CSCT Minutes for June 27, 2023

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

M – Member
EM – Ex-Officio
S – Scribe

<u>Virtual Roll call</u> – please acknowledge your presences in Teams chat.

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<u>Previous items update:</u>

- No open items to update

<u>Items for discussion:</u>

- Bob Wilson – Idaho NDA Measurement Event on the *Report on the High Mass Box and Drum at the Advanced Mixed Waste Treatment Project*
  - During the week of April 14, a team comprised of representatives from EM-41, Chief of Nuclear Safety, and the department's Nondestructive Assay Technical Support Group (TSG) visited the Advanced Mixed Waste Treatment Project (AMWTP) at the Idaho National Laboratory. The purpose of the review was to examine an incident where a box containing a significant amount of fissionable material was erroneously assigned a lower fissionable material mass value.
  - For a 4x4x8 ft box (10078315) from Rocky Flats Neutron, NDA was performed, and neutron measurements indicated about 2.4 kg Pu and gamma measurements indicated that the mass was much less. An expert reviewed the measurements and determined a mass of about 160 g Pu. The container was being prepared for shipment to WIPP with other drums. Later it was opened and determined to be about 900 g Pu. It was isolated and repackaged into 26 drums – shipper receiving cans (3 ft x 6 in). An extent of condition review was done. All boxes which were originally assayed above 325 grams ^{239}Pu FGE were selected for additional review and evaluation. There were 248 boxes identified that met these conditions. The questions asked to the CSCT attending were 1) How do criticality engineer to a measurement of the process system? 2) Who is doing NDA currently? There was little response from the group.
- Kermit Bunde then discussed the DNFSB was to meet with DOE criticality safety engineers October 17-19 in Oak Ridge. Travel funding will need to come from Field Office travel budgets.
- CSSG May meeting discussion points – Deferred to next month
  - How do the various DOE Sites rate infractions?
  - How do the various DOE Sites use moderation exclusion areas?
    - How do Sites define moderation exclusion areas
    - How do Sites regulate these areas
  - How do the various DOE Sites use CSSG taskings?
- *Bunde information on update for DOE-STD-1173-2009.* – Deferred to next month

<u>Open discussion:</u>

- NDA measurement issues affecting process analysis for the criticality safety analysis - continuing
- Site fire department personnel taking CS training - continuing

<u>Topics for future meetings?</u>

- Not discussed.

Meeting adjourned at 11:36 AM ET.

U.S. Department of Energy

Report on the
High Mass Box and Drum
at the
Advanced Mixed Waste Treatment Project

U.S. Department of Energy

Report on the High Mass Box and Drum at the Advanced Mixed Waste Treatment Project

Date Issued–May-2013

APPROVAL

Robert Wilson, Team Lead Date

CONTENTS

1. Background

During the week of April 14, a team comprised of representatives from EM-41, Chief of Nuclear Safety, and the department's Nondestructive Assay Technical Support Group (TSG) visited the Advanced Mixed Waste Treatment Project (AMWTP) at the Idaho National Laboratory. The purpose of the review was to examine an incident where a box containing a significant amount of fissionable material was erroneously assigned a lower fissionable material mass value. The team interviewed the staff from the nondestructive assay group, the criticality safety group, and operations personnel. The team also reviewed reports, program documents and procedures and visited the AMWTP site where the box and drum measurement equipment and box unloading area were located.

2. Event

The source of material that is the focus of the high fissionable mass drum occurrence (drum 10483042) is from a box packaged at the Rocky Flats Environmental Technology Site (RFETS). (box 10078315). This box contained material that was repackaged into drum 10483042. Box 10078315 had a Rocky Flats Item Description Code (IDC) of IDC 480, Mixed Metals, Non-special Source Metal. At the AMWTP this waste form was considered straightforward to assay, and these boxes had not exhibited significant attenuation affecting the waste assay in past measurements. Rocky Flats used this IDC to designate odd material which did not fit other codes. The fissionable material in these boxes has typically been distributed throughout the container and not been concentrated in a single location. The box came to AMWTP with a "low" (value not specified) fissionable material assay value from Rocky Flats.

