Performance Demonstration Program Plan for Nondestructive Assay of Criticality Control Overpacks for the TRU Waste Characterization Program

DOE/CBFO-21-3630

Revision 0

Effective Date: July 27, 2021

U.S. Department of Energy
Carlsbad Field Office
National TRU Program

This document implements the Waste Isolation Pilot Plant Documented Safety Analysis.

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CHANGE HISTORY

Revision Number	Description of Revision
0	Initial Issue.

ACRONYMS AND ABBREVIATIONS

%R	percent recovery
%RSD	percent relative standard deviation
AK	acceptable knowledge
ANSI/HPS	American National Standards Institute/Health Physics Society
CAP	corrective action plan
CAR	corrective action report
CBFO	Carlsbad Field Office
CCC	Criticality Control Container
CCO	Criticality Control Overpack
CFAC	custodial facility assay coordinator
CTAC	CBFO Technical Assistance Contractor
DOE	U.S. Department of Energy
EA	expert analyst
FGE	fissile gram equivalent
ID	identification
MDC	minimum detectable concentration
MT	metric ton
nCi/g	nanocuries per gram
NDA	nondestructive assay
NTP	National TRU Program
PDP	Performance Demonstration Program
QA	quality assurance
QAPD	*Quality Assurance Program Document*
SNM	special nuclear material
SOP	standard operating procedure
SPD	Surplus Plutonium Downblend
SPT	sample preparation team
SRS	Savannah River Site
TID	tamper indicating device
TIG	tungsten inert gas
TRU	transuranic
WAC	Waste Acceptance Criteria
WG Pu	weapons-grade plutonium
WIPP	Waste Isolation Pilot Plant
WRM	working reference material

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EXECUTIVE SUMMARY

The primary purpose of the Performance Demonstration Program is to independently acquire data from participating Nondestructive Assay (NDA) measurement systems for the evaluation of the system and the measurement organization's capability to produce data that meet the quality requirements for the Waste Isolation Pilot Plant (WIPP), and to reveal any technical or QA-related deficiencies that may negatively impact the characterization of WIPP wastes.

The *Performance Demonstration Program Plan for Nondestructive Assay of Criticality Control Overpacks for the TRU Waste Characterization Program* was written to support long term activities for Surplus Plutonium Downblend (SPD) at the Savannah River Site (SRS) which plans for exclusively loading Criticality Control Overpacks (CCOs) in K-Area for the purpose of disposing the downblended plutonium-containing materials at the WIPP. This is the initial issuance of the *Performance Demonstration Program Plan for Nondestructive Assay of Criticality Control Overpacks for the TRU Waste Characterization Program.*

1.0 INTRODUCTION TO THE PERFORMANCE DEMONSTRATION PROGRAM

The U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) is permitted for the disposal of transuranic (TRU) waste. All TRU waste shipped to WIPP must be characterized by a WIPP-certified program in compliance with WIPP's disposal, packaging, and transportation requirements, as outlined in DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WAC). Prior to achieving WIPP certification, CBFO designated TRU waste programs must develop and implement a quality assurance program that meets all applicable requirements of DOE/CBFO-94-1012, *Quality Assurance Program Document* (QAPD). When implementing the WAC, radiological characterization requirements for TRU waste include the successful participation in the Performance Demonstration Program (PDP). The PDP serves as a measurement comparison program and quality control check for data generated in the characterization of waste destined for WIPP. Single blind audit samples assembled at the waste generator site are used to evaluate analyses of TRU radionuclides by nondestructive assay (NDA) techniques.

The National TRU Program (NTP) within the Carlsbad Field Office (CBFO) is the review and approval authority for all PDP activities. The overall management of the PDP is described in DOE/CBFO-01-3107, *Performance Demonstration Program Management Plan*. This PDP Plan specifically addresses the purpose, design, management, coordination, and conduct of the NDA PDP that applies to down-blended plutonium-containing materials packaged in Criticality Control Overpacks (CCOs) destined for disposal at the WIPP.

1.1 Purpose of the CCO PDP

The CCO PDP is designed to test the participating measurement organization’s NDA techniques by evaluating alpha-emitting TRU radionuclide data from NDA measurements of simulated waste to support long term activities planned for Surplus Plutonium Downblend (SPD) at the Savannah River Site. WIPP is the preferred alternative for disposition as determined by the Record of Decision developed from the evaluations in the National Environmental Policy Act (NEPA) Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (DOE/EIS-0283-S2, April 2015) and Supplement Analysis for Disposition of Additional Non-Pit Surplus Plutonium (DOE/EIS-0283-SA-04, August 2020). Currently, 13.1 metric tons (MT) of surplus non-pit plutonium-contaminated material has been approved for disposal at WIPP through the down-blending process. It is anticipated that another 26.9 MTs of plutonium derived from pits will subsequently be approved for disposal through the NEPA process. Waste packages containing surplus plutonium CH-TRU waste that have been characterized and confirmed to meet the WIPP waste acceptance criteria will be placed in the queue of waste to be shipped to WIPP. The packages will be shipped to WIPP in approved shipping containers. With current security requirements, the shipping duration for this total amount of material is anticipated to be approximately 140,000 CCOs over 35 years.

The relevant down-blended plutonium-containing materials addressed by this plan are those exclusively loaded in CCOs within K-Area at the SRS. The CCO PDP tests provide a mechanism for the independent and objective assessment of NDA system performance and capability relative to the radiological characterization objectives and criteria of the NTP.

