CSCT Meeting for November 26, 2024

Meeting Attendance		
Attendee		**Present**
M	Arm, Cheryl	
M	Berg, Larry	
EM	Bowen, Doug	**X**
EM	Brady, Mikey	
M	Brooks, Franklin	**X phone 8**69**
M	Bunde, Kermit	**X**
M	Chambers, Angela	**X**
M	Collens, Jake	
M	Damba, Darwin	**X**
M	Dyke, Jimmy	
M	Eberle, Cris	**X**
M	Ellis, Daniel	
M	Fischahs, Christopher	
M	Gilbertson, Sarah	
M	Hahn, Kevin	
EM	Hayes, David	
M	Hines, Tom	**X phone 2**66**
M	Janson, Stephen	
M	Levine, Michael	**X**
M	Ly, Gary	**X**
M	Marenchin, Thomas	
M	Moore, Josiah	**X**
M	Moss, Patrick	
M	Murphy, Katie	
M	O'Donnell, Valentina	**X**
M	Ondara, Johnny	**X**
M	Perry, Christopher	
M	Petraglia, Jeffrey	**X**
M	Russell, Paige	
M	Sandgren, Kevin	
M	Thrasher, David	**X**
M	Udenta, Gladys	
M	Vickers, Linda	
M	Wallace, George	**X**
M	Washburn, Peter	**X**
M	Wilson, Robert	
M	Wise, Tammy	**X**

M – Member; EM – Ex-Officio; S – Scribe

Virtual Roll call – For those using phone-in, please assist roll call and let us know who you are. Thanks!

- Welcome Kaitlyn Brundage YFO
- Others in attendance
  - Dave Colman – NA-30 Naval Reactors
  - Paul Hogue – NA-NV
  - Eric Moore – DOE HQ EA-31
  - Hannah Wilhelm – YFO

Previous items update:

- No open items

Items for discussion:

- Cris noted the passing of Dr. Thomas P. McLaughlin. The link to his obituary in the Daily post is:
  Obituary: Thomas P. McLaughlin May 10, 1943 – Nov. 13, 2024
- Doug Bowen presented an overview of ANSI/ANS-8.28:
  - The standard is in place to ensure adequate and not overly conservative controls
  - This came about because of DNFSB Recommendation 2007-1 for controls on holdup in facilities and the health of the practice – various sites were doing their own thing
    https://tinyurl.com/3kz4cxxb
  - The NCSP funds the NDA program mission and vision through the NCSP 5-year plan
    - ORNL Task TS13 – O*RNL-NDA Technical Support Group and NDA Technical Infrastructure Project*
      Nuclear Criticality Safety Repository & NDA Program
  - Discussed the history of ANSI/ANS-8.28 it was approved by ANSI in 2011
  - In 2019 it was converted from a how-to-standard to what-to-do-standard
  - ANSI approved the standard in March 2024
  - All references were loaded into LLNL NCSP website:
    ANSI/ANS 8.28 References | DOE NNSA Nondestructive Assay Program
  - Doug reviewed responsibilities for Managers, Supervisors, NCS Staff, NDA Staff
- ***The CSCT December meeting is canceled.***
- Next meeting January 28, 2025

Open discussion:

- Kermit asked about building a split table in Idaho for HELU fuel funded by DOE NE

Topics for future meetings?

- No future topic were introduced in the meeting

Background and Overview of the ANSI/ANS-8.28 Non-Destructive Assay Standard for Nuclear Criticality Safety

Douglas G. Bowen, Ph.D.