Box 10078315 was assayed on the AMWTP Retrieval Box Assay System (RBAS) in building WMF-634 on 3-March-2006. The RBAS is an AWMTP specific designation for an Imaging Passive/Active Neutron System (generically called IPAN) originally developed at LANL and commercialized at Pajarito Scientific (a LANL technology transfer spin-off; Pajarito Scientific was bought by BNFL Instruments (BII) and has more recently taken back the original Pajarito Scientific name). The IPAN type instruments are and have been widely used throughout the DOE complex to assay items going to WIPP. WIPP requirements were the driver for the technical specifications of the IPAN. A sister instrument to the RBAS was used at Rocky Flats (the Multi-Purpose Crate Counter (MPCC)), but it is not known if the MPCC was used at Rocky Flats on box 10078315 before it came to AWMTP.

The 2006 RBAS assay of box 10078315 produced a result of 3,420 +/- 1,141 g ^{239}Pu FGE. The gamma ray spectrum results from the box indicated severe low energy attenuation with no significant Pu gamma-ray peaks visible below 300 keV. The gamma ray spectra on file for the box were inspected by a member of the review team and the severe attenuation confirmed. The Real Time Radiography (RTR) inspection of the box on 1-March-2006, two days before the assay, was annotated with the note "Box contents appear to be heavy dense metal containers." One of the team members also inspected the RTR results on file and confirmed the original RTR observation. The passive neutron portion of the RBAS assay indicated extra neutrons beyond those expected from weapons grade Pu spontaneous fission. A common source of extra neutrons in these Rocky Flats materials arises from (α,n) reactions on fluorides in the waste but there was no indication of this reaction in the gamma ray spectrum. The imaging portion of the RBAS assay results indicated that the majority of the mass was concentrated in one region of the box, an observation that was confirmed from the assay of the 26 drums produced from the box and also an observation that conflicted with the general knowledge of the IDC 480 classification of the box.

Because of the high fissionable material assay result from box 10078315, the box could not enter the AMWTP under the criticality safety limits that existed. The staff noted the attenuation in gamma ray spectrum and the assay results underwent Expert Technical Review (ETR) on 5-March 2006, with a result that the fissionable mass value assigned to the box was downgraded by over a factor of 20, with the new value of 158 +/- 26 (1-sigma) g ^{239}Pu FGE. This newly assigned value allowed the box to enter the AMWTP and enabled processing of the box to continue. The box was placed in storage at that time. In March 2013 it entered the processing box line in building WMF-676 (Advanced Mixed Waste Treatment Facility (AMWTF)) where the contents were repackaged into twenty-six 55-gallon drums, one of which was overmass drum 10483042. It is important to note that there is no documentation of the ETR conducted on box 10078315 and no apparent technical justification for such a large reduction in fissionable material mass. The individual who performed the ETR of the box data in 2006 does not have clear recollection of the rationale behind the decision to reduce the mass value.

The 26 daughter drums produced from box 10078315 were assayed on the Retrieval Drum Assay System (a different instrument than the RBAS). The total fissionable material mass of all 26 drums was 978.5 g +/- 260 (1-sigma) g ^{239}Pu FGE; this included 885 +/- 251 (1-sigma) g ^{239}Pu FGE in overmass drum 10483042. The next highest drum assay was 70 g +/- 7 (1-sigma) g ^{239}Pu FGE; with no other drum over 10 g nominal g ^{239}Pu FGE. These results confirm the imaging portion of the original RBAS box assay--that the majority of the fissionable mass was concentrated in a single location.

A recent (since the occurrence) document from AMWTP "Description of Occurrence/Discovery" states, "Subsequent ETR evaluation, using current techniques, has determined that the value to be assigned to the original waste box (ID # 10078315) is 1430 +/- 430 Pu-239 FGE (430 Pu-239 FGE represents one times the error)." This value agrees with the rollup value of the 26 drums produced from the box within 1 sigma limits for the assay values. A member of the review team independently verified the gamma-ray isotopic analysis on spectra from both the box and the drum.

The dense items in the box were observed when the box contents were unloaded into the box processing line; photographs show stainless steel shipping containers used to send fissionable material to Rocky Flats. The containers were about 18 in tall and about 4 in diameter with wall thickness typical of shipping containers. The gamma ray spectrum of drum 10483042 shows a prominent 100 keV x-ray region indicating that the Pu in the drum was not heavily shielded, unlike the spectrum from the box. A half inch of steel is usually enough to completely attenuate the 100 keV x-ray region. Historical RFETS data for the box, and an examination of the box contents in the processing line, indicates that the box contents matched RFETS IDC 479 (Empty Reusable Cans) more closely than the original listing of IDC 480.

