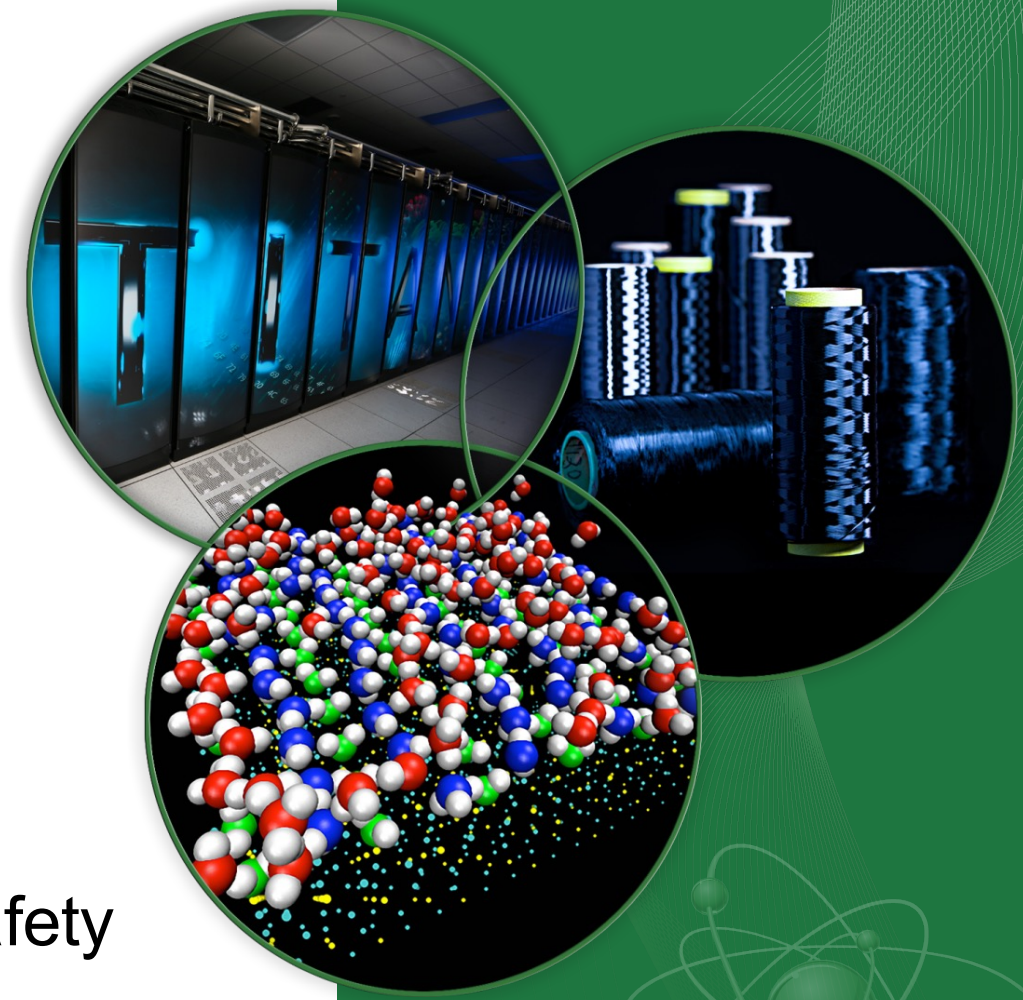
NDA Uncertainty and Implications for Safety Basis and Nuclear Criticality Safety - PANEL