Section Head
Oak Ridge National Laboratory

NCSP Execution Manager

U.S. DEPARTMENT OF ENERGY

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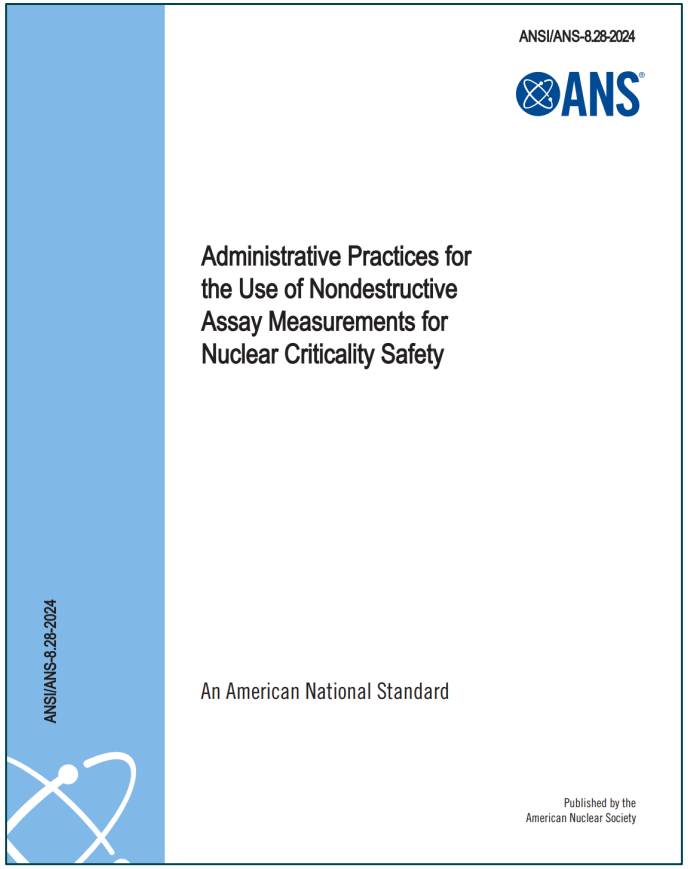
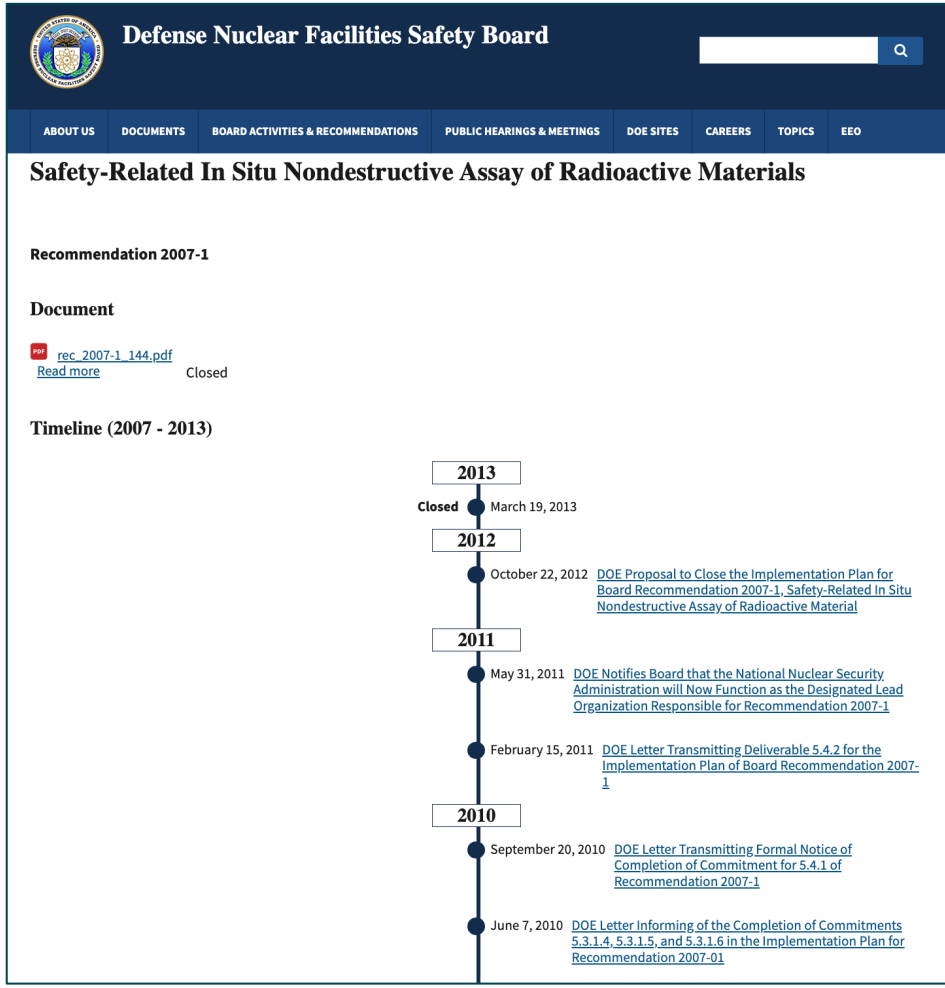
Introduction

- Accurate Non-destructive Assay (NDA) Measurements Needed
  - NDA for NCS is used to estimate amounts of fissile material) present in containers or *in situ* (i.e., holdup in process equipment)
  - Accurate and defensible NDA measurements are needed to properly inform NCS analyses, facility safety basis , and MC&A
  - If NDA measurements significantly **underestimate** the amount of fissile material present, **necessary NCS controls may not be identified and implemented**
  - If NDA measurements significantly **overestimate** the amount of radioactive material, **unnecessary controls and restrictions may be identified and implemented, curtailing operations and throughput**