3. Subsequent actions

The drum was measured on March 1, 2013 (Friday) and the Expert Technical Review result reported on March 4 (Monday). The Plant Shift Manager, the Facility Manager and the Criticality Safety Lead were promptly notified and the drum was isolated. On March 7 a procedure was approved to transfer the drum to an isolated and locked storage area. A picture of the drum in the isolated storage area is in Appendix III.

This occurrence raised the question of whether other such boxes had the measured masses downgraded in a like manner. On March 5 a query was performed in WTS to identify all boxes that are currently at AMWTP which have an assay with their FGE value modified through the Expert Review Process. All boxes which originally assayed above 325 grams 239Pu FGE were selected for additional review and evaluation. There were 248 boxes identified meeting these conditions. One box was found to have its original data file overwritten and contained no reviewable assay information. This overriding occurred the same day the assay was performed in April 2005. An Expert Review had been performed on the container immediately following the completion of the assay, prior to the data being lost. A Type 1 Non-Conformance Report (NCR) was then written on this box because the original data is unavailable and a new assay is required to ensure the results
All subsequent and recovery actions are deemed appropriate.

4. Safety Significance

Subsequent reviewers looking at the 2006 NDA data on the box could not reconcile the data with the downgrade decision. As the mass values from the measurement process are a key component in the criticality safety program at the facility, the expert review process was clearly safety significant and was a weak link. The weakness was an administrative process which allowed a reviewer to change the mass measurements without checks and balances

The result of considering the measurement of the contents of the 26 daughter drums, the original box is considered to have 1430 grams with a two sigma of 860 grams. This amount was considered in Criticality Safety Evaluations as an upset condition and shown to be subcritical for credible moderation and distribution conditions; the mass contingency was lost but other contingencies remained.

5. Causes of the Drum Overmass Incident

- The principal cause was a flawed review process that produced an incorrect and undocumented ETR of the box assay and was not accompanied by a peer review process to check on such a major downgrade in assay value.
- The ETR and the measurement staff did not recognize that the RTR results showing high density box contents supported by the gamma spectroscopy measurements showing high gamma ray attenuation were inconsistent with the IDC 480 assigned for the box contents.

- The ETR and the measurement staff did not observe or note that the RBAS imaging results showed the Pu to be localized and not distributed throughout the box as historical knowledge of IDC 480 would indicate.
- A likely contributing factor to the event is the production driven climate of the facility and the pressure to get drums out the door. There is no incentive, driver, or available equipment to further investigate a problem container off line to further understanding of the NDA measurement process.

6. NDA Requirements in the AMWTP Documented Safety Analysis

The safety program approved by the department is described in the Documented Safety Analysis (DSA). The AMWTP DSA Section 6.4.2.2 allows expert review of assay data in the event that: (a) the container configuration falls outside the range of the assay equipment (large or small container), (b) there are variations in waste matrix materials (such as heterogeneity or non-standard constituents), (c) the data from the different platforms are not statistically similar, or (d) some other anomaly warrants further review of the assay process and/or data. Additionally, DSA Section 4.4.5.2 states that the ^{239}Pu FGE for a waste container is forwarded by the assay machine to the Fissile Tracking System (FTS) database and then to the Raw File System (RAWFS). If the FTS determines that a technical review is required, the expert technical reviewer (ETR) uses the ETR PC to develop an evaluation of existing data about the waste that exists in computer files. The result of the review is then forwarded to the RAWFS. The result of the ETR can be to revise the ^{239}Pu FGE that was developed by the assay machine. The ETR process is controlled by procedure.

DSA Section 4.4.5.4.2 states that when performing manual data entry into the FTS or bar code number entry into the drum or box assay, the data shall be independently verified to match the source data. When performing manual bar code number entry into FTS for a waste container at a Mass Control Area (MCA) boundary, the manual bar code number entry shall be independently verified to match the source bar code PRIOR to formal entry of the bar code number into FTS, in accordance with TSR LCO 3.7, Fissile Tracking System Manual Bar Code Number Entry at Mass Controlled Area Import. According to the DSA, this rigor is required because an incorrect bar code entry can cause an incorrect 239Pu FGE value to be assigned to the container, and there exists no further check of FTS prior to release of the FTS interlock and introduction of the affected container to the Mass Control Area (MCA).

