on this guide are intended to provide assurance that NDA personnel are qualified to perform their jobs competently. This guide presents a series of options but does not recommend a specific course of action.

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. Current edition approved ~~Jan. 10, 2001~~; Feb. 1, 2004. Published March 2004. Originally approved in 2001. Last previous edition approved in 2001 as C 1490-01.

2. Referenced Documents

2.1 ASTM Standards:²

- C 1030 Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry
- C 1133 Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning
- C 1207 Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting
- C 1221 Test Method for Nondestructive Analysis of Special Nuclear Materials in Homogeneous Solutions by Gamma-Ray Spectrometry
- C 1268 Test Method for the Quantitative Determination of Americium 241 in Plutonium by Gamma-Ray Spectrometry
- C 1316 Test Method for Nondestructive Assay of Nuclear Material in Scrap and Waste by Passive-Active Neutron Counting Using a ²⁵²Cf Shuffler
- C 1455 Guide for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectrometric Methods
- C 1458 Test Method for Non-destructive Assay of Plutonium, Tritium and ²⁴¹Am by Calorimetric Assay

2.2 U.S. Government Documents:

- 10 CFR 830.120 Code of Federal Regulations, Title 10, Part 830, Paragraph 120, Quality Assurance Requirements³
- DOE Order 5480.20A
- DOE QAPD CAO-94-1012 U.S. Department of Energy, Quality Assurance Program Document
- TWCP-QAPP CAO-94-1010 TRU Waste Characterization Quality Assurance Program Plan

3. Significance and Use

3.1 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.

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

3.3 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.

3.4 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 4.

3.5 This guide may be used as an aid in the preparation of a Training Implementation Plan (TIP) for the Transuranic Waste Characterization Program (TWCP). Requirements for TWCP training include but are not limited to: 10 CFR 830.120, DOE Order 5480.20A, DOE QAPD CAO-94-1012, TWCP-QAPP CAO-94-1010, TWCP-QAPP and the TUM.

4. NDA Roles, Responsibilities, and Duties

4.1 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, electronics, engineering, health physics, quality assurance and nuclear safety. 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.

4.2 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.

4.2.1 Senior NDA Professional:

4.2.1.1 *Education*—Advanced degree (M.S. or Ph.D.) in physics, chemistry, or nuclear engineering and five years NDA experience; or fifteen (15) equivalent years of experience in the NDA field.

4.2.1.2 *Expertise*—Expertise in most or all NDA techniques. Recognized nationally as an expert in one or more NDA fields through such things as publications, active participation in national NDA conferences or conducting NDA training courses. Knowledge areas cover most of those listed in 4.1. In-depth knowledge and understanding of the NDA methods and underlying principles contained in Test Methods C 1030, C 1133, C 1207, C 1221, C 1268, C 1316, Guide C 1455, and Test Method C 1458 are essential.

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*, Vol 12.04-volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

4.2.1.3 *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 (ETR) services. 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.

4.2.2 *NDA Professional:*

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

4.2.2.2 *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 4.1. Understanding of the NDA methods contained in one or more of the following: Test Methods C 1030, C 1133, C 1207, C 1221, C 1268, C 1316, Guide C 1455, and Test Method C 1458, is essential.

4.2.2.3 *Duties*—Expert technical data review (ETR). NDA measurement oversight. Performs routine instrument qualification, calibration, and validation. Reviews, approves measurement control data. Provides consulting on NDA matters within his area of expertise to various facility departments and organizations such as nuclear safety, safeguards, nuclear materials control and accountability, waste characterization, waste disposal, production operations. Mentors technical specialists and operators.

4.2.3 *NDA Technical Specialist:*

4.2.3.1 *Education*—~~High school or college~~—College degree with emphasis in physical sciences and one year NDA experience or High school and two years NDA experience; or five equivalent years of experience in the NDA field.

4.2.3.2 *Expertise*—Knowledgeable in one or more NDA techniques. Knowledge areas may cover one or more of those listed in 4.1.

4.2.3.3 *Duties*—Independent technical data review (ITR); instrument calibration, and validation. Performs measurement control activities, instrument operation. Provides first response to instrument problems, upset conditions. Performs troubleshooting.

4.2.4 *NDA Qualified Instrument Operator:*

4.2.4.1 *Education*—High School or equivalent technical training, or equivalent years (2) of experience in the nuclear facility field.