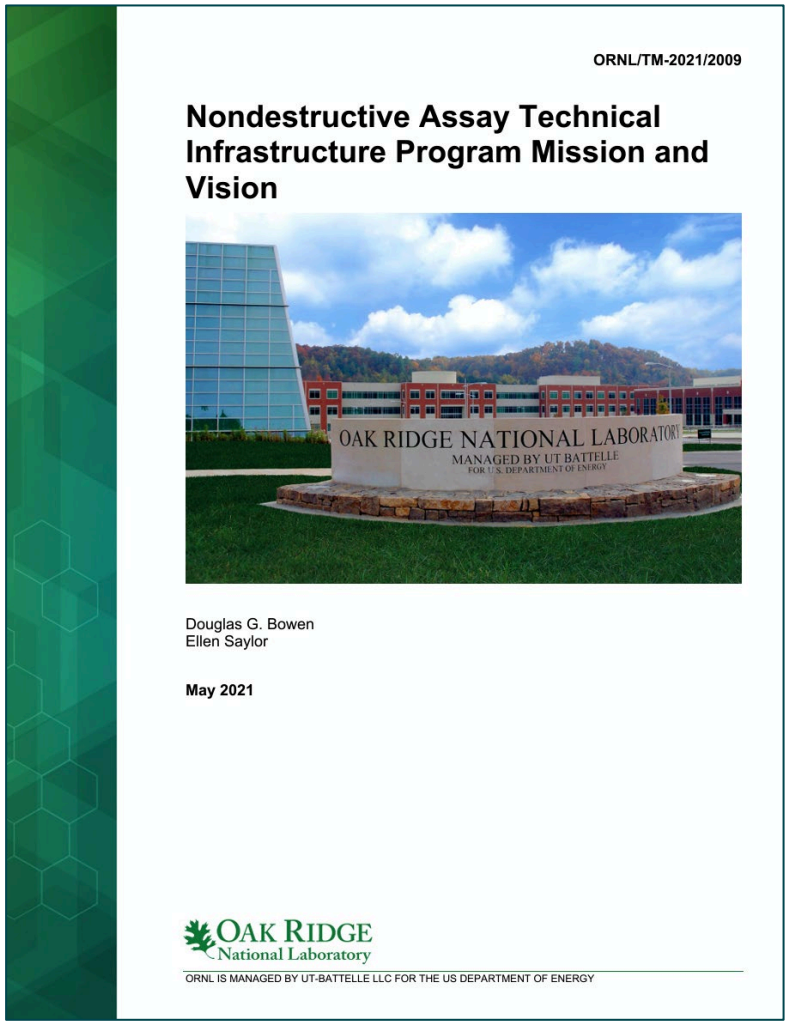
Introduction

- In 2007, the DNFSB issued Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*, to specify improvements needed in NDA programs and equipment
  - Evaluate the condition of *in situ* NDA programs against evaluation criteria, which will be developed;
    - **Identify state of the practice**, both commercial as well as within the Department, in training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA, implementation of standards, and oversight;
    - **Identify any relevant ongoing research and development activities**;
    - Identify what is needed and any resulting gaps in **personnel capabilities and training, equipment capabilities, policy and directives, and oversight**;
    - **Establish requirements, programs, and guidance**, as needed; and
    - Develop a **prioritized plan for implementing the above criteria and requirements**



DOE NDA Program – funded through NCSP

- The NCSP funds the NDA program Mission and Vision through the NCSP 5-year plan
  - ORNL Task TS13 – *ORNL–NDA Technical Support Group and NDA Technical Infrastructure Project*
    - Mostly funds *In Situ* Hold-up Measurment Training courses at ORNL
- The DOE NDA program has a charter -
  - https://nda.llnl.gov/sites/nda/files/2021-05/charter_tsg.pdf
- The DOE NDA program has a Mission and Vision Document similar to the NCSP
  - https://nda.llnl.gov/sites/nda/files/2022-07/ORNL_TM-2021_2009_NDA_Mission_and_Vision-FINAL.pdf
- The DOE NDA program has a Technical Support Group concept analogous to the NCSP CSSG
  - https://nda.llnl.gov/tsg



DOE NDA Program – funded through NCSP

- NDA Technical Support Group is now no longer funded nor active
  - Last active under the NSRD program but not active under modest NCSP funding

TSG Members

Name/DOE Site		Status
	David Dolin Savannah River Site	Chairman
	Cory Hudson	Member
	Jeff Chapman NNSA	Member
	Cynthia Gunn Y-12	Member
	Doug Bowen ORNL	Member
	Thomas Sampson ORNL contractor	Member

CHARTER OF THE
DEPARTMENT OF ENERGY
NONDESTRUCTIVE ASSAY TECHNICAL SUPPORT GROUP

I. BACKGROUND

On October 24, 2007, the Department of Energy (DOE) accepted Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*. In DOE's Implementation Plan for the Recommendation, DOE stated:

> *To assist in the Implementation Plan an NDA Technical Support Group of subject matter experts (SMEs) will be established. This support group will consist of Federal employees from Headquarters and Field Elements and DOE management and operating contractors who have expertise in NDA holdup measurement. The support group will assist the Department in the specific areas of concern highlighted in Recommendation 2007-1.*

The original Technical Support Group (TSG) was formed on 31 Jul 2008 in response to DNFSB Recommendation 2007-1 and was comprised of personnel from DOE staff and contractors. TSG Work Instructions are attached as Appendix A. The TSG Membership Policy is attached as Appendix B.

II. MISSION

The primary function of the TSG is to provide operational and technical expertise to the Department of Energy through the Nuclear Criticality Safety Program Manager. The TSG provides advice and technical support to meet the needs of the DOE complex in in situ nondestructive assay, supporting all the unique programmatic needs of EM and NNSA sites. Specific TSG functions include the following:

- Programmatic input regarding the development and implementation of an effective NDA holdup measurement program;
- SMEs to assist in conducting periodic evaluations to ensure that NDA holdup measurement programs are using appropriate technology, consensus standards and processes;
- Conduct triennial reviews of the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs with the first review to be completed by May 2015.
- A mechanism to identify and address major NDA holdup measurement issues that have crosscutting impacts across the DOE complex or within a site;
- A forum for sharing lessons-learned, ideas and proven processes or programs to both DOE and contractor management; and
- A forum for ensuring that advances in DOE and consensus standards are made when appropriate.

III. OPERATION OF THE TSG

A. Organization

History of the 8.28 Standard

- In addressing the items in DNFSB Recommendation 2007-1, it became evident a new standard was needed on the use of NDA results for NCS purposes.
  - Initially conceived as a DOE Technical Standard within the implementation plan for 2007-1, this evolved into an effort to write a national consensus standard
- The ANSI/ANS-8.28 project was approved by ANSI in 2011
  - Working group was established – very large compared to other standards
  - Slow progress was being made but with good discussions, led by the TSG – progress picked up in 2019 after Bowen assigned a co-chair to the standard
    - Standard was reorganized from a how-to-standard (ASTM-format) to a what-to-do standard similar in format to ANSI/ANS-8.19

History of the 8.28 Standard

- Ballot history
  - The working group developed the first draft of 8.28 in 2020
  - ANS-8 subcommittee ballot for technical review in 2021
  - Nuclear Criticality Safety Consensus Committee (NCSCC) in late 2021
    - Resolution of comments from the NCSCC took significant time; the recirculation ballot for 8.28 was approved by the NCSCC in December 2023
  - Approved by ANS standards board and ANSI in 2024
  - The final step was to ensure the documents listed in the annotated bibliography (Appendix B) were publicly available on the NCSP NDA website
    - https://nda.llnl.gov/ansians-828-references