As noted above, the ETR evaluation in 2006, although performed in accordance with the training and experience available at the time, underestimated the amount of attenuation present within the container and did not recognize the point source characteristics of the neutron data resulting in the assignment of a non-conservative fissile content value. In addition, waste boxes with highly concentrated fissile content, rather than uniformly distributed content, and with high degrees of gamma attenuation pose the risk of being assigned non-conservative FGE values through the ETR process which could result in their introduction into the Treatment Facility in excess of the Nuclear Material Safety Limits established in the Documented Safety Analysis.

Although DSA Sections 4.4.5.2 and 4.4.5.4.2, state that the ETR process is controlled by procedure, sufficient rigor associated with the ETR process has not been established to ensure that a non-conservatively FGE assigned container is introduced into the Treatment Facility in excess of the Nuclear Material Safety Limits. Specifically, a valid assay is defined in the TSR as a Fissile Tracking System assay for waste drums and waste boxes that (1) has an acceptable pre-assay of a nuclear criticality safety (NCS) check container and trailing assay of an NCS check container, and (2) has undergone expert technical review (ETR), when required by FTS. TSR SR 4.4.4 requires a verification that when a bar code without a VALID ASSAY is input into the FTS software, the FTS software does not send a permissive signal to the associated FTS interlock. As demonstrated by the March 2013 ORPS reportable event, a less than rigorous ETR process produced a valid assay, and permitted a container in excess of Nuclear Material Safety Limits to be introduced into the facility.

7. Review of NDA Program

The AMWTP NDA program should receive a Programmatic Review. The NDA program lacks a single, overarching document that discusses many things that are sitewide in nature. The program is clearly expert based and is defined piecemeal in the various procedures provided to the team for review.

- Positions such as NDA SME, Acceptable Knowledge Expert, Physicist SME, Assay Cognizant Engineer, RTR SME, ITR Lead, need to be clearly defined. Also, what constitutes a “designee” also needs to be addressed.
- Roles and responsibilities for the various positions do not appear to be consistent between different procedures.
- Procedures provided have typically one signature; author, reviewer, and approver are more typical. Some procedures have a position listed for signature, some have name and positions, some have neither. How are SMEs involved in writing, reviewing, approving procedures? How is change control managed for procedure changes?
- NDA should be listed explicitly in Section 4.8 of the NCS program manual as helping to determine credible abnormal conditions that need to be analyzed in the NCS evaluation.
- Training and qualification requirements for ETR are inconsistent between procedures and between procedures and the Qualification Checklist. Experience required varies from 5 years (stated during our review), 2 years (box assay technical review), not addressed in Qual Checklist. Also, need to define levels of qualification for ETRs such as junior and senior.
- Interfaces between NDA, the measurement process, DQOs/QAOs, and customer groups need to be clearly defined. Also, clear definition at a program level would be helpful for DQOs/QAOs since both are used in procedures.
- Training and qualification requirements for ETR/ITR are subjective; objective goals need to be identified as to what constitutes “detailed understanding”, “extensive knowledge”, etc. How the NDA SME is identified and under what situations is a designee allowed to approve an ETR/ITR knowledge requirement?

- How familiar does the ETR/ITR need to be with failure modes, potential magnitude of incorrect results for the various NDA measurement devices (RBAS, drum assay)? Familiarity or knowledge of an NDA method does not directly translate in expertise for a machine using that technique.
- Terms used throughout the various procedures need to be clearly defined: historical data, acceptable knowledge, expert review etc. This should be done at the program level.
- The NDA program should identify all of the positions necessary for the program to function correctly, and list them in a program document, and should include: roles and responsibilities, T&Q requirements for each. Also, clear lines should be drawn as to when and why duties of one position can be fulfilled by another position.

8. Principle Recommendations

- From conversations with Operations management and NDA staff, the need for an Expert Technical Review is routine. The team recommends a staffing analysis should be performed for the Expert Technical Reviewer position.
- The team discussed the following with the NDA staff and noted agreement and action on the upgrade of the ETR function. The team recommends the Expert Review Process should be defined in program documents to include
    - documenting the basis for all decisions made,
    - reviewing the Real Time Radiography results before changing the NDA software mass determinations, and
    - having a second Reviewer agree to a significant administrative downgrade of a container fissile mass.
- Although there is an initial training requirement for the Expert Reviewers there should be documentation of the difficult data analyses. The team recommends the program document the difficult interpretation of NDA scans in white papers to assist future reviews
- The downgrading of high mass containers is a significant feature of the criticality safety program. The DSA should include a SAC for significantly downgrading high mass containers
- The NDA program should be identified as a Safety Management Program in the DSA.