Jeff Chapman

Thursday, August 11, 2016

EFCOG Nuclear & Facility Safety Workshop

Argonne National Laboratory

ORNL is managed by UT-Battelle
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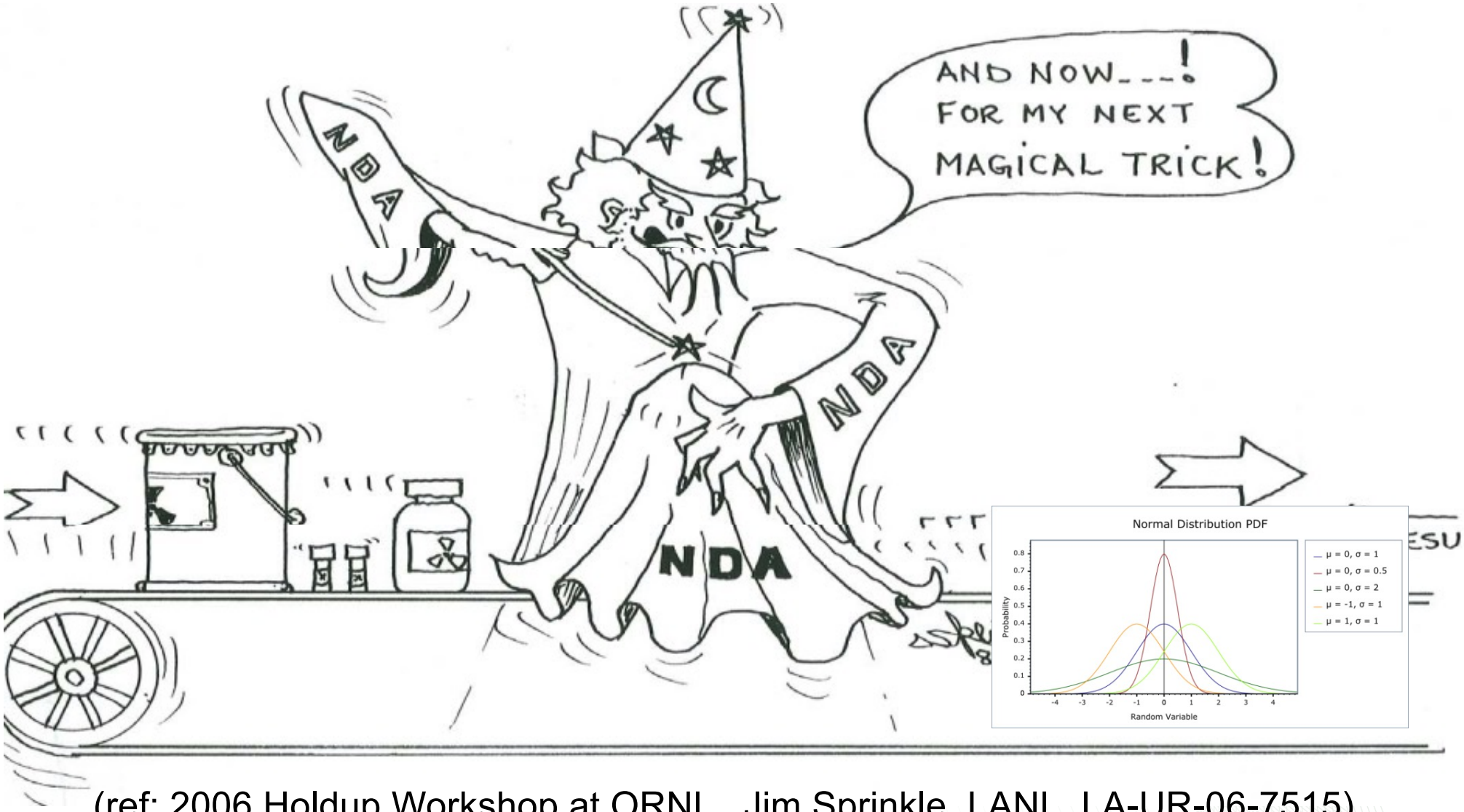
Preconceived Perception



(ref: 2006 Holdup Workshop at ORNL , Jim Sprinkle, LANL, LA-UR-06-7515)

Fundamental Questions for the NDA Practitioner

- How do I estimate bias and precision?
  - Look up values in ASTM standard?
  - Use ITV published values?
  - Calibration, Test and Evaluation of System Performance? (Interferences?)
  - Stochastic or Deterministic Analysis?
  - Use GUM (Guide to the Expression of Uncertainty in Measurement?
  - Hire a statistician? (Especially for estimating the MDA/MDM?)
  - Use Modelling and Simulation, exclusively?
  - Implementation of a QC program?
- How do I reduce human error and mistakes?
  - Training and Qualification
  - Conduct of Operations
  - Configuration Management
  - Systems Engineering
- How can I take advantage of smart NDA systems, with feedback?
  - Expert Analyst Review?
- How do I integrate NDA results with DA Results?

What are we doing to understand NDA system measurement bias and precision…..in the presence of confounding interferences, background variation, isotopics, etc….

so that the Nuclear Safety and Criticality Safety Analysts have a greater confidence in NDA results?

Remarks

- DNFSB Recommendation 2007-1
  - Formation of the TSG (Technical Support Group)
    - "Parallels" the CSSG (David Erickson, Chair)
  - Ongoing Tasks of the TSG
- ASTM Standard Writing Group C26.10
- ANSI N15.56-2014, "…for Methods of Nuclear Material Control– NDA Measurements of Nuclear Material Holdup: General Provisions
- ANSI ANS8.28
- Workshops and Training

DNFSB 2007-1
"Safety Related In Situ Nondestructive Assay of Radioactive Materials"

Defense Nuclear Facilities Safety Board Recommendation from A. J. Eggenberger to the Honorable Samuel Bodman, Secretary for the U.S. Department of Energy (April 25, 2007)

(http://www.dnfsb.gov/)

http://www.dnfsb.gov/board-activities/recommendations/safety-related-situ-nondestructive-assay-radioactive-materials

Federal Register, July 13, 2007

DEPARTMENT OF ENERGY

DOE Response to Recommendation 2007–1 of the Defense Nuclear Facilities Safety Board, Safety-Related In Situ Nondestructive Assay of Radioactive Materials

AGENCY: Department of Energy.