ANS-8 Standards Today – 18 Total NCS Consensus Standards

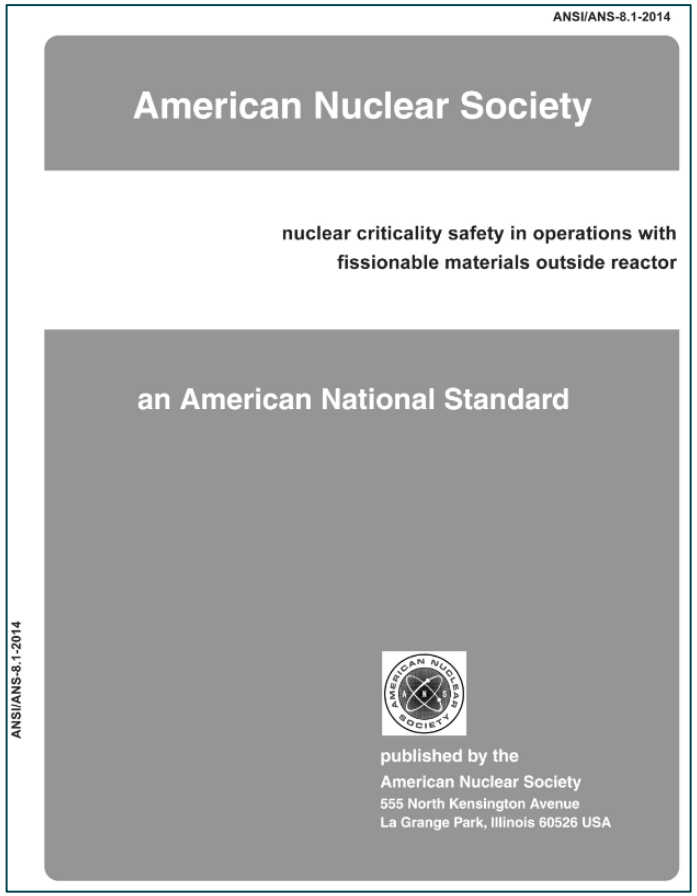
Administrative	
ANSI/ANS-8.1	**Nuclear Criticality Safety in Operations with Fissionable Material Outside of Reactors**
ANSI/ANS-8.10	Criteria For Nuclear Criticality Safety Controls in Operations with Shielding and Confinement
ANSI/ANS-8.19	**Administrative Practices For Nuclear Criticality Safety**
ANSI/ANS-8.20	Nuclear Criticality Safety Training
ANSI/ANS-8.24	Validation of Neutron Transport Methods For Nuclear Criticality Safety Calculations
ANSI/ANS-8.26	Criticality Safety Engineer Training and Qualification Program
ANSI/ANS-8.28	**Administrative Practices for the Use of Nondestructive Assay Measurements for Nuclear Criticality Safety**

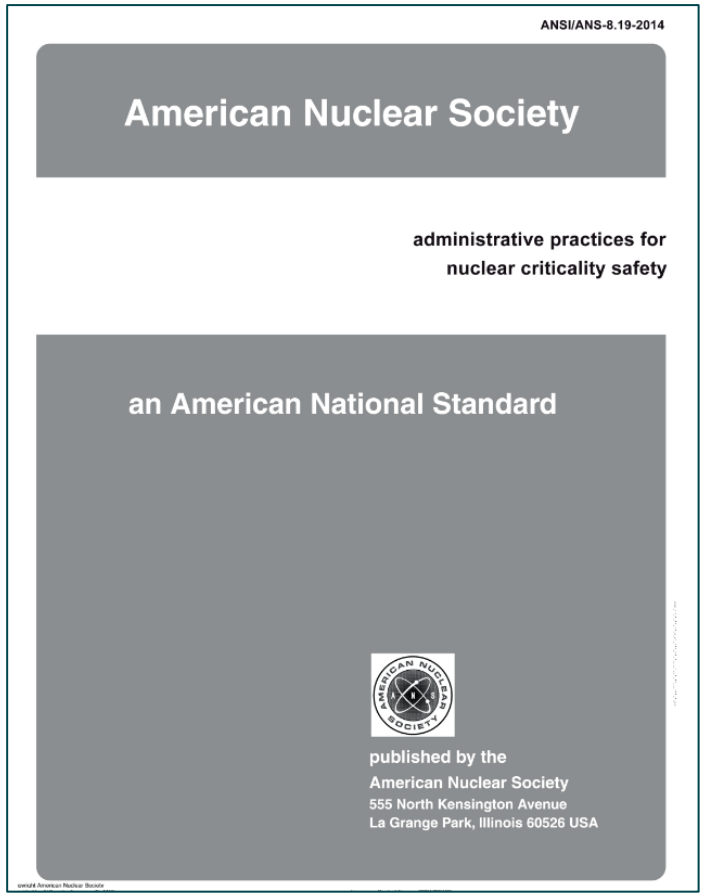
Application	
ANSI/ANS-8.6	Safety in Conducting Subcritical Neutron Multiplication Measurements In-Situ
ANSI/ANS-8.7	Nuclear Criticality Safety in the Storage of Fissile Materials
ANSI/ANS-8.12	Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside of Reactors
ANSI/ANS-8.14	Use of Soluble Neutron Absorbers in Nuclear Facilities Outside Reactors