9. Summary

A team with representation from EM-41, CNS, and the NDA TSG visited the AMWTF at the Idaho National Laboratory to review an incident involving erroneously downgrading the fissile mass in a box following an NDA measurement. In 2006 a box was determined by the Box NDA counter software to have a fissile mass of 3400 gm. An Expert Technical Reviewer overrode this result and substituted a mass of 210 gram for the inventory record. The Reviewer left no written record for the rationale of the decision process.

The waste box was subsequently processed in the AMWTF, and one of the daughter drums from the box was determined to have over 800 gram fissile. With this determination all the appropriate notifications were made to operations and safety supervision and the drum was isolated. A process was developed and performed to move the drum to an isolated and locked storage area. All recovery actions are deemed appropriate.

The apparent cause was the failure of an administrative action which allowed a reviewer to change the mass measurements without checks and balances. Corrective actions in progress include upgrading the qualification standard for the Expert Technical Reviewer position and formally defining the checks and balances for the Expert Technical Review Process. The team also recommends that significant administrative downgrades of fissile mass following an NDA measurement be covered in a Specific Administrative Control and the NDA program be included in the Safety Management Programs

Appendix I

Documents Reviewed

Finding Report Form FF-MM13-015, Repackaged Drum Exceeds Allowable Fissile Material Content, no date

White paper, 'High FGE Drum 10483042 from Box 10078315', James V. Seamans, Jr., no date

EM-ID-ITG-AMWTP-2013-0005, Occurrence Report; Discovery Screen 76092; PISA USQ 76251, no date

INST-TOI-014, Rev 0, Recovery of High FGE Drum 10483042, 03/07/13

INST-TRUW-8.8.1, Rev 6, Expert Technical Review of Data and Modification of FGE Values in WTS, 03/14/13

Qualification Checklist, Non-destructive Assay Expert Technical Reviewer/Independent Technical Reviewer, 12/08/08

INST-AOI-12, Rev 9, Indicated High Fissile Gram Equivalent Drum Recovery, 03/07/13

MP-RTQP-14.4, Rev. 19, Personnel Qualification and Training, 10/17/12

RPT-TRUW-07, Rev. 18, Determination of Radioisotopic Content in TRU Waste Based on Acceptable Knowledge, 3/19/13

LST-NFCS-02-IM, Rev. 0, AMWTP Criticality Safety Implementation Matrix for DOE and ANSI/ANS Requirements, 5/16/11

INST-FOI-01, Rev. 27, Operating Procedure for Assaying Drums in the Facility Drum Assay Systems, 04/02/13

RPT-TRUW-03, Rev. 8, Drum Assay Counter Technical Review Report, 06/27/12

INST-TRUW-8.8.1, Rev. 11, Drum Assay Post Maintenance Calibration and Validation Procedure, 01/05/10

MP-NFCS-4.4, Rev. 8, Criticality Safety Evaluation, 03/06/12

PD-NFCS-01, Rev. 3, Nuclear Criticality Safety Program Manual, 03/26/13

RPT-TRUW-08, Rev. 2, Box Assay Technical Review Report, 08/10/09

RPT-NFCS-11, Rev 2, Criticality Safety Evaluation for Container Conveyors within AMWTP, 10/15/12

RPT-NFCS-08, Rev. 2, Criticality Safety Evaluation for AMWTP Retrieval Operations, 11/06/12

RPT-NFCS-02, rev. 2, Criticality Safety Evaluation of AMWTF Box Lines, , November, 2012

RPT-NFCS-07, Rev 2, Criticality Safety Evaluation for the AMWTP, 11/06/12

RPT-DSA-02, Rev. 9, DSA for Advanced Mixed Waste Treatment Project, August, 2012

RPT-TSR-03, Rev. 12, TSR for Advanced Mixed Waste Treatment Project, June, 2012

DOE/ID SSO Assessment Reports for 2011 and 2012 for June 2011 and June 2012

RTR results on Box 10078315

Gamma spectral data files from Box 10078315 and Drum 10483042

Appendix II

Review Team Biographies

Robert Wilson

Robert Wilson obtained a Bachelor and Masters of Science degree in Engineering Physics from the University of California at Los Angeles and a PhD in Nuclear Engineering from the University of Washington.