ACTION: Notice.

SUMMARY: The Defense Nuclear Facilities Safety Board Recommendation 2007–1, concerning Safety-Related In Situ Nondestructive Assay of Radioactive Materials was published in the **Federal Register** on May 2, 2007 (72 FR 24279). In accordance with section 315(b) of the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2286d(b), the Secretary transmitted the following response to the Defense Nuclear Facilities Safety Board on June 28, 2007.

DATES: Comments, data, views, or arguments concerning the Secretary's response are due on or before August 13, 2007.

ADDRESSES: Send comments, data, views, or arguments concerning the Secretary's response to: Defense Nuclear Facilities Safety Board, 625 Indiana Avenue, NW., Suite 700, Washington,

with Integrated Safety Management System principles:

- 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.

I have assigned Mr. Richard Lagdon, Chief of Nuclear Safety, Office of the Under Secretary of Energy, as the Department's responsible manager for developing the Implementation Plan. He can be reached at (202) 586–9471.

Sincerely,

Samuel W. Bodman

[FR Doc. 07–3431 Filed 7–12–07; 8:45 am]

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The Technical Support Group

- Created as a result of DNFSB Recommendation 2007-1: "Safety Related In-Situ NDA of Radioactive Materials." (refer to dnfsb.gov website)
  - May 2, 2007: Issue Date
  - March 19, 2013: Boarded Closes 2007-1
- Reports to the NCSP Manager at HQ: Jerry McKamy
- Parallel to the CSSG
  - "The function of the CSSG is to provide operational and technical expertise to the DOE through the NCSP manager"

Charter of the TSG (MISSION)

- The primary function of the TSG is to provide operational and technical expertise to the Department of Energy through the Chief of Nuclear Safety (CNS). 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:

Charter of the TSG

- Assistance, as requested, to support DOE's efforts in accomplishing the Implementation Plan for DNFSB Recommendation 2007-1;
- Programmatic input regarding the development and implementation of an effective NDA holdup measurement program;
- SMEs to assist in conducting periodic assessments to ensure that NDA holdup measurement programs are using appropriate technology, consensus standards and processes;
- A mechanism to identify and address major NDA holdup measurement issues thathave 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.

Members

- Frank Lamb, Chair of TSG
- Jerry McKamy, Director of NCSP
- Doug Bowen
- Mike Dunn
- Jeff Chapman
- Tom Sampson
- Cynthia Gunn
- Glenn Pfennigwerth -- > Cory Hudson

Tasks

- Implementation Plan
- Mission and Vision
- DOE Standard “Guidelines for Effective In-Situ Non-Destructive Assay Holdup Measurements in Support of Nuclear Criticality Safety”
- WIPP – Uncertainty Analysis
- ANSI ANS8.28

ANSI ANS8.28 Work Group
Administrative Practices for the Use of Non-Destructive Assay Measurements for Nuclear Criticality Safety

- Meet semi-annually in conjunction with the Annual and Winter ANS Meetings
- Chair: Jeff Chapman

ANSI ANS 8.x

ANS-8.1 (R), *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, D. Bowen/N. Brown
ANS-8.3 (R), *Criticality Accident Alarm System*, S. Monahan
ANS-8.5 (M), *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material*, J. Hicks
ANS-8.6 (M), *Safety in Conducting Subcritical Neutron-Multiplication Measurements in Situ*, B. Myers
ANS-8.7 (M), *Nuclear Criticality Safety in the Storage of Fissile Materials*, K. D. Kimball
ANS-8.10 (R), *Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement*, A. Prichard
ANS-8.12 (R), *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors*, D. Biswas
ANS-8.14 (M), *Use of Soluble Neutron Absorbers in Nuclear Facilities Outside Reactors*, L. J. Berg
ANS-8.15 (R), *Nuclear Criticality Control of Special Actinide Elements*, C. Rombough
ANS-8.17 (M), *Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors*, B. O. Kidd
ANS-8.19 (R), *Administrative Practices for Nuclear Criticality Safety*, R. W. Carson
ANS-8.20 (R), *Nuclear Criticality Safety Training*, R. A. Knief
ANS-8.21 (R), *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*, D. Erickson
ANS-8.22 (M), *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*, M. J. Crouse
ANS-8.23 (M), *Nuclear Criticality Accident Emergency Planning and Response*, J. S. Baker
ANS-8.24, (M) *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations*, L. L. Wetzel
ANS-8.26, (M) *Criticality Safety Engineer Training and Qualification Program*, J. A. Morman
ANS-8.27, (M) *Burn-up Credit for LWR Fuel*, D. Lancaster
ANS-8.28, *Administrative Practices for the Use of Non-Destructive Assay Measurements for Nuclear Criticality Safety*, J. Chapman
Proposed ANS-8.29, Nuclear Criticality Safety in *Reprocessing*, A. Garcia