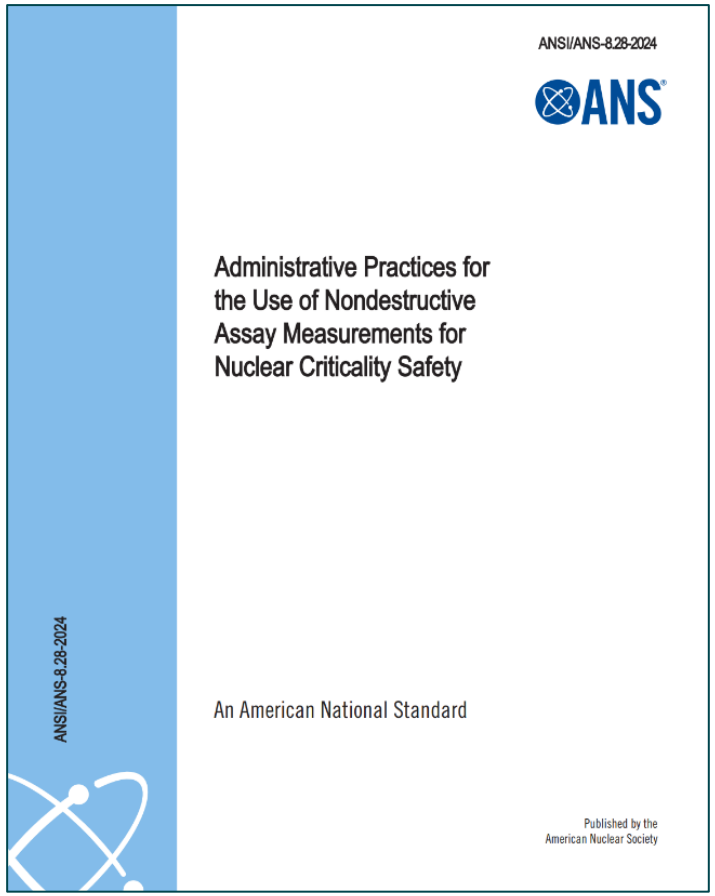
Application	
ANSI/ANS-8.15	Nuclear Criticality Safety Control of Selected Actinide Nuclides
ANSI/ANS-8.17	Criticality Safety Criteria For the Handling, Storage, and Transportation of LWR Fuel Outside of Reactors
ANSI/ANS-8.21	Use of Fixed Neutron Absorbers in Nuclear Facilities Outside of Reactors
ANSI/ANS-8.22	Nuclear Criticality Safety Based on Limiting and Controlling Moderators
ANSI/ANS-8.27	Burnup Credit for LWR Fuel

Emergency Response	
ANSI/ANS-8.3	Criticality Accident Alarm System
ANSI/ANS-8.23	Nuclear Criticality Accident Emergency Planning and Response

ANS-8 Standards for Nuclear Criticality Safety Program Development and Maintenance







ANS-8.1, ANS-8.19, & ANS-8.28 Content Structure

Program Category	ANS-8.1-2014	ANS-8.19-2014	ANS-8.28-2024
Roles and Responsibilities	SECTION 4.1.1 Responsibilities	SECTION 4.1-4.10 Management Responsibilities SECTION 5.1-5.8 Supervisor Responsibilities SECTION 6.1-6.8 NCS Staff Responsibilities	SECTION 3.1-3.8 Management Responsibilities SECTION 4.1-4.3 Operations Supervisor Responsibilities SECTION 5.1-5.4 NCS Staff Responsibilities SECTION 6.1-6.8 NDA Staff Responsibilities
Safety Margin	SECTION 4.1.2 Process Analysis	SECTION 7.1-7.5 Evaluations for Nuclear Criticality Safety	SECTION 7.1-7.2 Measurement Plan for NDA Measurements Supporting NCS
	SECTION 4.2 Technical Practices		SECTION 8 Use of NDA Measurements to Support NCS Evaluations
Formality of Operations	SECTION 4.1.3 Written Procedures	SECTION 8.1-8.8 Implementation of NCS Controls	SECTION 9.1-9.2 Implementation and Maintenance of NCS Controls
	SECTION 4.1.5 Operational Control		
	SECTION 4.1.6 Operational Reviews		
Materials Control	SECTION 4.1.4 Material Control	SECTION 8.9-8.11 Material Control	
Emergency Response	SECTION 4.1.7 Emergency Procedures	No guidnace in ANS-8.19 Refer to ANSI/ANS-8.23-2019	

OAK RIDGE National Laboratory NCSP NUCLEAR CRITICALITY SAFETY PROGRAM

ANS-8.28 Content – Management Responsibilities

- Management (MGT) shall
  - **assign responsibilities** among NCS, NDA, and Operations staff in implementing NDA measurements when used to support the NCS program
  - **provide personnel skilled in the physics, methods, and instrumentation used for NDA measurements**. NDA specialists should be, to the extent practicable, independent of operations.
  - be responsible for ensuring NDA **measurement requirements are developed and shall provide the necessary hardware and software systems to satisfy measurement quality assurance and quality control** to support the NCS program.
  - establish a documented process to **identify deviations of NDA measurements from acceptable performance** and shall take action to **investigate and prevent recurrence**.
  - participate in **auditing the overall effectiveness of the NDA performance** in support of the NCS program. (Once every 3 years)
  - **establish NDA training for NCS** staff sufficient to understand interactions between NDA and NCS and to understand how NDA measurements are used to meet requirements in support of the NCS program.
  - establish **NCS training for NDA staff**.
- MGT may use consultants to achieve the objectives of this standard.

ANS-8.28 Content – Operations Supervisor Responsibilities

- Each supervisor, when using NDA results, shall **be knowledgeable of the relationship between the NDA methodologies and NDA measurement** results, including uncertainties, that are applied to effectively meet NCS controls relevant to operations that the supervisor controls.
    - **Training and assistance** should be obtained as necessary from the NDA and NCS staffs.
    - Each supervisor should **ensure NDA training outlined in Sec. 6.3 is provided** to personnel under the control of the supervisor.
- Supervisors should ensure **support is provided to NDA staff, as needed, in performing measurements** in support of the NCS program.