Dr. Wilson completed a dissertation in Critical Mass Physics at the Plutonium Critical Mass Laboratory in Richland, Washington and post-doctoral work in safety analysis for the FFTF Reactor. Following academia he assumed responsibility for the Criticality Safety Program at the Idaho Chemical Processing Plant (ICPP). While at the ICPP he managed the safety response to a criticality accident in 1978 and managed the rebuilding of the criticality safety program. Following ICPP, he worked as the senior criticality safety specialist for the U.S. Nuclear Regulatory Commission. In 1995, he assumed responsibility for the criticality safety program at the Rocky Flats Environmental Technology Site and instituted the program manual, the Criticality Safety Officer Program and safety analysis methods. He is currently the Criticality Safety Program Manager for the DOE Office of Environmental Management.

He was appointed a Westinghouse Advisory Scientist in 1987, a Fellow of the American Nuclear Society in 1994, and earned a Meritorious Service Award for Engineering Excellence from the NRC in 1992. He has served as a member of the Argonne National Laboratory Nuclear Facility Safety Committee, the DOE Nuclear Criticality Technology and Safety Panel (1989 - 1993), and the DOE Criticality Safety Support Group (1997 - present). He is the convener of the committee of federal employees with Criticality Safety responsibilities. He has been the General Chairman and Program Chairman for ANS topical meetings in criticality safety. He has twice served as vice chair and chair of the ANS Nuclear Criticality Safety Division. He is currently chair of the Colorado Section of the ANS. He has served as an Affiliate Professor of Nuclear Engineering for the University of Idaho and has lectured at dozens of University of New Mexico Short Courses on Nuclear Criticality Safety.

He is a member of several ANSI writing groups for criticality safety related standards and is a member of N-16, the Nuclear Criticality Safety Consensus Committee for the American National Standards Institute.

Ernest Elliott
E.P. Elliott has over 20 years of experience in nuclear criticality safety. Most recently, he served for seven years as the criticality safety expert for the Defense Nuclear Facilities Safety Board in Washington, D.C. which has oversight jurisdiction of all defense nuclear facilities in the DOE complex. Before joining the DNFSB, he was the criticality safety manager for Bechtel Jacobs Company in Oak Ridge, Tennessee, with responsibility for criticality safety in operations at East Tennessee Technology Park, Oak Ridge National Laboratory, Paducah Gaseous Diffusion Plant, and Portsmouth Gaseous Diffusion Plant. He supported fissionable material operations in Building 771 at the Rocky Flats Environmental Technology Site for six years during decommissioning efforts, and also worked as a criticality safety engineer for four years at the Y-12 Plant in Oak Ridge. Mr. Elliott is a member of the American Nuclear Society Subcommittee 8, which reviews and approves draft consensus standards on criticality safety.

Thomas Sampson
Dr. Thomas Sampson received his BS in Physics from Case Institute of Technology and an MS and PhD from the Nuclear Engineering Department at The University of Michigan. His career has been devoted

to experimental nuclear measurements supporting Nuclear Safeguards and Nuclear Nonproliferation research and development. His work for over 35 years at Los Alamos National Laboratory has included development of automated nondestructive assay systems for weapons component dismantlement and support of plutonium disposition programs in both the United States and the Russian Federation. He has developed gamma ray spectroscopy measurements for solution assay and waste measurements and is internationally recognized for his work in nondestructive gamma ray isotopic analysis having been responsible for all phases of the development, application, and technology transfer of the FRAM gamma ray isotopic analysis software. He has been a member of the DOE's NDA Technical Support Group since 2010 and continues consulting, technical training, and support of consensus standards development with his company, Sampson Professional Services.

Larry Berg

Mr. Berg is the Nuclear Materials Handling (Criticality Safety) Engineer from the staff of the Environment Chief of Nuclear Safety. Mr. Berg has extensive criticality safety expertise as both a practitioner and as a regulator. He was a lead criticality safety engineer for Rocky Flats and the Y-12 plant during enriched uranium operations restart. Prior to coming to the Department, Mr. Berg was a member of the NRC staff as the lead criticality safety technical reviewer for the Portsmouth and Paducah Gaseous Diffusion plants and the lead criticality safety inspector for commercial fuel fabrication and enrichment facilities. Mr. Berg has a B.S. degree in Nuclear Engineering, and has completed graduate course work with specialization in Criticality Safety from the University of Tennessee.

Appendix III

Picture of High Mass Drum