Existing Scope

- Project need (from PINS form): Non-Destructive Assay (NDA) measurements of fissionable material are made for many purposes for varying data quality objectives. This has often caused confusion on the part of both the NDA community and the criticality safety community in communicating measurement needs for criticality safety uses.

- Scope summary (from PINS form): This standard provides administrative practices covering the interface between the criticality safety community and the NDA community including in-situ measurements and measurements of containerized materials.

- Goal statement - This standard will provide guidance for ensuring that NDA measurements made for criticality safety purposes are planned, executed, and results used in a consistent and defensible manner, and that the infrastructure necessary to accomplish this is identified and provided.

ASTM C26.10. Non-Destructive Assay Techniques

- Current Chairman and Vice-Chairman

- Ram Venkataraman (C26.10 Chairman)
  - Phone: (865) 574-4247
  - Email: venkataramar@ornl.gov
- Ron Jeffcoat (C26.10 Vice-Chairman)
  - Phone: (803)725-4135
  - Email: ron.jeffcoat@srnl.doe.gov

C26.10 Standards - Gamma

- C1030-10 Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry
- C1133-10 Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning
- C1221-10 Nondestructive Analysis of Special Nuclear Materials in Homogeneous Solutions by Gamma-Ray Spectrometry
- C1455-07 Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods
- C1514-08 Measurement of U-235 Fraction Using the Enrichment Meter Principle
- C1718-10 Standard Test Method for Nondestructive Assay of Radioactive Material by Tomographic Gamma Scanning

C26.10 Standards - Neutron

- C1207-10 Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting
- C1316-08 Nondestructive Assay of Nuclear Material in Scrap and Waste by Passive-Active Neutron Counting Using a Cf-252 Shuffler
- C1493-09 Non-Destructive Assay of Nuclear Material in Waste by Passive and Active Neutron Counting Using a Differential Die-Away System
- C1500-08 Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting

C26.10 Standards – Misc.

- C1458-09 Nondestructive Assay of Plutonium, Tritium and Am-241 by Calorimetric Assay
- C1673-10 Standard Terminology of C26.10 Nondestructive Assay Methods

C26.10 Guides

- C1490-04 The Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel
- C1592-09 Standard Guide for Making Quality Nondestructive Assay Measurements
- C1726-10 Standard Guide for Use of Modeling for Passive Gamma Measurements

Organization of ATM Standards & Guides

- Title (mandatory)
- Designation (mandatory)
- Introduction
- Scope (mandatory)
- Referenced Documents
- Terminology
- Summary of Test Method
- Significance and Use (mandatory)
- Interferences
- Apparatus
- Reagents and Materials
- Hazards (mandatory when applicable)
- Sampling, Test Specimens, and Test Units
- Preparation of Apparatus
- Calibration and Standardization
- Conditioning
- Procedure (mandatory)
- Calculation or Interpretation of Results
- Report
- Precision and Bias (mandatory)
- Keywords (mandatory)
- Annexes and Appendixes
- References
- Summary of Changes

Workshops and Training

- NCSP T&E
  - Implemented Introduction to NDA and Human Factors into the first week of two-week training, NFO
- Training
  - In 1980s-1990s, significant financial resources were provided to develop and maintain “state of the art” training for NDA measurements.
  - Today, training must be requested on an as-needed, ad hoc basis
- Holdup Measurement Workshops
  - 2006, ORNL
  - 2017, ORNL

The INMM Holdup Workshop at ORNL (Oct. 29-Nov 3, 2006)

- Goals and Objectives:
  - Bring international experts together into one forum/workshop
  - Technical Presentations on Methods and Instruments
  - Operations Lessons Learned

- All papers are posted on the INMM website:

  http://www.inmm.org/AM/Template.cfm?Section=Technical_Divisions&Template=/CM/ContentDisplay.cfm&ContentID=1404

Results of the 2006 ORNL Workshop

- JNMM Winter 2008, Volume XXXVI, Number 2
  - Summaries of the Meeting
  - Several Excellent Technical Papers
  - Lessons Learned
- Powerpoint presentations remain posted on website
- Next Holdup Measurement Workshop Scheduled for April 2017, at ORNL

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