ANS-8.28 Content – NCS Staff Responsibilities

- NCS staff shall
  - **consult with NDA staff to ensure that NDA measurement requirements and specifications are designed to meet the requirements** needed to support the NCS program
  - **maintain familiarity with NDA measurement results** for fissionable material operations which they are responsible
  - **participate in the multidisciplinary evaluation of the NDA measurement process, as described in Sec. 6.7, for operations that rely upon NDA measurements to support an NCS control**
    - The NCS evaluation shall use **results of this process analysis activity to identify normal and credible abnormal conditions arising out of the NDA measurement process for the operation**
- NCS staff should **understand the potential impact of components of the NDA measurement used to derive the total measurement uncertainty (TMU) estimate**—specifically, how changes to values of those components and how any measurement assumptions affect this estimate.
  - This understanding is particularly important when one or more of the necessary inputs needed for the NDA measurement (type of material, geometry of material, process knowledge) is not completely known or is questionable

ANS-8.28 Content – NDA Staff Responsibilities

- NDA staff shall
  - **work with NCS staff and operations supervisors to understand the NDA measurement needs for NCS purposes** (e.g., NCS limit confirmation, measurement of existing material, measurement of discovered material).
  - provide supervisors and NCS staff **access to NDA measurement results**
  - **maintain familiarity with current developments in NDA instrumentation, methods, standards, guides, and research and development**.
    - Knowledge of NDA measurement methods and techniques should be maintained to provide effective support to the NCS program.
  - **receive training on the risks of, and consequences associated with, a criticality accident** and should be knowledgeable of the role NDA measurements have in criticality accident retention.
  - **implement measurement quality assurance and quality control and have a documented measurement plan to meet the needs of NDA measurements** in support of the NCS program and to ensure the measurement specifications in Sec. 5.1 are met.

ANS-8.28 Content – NDA Staff Responsibilities

- NDA staff shall
  - be **responsible for documenting any specific deviations from the process evaluated in Sec. 6.7 and ensuring that this reporting is communicated to NCS staff**. To assist in the identification of either systematic biases or random errors, the techniques in Secs. 6.8.1 and 6.8.2 may be used.
    - For holdup measurements, comparison of NDA data from measuring material in situ may be compared to NDA measurements made in bulk, after removal
    - For NDA measurements of containerized materials, repeat measurements (over time or after recalibration/renormalization) may be used to understand measurement performance and to refine assumptions on heterogeneity, homogeneity, fill height, and density or to correct for changes to measurement system efficiency or radiation background

6.7

A multidisciplinary evaluation of the NDA measurement process shall be performed to identify mistakes, errors, or omissions in performing NDA measurements applicable to NCS and the magnitude of their impact on the results of the measurements. These include the steps of algorithm selection, instrument calibration, TMU, selected measurement locations or batch sampling frequency, and incomplete assessment of background for the measurements.

6.8

NDA staff shall be responsible for documenting any specific deviations from the process evaluated in Sec. 6.7 and ensuring that this reporting is communicated to NCS staff. To assist in the identification of either systematic biases or random errors, the techniques in Secs. 6.8.1 and 6.8.2 may be used.

6.8.1

For holdup measurements, comparison of NDA data from measuring material in situ may be compared to NDA measurements made in bulk, after removal.

6.8.2

For NDA measurements of containerized materials, repeat measurements (over time or after recalibration/renormalization) may be used to understand measurement performance and to refine assumptions on heterogeneity, homogeneity, fill height, and density or to correct for changes to measurement system efficiency or radiation background.

ANS-8.28 Content – NDA Staff Responsibilities

- NDA staff should **participate in the development of training on the limitations and uncertainties in NDA measurement methods and interpretation of measurement results** and should provide these to NCS staff, supervisors, and personnel under control of the supervisor.
- A multidisciplinary evaluation of the NDA measurement process shall be performed **to identify mistakes, errors, or omissions in performing NDA measurements applicable to NCS and the magnitude of their impact on the results of the measurements**
    - These include the steps of algorithm selection, instrument calibration, TMU, selected measurement locations or batch sampling frequency, and incomplete assessment of background for the measurements.

ANS-8.28 Content – Measurement plan for NDA measurements supporting NCS

- All NDA measurements supporting NCS evaluations shall **have a documented measurement plan**. This plan shall be developed by NDA staff in consultation with operators, supervisors, NCS staff, and other affected organizations as necessary. Guidance may be found in ANSI N15.56-2014.
  - The documented measurement plan shall **address the purpose of the measurements, the measurement conditions expected, the measurement data to be acquired, and details of data reporting, including an estimate of TMU**.
  - Measurement instrumentation shall be **selected by NDA staff to meet the requirements of the documented measurement plan**. Guidance for equipment selection for making quality NDA measurements is provided in ASTM C1592/C1592M-21, Secs. 5.4 and 5.5 [10].
  - The documented measurement plan shall **provide the methodology or reference to the specific methodology used to calculate TMU for each measurement**.
- Prior to performing NDA measurement(s) on fissionable material that is not well characterized or not routine (i.e., the biases, uncertainties, etc., are not well known), NCS, NDA, and operations personnel should confirm that the **NDA measurement(s) will accomplish the intended purpose and ensure the reporting details are understood**

ANS-8.28 Content – Use of NDA Measurements to Support NCS Evaluations

- NCS staff shall **obtain descriptions of NDA measurements and results from NDA staff to ensure NDA methods, potential error/failure modes in the applied method, and measurement uncertainties are sufficiently understood by NCS staff** if relied upon by the NCS evaluation.

ANS-8.28 Content – Use of NDA measurements to support NCS evaluations

- NDA measurements performed in support of the NCS program shall be reviewed by NCS and NDA staffs at least annually to
    - (1) **verify that NDA measurements used to implement NCS controls are being performed in accordance with the documented measurement plan** and
    - (2) **review fissionable material operations for changes in the process condition(s) that could significantly impact the current documented measurement plan** such that a new/revised one is needed
- Corrective actions shall be developed and implemented for all i**dentified deficiencies and weaknesses that could impact NCS controls** for which NDA is relied upon

References

The user is advised to review each of the following references to determine whether it, a more recent version, or a replacement document is the most pertinent for each application. When alternate documents are used, the user is advised to document this decision and its basis.