4.2.4.2 *Expertise*—Trained and qualified in operation of one or more NDA instruments.

4.2.4.3 *Duties*—Operation of NDA instrument. Recording of NDA data and other duties as qualified and assigned.

4.3 The hierarchy described above is only one set of possible tiers. Other tiered hierarchies providing equivalent functions are equally valid. The important consideration is the increasing level of required expertise and independence of action with increasing job level function. Based on site-specific practices and policies, the four levels presented above may be collapsed or expanded and the duties listed may move to other tiers in the hierarchy.

4.4 In addition to the NDA personnel described above, the services of other specialists are often required. These include statisticians to help establish measurement uncertainties, control limits, etc. Also, personnel trained in the maintenance and repair of electronic and mechanical systems may be required. In all cases, the value of the services provided by these specialists is enhanced if they have a basic understanding of NDA methods and instruments.

5. Selection

5.1 The selection of NDA personnel should be a careful and thoughtful process that recognizes the responsibilities that are unique to the NDA position. The selection process should include an evaluation of the NDA candidate's technical skills, as well as the individual's experience and past performance relative to the position requirements.

5.2 The attributes, characteristics, and skills used as criteria for selecting NDA candidates or trainees should include demonstrated qualities such as: judgment, motivation, integrity, communication skills, teamwork skills, diagnostic skills, analytical ability, and strong technical competence.

5.3 The NDA organization should have a selection process for initial hiring and promoting of personnel. This process may involve a selection test, in addition to interviews. Selection should be based on the ability to meet position qualification criteria with reasonable amounts of training.

6. Training

6.1 A training program should be established to develop and enhance the skills, knowledge, and abilities of NDA trainees to perform their job assignments. The program should consist of a combination of classroom-type and on-the-job training and should include laboratory training (for those facilities that have laboratory facilities), as it applies to the NDA position.

6.2 Full implementation of an NDA training program requires a long-term commitment from both the NDA personnel and management. Training activities should be carefully managed to produce effective results.

6.3 Each NDA organization should assess its training needs to develop a facility-specific training program. It is important to implement a systematic method to update training program content to incorporate facility modifications, operating experiences, procedure changes, and changes in job requirements.

6.4 The complete training program for NDA personnel may include courses offered by the national laboratories, commercial vendors, universities, and other centers of excellence. The necessity for this type of training will depend on the roles and responsibilities of the NDA personnel.

6.5 Senior NDA professionals should conduct mentoring sessions with NDA trainees to discuss and promote areas that include commitment to high standards of performance. These sessions may be conducted in either a one-on-one setting, or as small group activities, as appropriate.

7. Qualification

7.1 Qualification is attained by demonstrating that an individual has satisfied the education, experience, training and other special requirements necessary for the performance of assigned responsibilities. Qualification is the result of the process of personnel selection and training required to effectively accomplish the duties of an NDA position or perform an NDA task.

7.2 Qualification for NDA personnel should be documented. The process for progressing through the levels of qualification, frequency for and renewal of qualification, and personnel record keeping should be defined and documented. NDA organizations should describe the authority, duties, and responsibilities of each NDA professional or technician as they apply to NDA activities.

7.3 Training should be conducted, evaluated, and documented through the use of qualification guides, discussion outlines, or checklists. Use of qualification guides is an excellent method of tracking progress through the training program. Some portions of initial training may also be accomplished through the on-the-job instruction by an NDA professional. Training may also include specific training by other departments in associated knowledge areas such as safeguards, measurement control, material accountability, and nuclear safety.

7.4 Auditable records of each individual's participation and performance in, or exception(s) granted from, the training program(s) should be maintained. Training records should identify the qualification and requalification dates and should include the following (as appropriate):

NDA education, experience, employment history,
Training programs completed and qualification(s) achieved,
Correspondence relating to exceptions granted to training requirements (including justification and approval),
Attendance records for required training courses or sessions,
Latest completed checklists, graded written examinations, and operational evaluations used for qualification.

7.5 A historical record that documents initial qualifications on each position qualified should be maintained. If more than one qualification is achieved and maintained, the individual training record should contain documentation to that effect.

7.6 For presently held qualification(s), the completed examinations, checklists, operational evaluations, etc., should be maintained on record. When an individual holds qualification on multiple positions, records that support current qualifications for each position should be maintained.

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