1. ANSI/ANS-8.1-2014 (R2023), Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, American Nuclear Society.
2. ANSI/ANS-8.19-2014 (R2019), Administrative Practices for Nuclear Criticality Safety, American Nuclear Society.
3. Glossary of Terms in Nuclear Science and Technology, American Nuclear Society (1986). American National Standard ANSI/ANS-8.28-2024
4. LA-11627-MS, H. C. Paxton, Glossary of Nuclear Criticality Terms, Los Alamos National Laboratory (1989).
5. ASTM C1673-10a(2018), Standard Terminology of C26.10 Nondestructive Assay Methods, ASTM International.
6. ASTM C1455-14(2023), Standard Test Method for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods, ASTM International.
7. ANSI N15.56-2014, Methods of Nuclear Material Control—Nondestructive Assay Program— Nondestructive Assay Measurements of Nuclear Material Holdup: General Provisions, Institute of Nuclear Materials Management.
8. ANSI/ANS-8.26-2007 (R2022), Criticality Safety Engineer Training and Qualification Program, American Nuclear Society.
9. ANSI/ANS-8.20-1991 (R2020), Nuclear Criticality Safety Training, American Nuclear Society.
10. ASTM C1592/C1592M-21, Standard Guide for Making Quality Nondestructive Assay Measurements, ASTM International.

Appendix A

NDA Technical Reference Standards

This appendix provides technical reference standards that may be used by nondestructive assay (NDA) staff for conducting various categories of NDA measurements.

International standards for implementing the technical aspects (methodology, instrumentation, calibration, test, evaluation, total measurement uncertainty, data management, precision, bias) of conducting an NDA measurement are provided here as a reference.

ASTM C1807-15(2023), Standard Guide for Nondestructive Assay of Special Nuclear Material (SNM) Holdup Using Passive Neutron Measurement Methods, ASTM International.

ASTM C1455-14(2023), Standard Test Method for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods, ASTM International.

ASTM C1490-14(2023), Standard Guide for the Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel, ASTM International.

ASTM C1726/C1726M-10(2018), Standard Guide for Use of Modeling for Passive Gamma Measurements, ASTM International.

ASTM C1030-10(2018), Standard Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry, ASTM International.

ASTM C1133/C1133M-10(2018), Standard Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning, ASTM International.

ASTM C1221-10(2018), Standard Test Method for Nondestructive Analysis of Special Nuclear Materials in Homogeneous Solutions by Gamma-Ray Spectrometry, ASTM International.

ASTM C1514-08(2017), Standard Test Method for Measurement of 235U Fraction Using the Enrichment Meter Principle, ASTM International.

ASTM C1718-10(2019), Standard Test Method for Nondestructive Assay of Radioactive Material by Tomographic Gamma Scanning, ASTM International.

ASTM C1207-10(2018), Standard Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting, ASTM International.

Appendix A

NDA Technical Reference Standards - continued

ASTM C1316-08(2017), Standard Test Method for Nondestructive Assay of Nuclear Material in Scrap and Waste by Passive-Active Neutron Counting Using a 252Cf Shuffler, ASTM International.

ASTM C1500-08(2017), Standard Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting, ASTM International.

ASTM C1458-16, Standard Test Method for Nondestructive Assay of Plutonium, Tritium and 241Am by Calorimetric Assay, ASTM International.

ASTM C1493-19, Standard Test Method for Non-Destructive Assay of Nuclear Material in Waste by Passive and Active Neutron Counting Using a Differential Die-Away System, ASTM International.

ASTM C1673-10a(2018), Standard Terminology of C26.10 Nondestructive Assay Methods, ASTM International.

ANSI N15.36-2021, Methods of Nuclear Material Control—Measurement Control Program—Nondestructive Assay, Institute of Nuclear Materials Management.

Appendix B

Annotated Bibliography for Use in Administrative Practices for the Use of Nondestructive Assay Measurements for Nuclear Criticality Safety

Users of this standard may wish to consult the literature for details and examples of nondestructive assay (NDA) equipment and methods, measurement applications, and NDA measurement program elements. Following is a list of documents related to each of these three broad topical areas. Citation of a document in this appendix does not constitute an endorsement of that document by the working group for this standard.

Each document is grouped into one or more of these three broad topical areas:

A = NDA equipment and methods;
B = NDA measurement applications;
C = NDA program elements.

A: LA-UR-90-732, NUREG/CR-5550, D. RILEY et al. Passive Nondestructive Assay of Nuclear Materials, Los Alamos National Laboratory (1991).

B, C: "NDA Issues Affecting Nuclear Criticality Safety—Panel," R. M. WESTFALL, organizer, Trans. Am. Nucl. Soc., 113, 771 (Nov. 2015).

B: J. A. CHAPMAN, "NDA Uncertainty and Implications for Safety Basis and Nuclear Criticality Safety—Panel," presented at EFCOG Nuclear & Facility Safety Workshop, Argonne National Laboratory (August 11, 2016); https://doi.org/10.2172/2396633.

A, C: ORNL/TM-2018/923, A. LOUSTEAU, C. PARKS, and S. CROFT, Technical and Programmatic Needs for a Sustainable NDA Program for the US Department of Energy, Oak Ridge National Laboratory (Mar. 2019); https://nda.llnl.gov/sites/nda/files/2021-05/NDA_Workshop_Summary_Report_FINAL.pdf.

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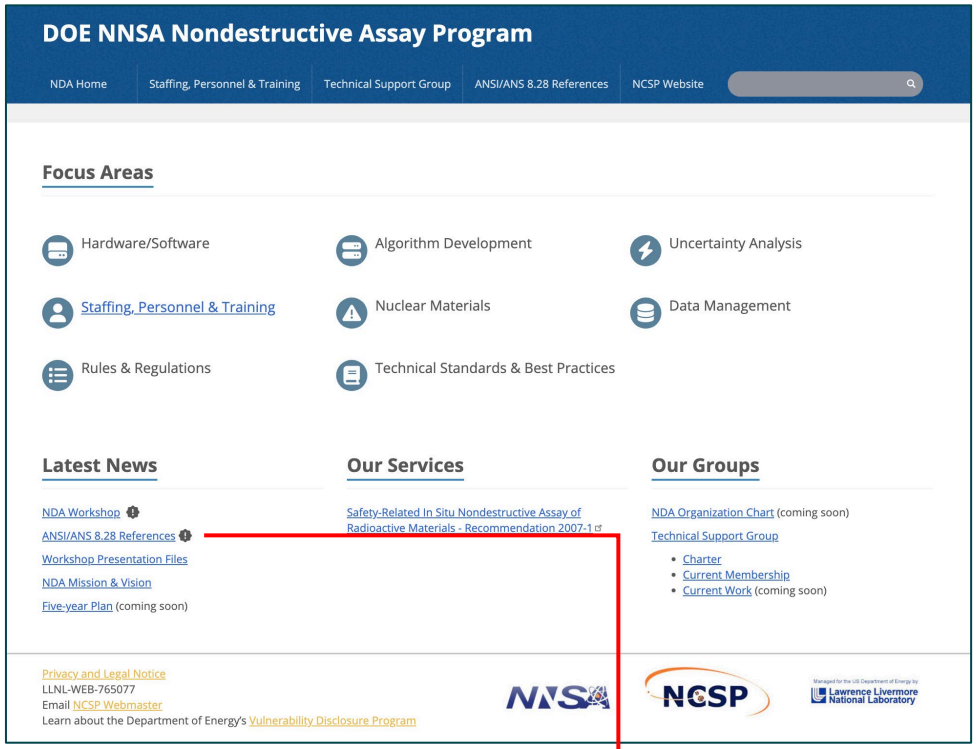

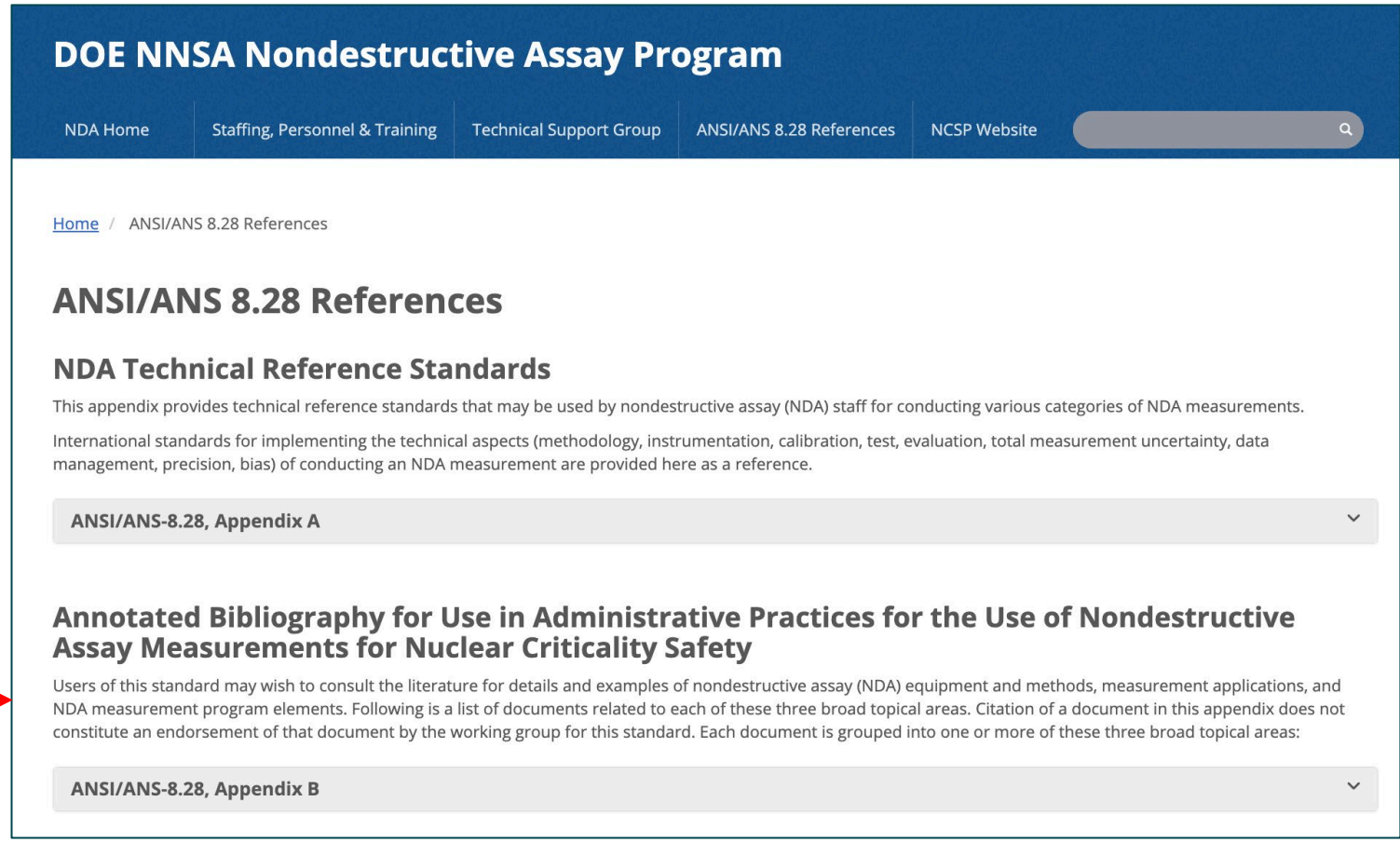

Questions