The CCOs are handled similarly to 55-gallon drums. A surrogate matrix (discussed in detail in Appendix F) has been developed to allow for the use of the PDP standards in evaluating the CCO NDA system performance. The CCO consists of two ten-inch-tall by five-inch diameter packing cans placed into a six-inch stainless-steel pipe (the Criticality Control Container [CCC]) centered in a standard 55-gallon drum. An expanded view of the CCO depicting the CCC and other components is shown in Figure F-1. A packing can with and without a source insert fixture and demonstration source is shown in Figure F-2. A cut away view and an actual source insert fixture assembly is shown in Figure F-3.

1.2 Scope and Frequency of the CCO PDP

The CBFO uses the NDA PDP as part of the assessment and approval process for measurement organizations and NDA measurement systems used to characterize waste for disposal at WIPP. Measurement organizations are required to analyze the CCO PDP samples using the same procedures approved and implemented for routine operational WIPP waste characterization activities. The NDA PDP is **not** designed for testing method or procedural changes unless those changes have been accepted by the CBFO based upon approved protocol for demonstration of the method validity for the targeted wastes. The NDA PDP is designed to annually "spot check" capabilities for radioassay of one specific combination of activity distribution within the CCO matrix. Thus, the NDA PDP provides insufficient rigor for testing as a method validation program.

This CCO PDP Plan describes the elements comprising the test program, including test apparatus, test sample configuration, and required sample analyses. The Plan further identifies and defines the responsibilities of the program entities, including the NDA PDP Coordinator, custodial facility, the custodial facility assay coordinator (CFAC), the sample preparation team (SPT), competent individuals, and the measurement organization.

All participating facility measurement organizations and NDA measurement systems must demonstrate acceptable performance in the CCO PDP before the CCO waste assays can be WIPP certified. NDA measurement systems that have not obtained the CBFO approval may choose to proceed with waste characterization on an "at risk" basis. Waste characterization data obtained prior to the CBFO approval of the measurement organization, NDA measurement systems, and procedures may be found to be unacceptable to the CBFO.

After the initial PDP approval, each measurement organization and NDA system shall be evaluated annually, as specified in the WAC. The primary cycle for CCO PDP participation will be conducted annually (i.e., every 12 months, with a one-month grace period).

In addition to the primary test cycle, the NDA PDP Coordinator may schedule a supplemental cycle prior to the next annual cycle. A supplemental NDA PDP cycle can be requested by measurement organizations for measurement systems that have failed one or more NDA PDP samples, for newly implemented measurement systems, or for measurement systems that have been inactive or have undergone changes that could impact the NDA PDP approval status. Requests for a supplemental cycle must be submitted in writing or by email to the CBFO for evaluation. Timing and selection of measurement systems for participation in supplemental cycles will be at the discretion of the CBFO. The CBFO will typically require the costs

associated with administration of supplemental cycles to be borne by the requesting organization via funds transfer to the PDP Program Coordinator.

1.3 CCO PDP Cycle Description

The CCO PDP cycle is a process that implements a sequence of documented activities designed to produce, evaluate, and report NDA measurement results. The scored results are used as evidence indicating the measurement organization's NDA measurement system and procedural capabilities to produce data of sufficient quality for WIPP certification.

Sequentially, the CCO PDP cycle is described by the following major activities:

- Approximately 2-3 months prior to cycle initiation, the NDA PDP Coordinator coordinates with the host site and measurement organization to establish a schedule and identify the NDA measurement systems that will participate in the cycle and prepares a letter for the CBFO PDP Appointee's signature to document the schedule and participants.

- In the case of a supplemental cycle, the host site and measurement organization are documented in the CBFO PDP Appointee's approval of the requested supplemental cycle.

- Approximately 2 weeks prior to the scheduled start of the cycle, instructions are sent to the participating facilities' CFAC for the assembly and verification of the cycle's PDP samples (activity type, position, and quantity). These instructions are confidential information; to ensure cycle integrity, these instructions must not be shared with the measurement organization.

- Prior to sample assembly, a tailgate briefing meeting (which may be by telecom) is held between the NDA PDP Coordinator, Sample Preparation Team, and the competent individuals who will witness the loading to review the instructions, resolve any questions, and identify all necessary materials to assemble the sample as outlined in the upcoming cycle.

- Upon commencement of the cycle, the participating measurement organization performs nondestructive radioassay of each sample utilizing the NDA measurement systems and procedures authorized by the CBFO on a cycle-specific basis. Each sample is counted six times. The results are sent to the NDA PDP Coordinator.

- The NDA PDP Coordinator scores the results against criteria set forth in the CCO PDP plan.

- Approximately 2 weeks after receiving the results, the NDA PDP Coordinator makes NDA system approval recommendations to the CBFO PDP Appointee based on performance of each of the participating NDA measurement systems to PDP criteria.

- The CBFO PDP Appointee considers the recommendations of the NDA PDP Coordinator and other QA information gathered from onsite assessments to approve, conditionally

approve, or disapprove each of the participating NDA measurement systems on an individual basis.

- If not approved, or if conditionally approved, a measurement organization may enter a corrective action process to obtain a higher CBFO approval status for one or more of their NDA measurement systems.

- Upon completion of the SPT and assay activities and receipt of all the results from all the participating facilities, a scoring report is generated that includes: the values reported by the measurement organizations; the reference activity values; the acceptance ranges; the pass-fail status of each individual measurement system relative to the NDA PDP pass-fail criteria; and the CBFO approval status of each participating NDA system. The report is generated by the NDA PDP Coordinator and distributed by CBFO to the relevant stakeholders.

An approximate timeline schedule of PDP cycle activities is shown in Figure 1.

An NDA PDP cycle is considered initiated on the date specified in the letter transmitting the NDA PDP sample configuration instructions to the CFAC. A cycle is concluded upon issuance of the scoring report for the cycle. For compliance with required annual participation, an NDA measurement system must participate in a PDP cycle within 12 months (plus a one-month grace period) from the date results for the cycle are received by the NDA PDP Coordinator (see section 4.2).

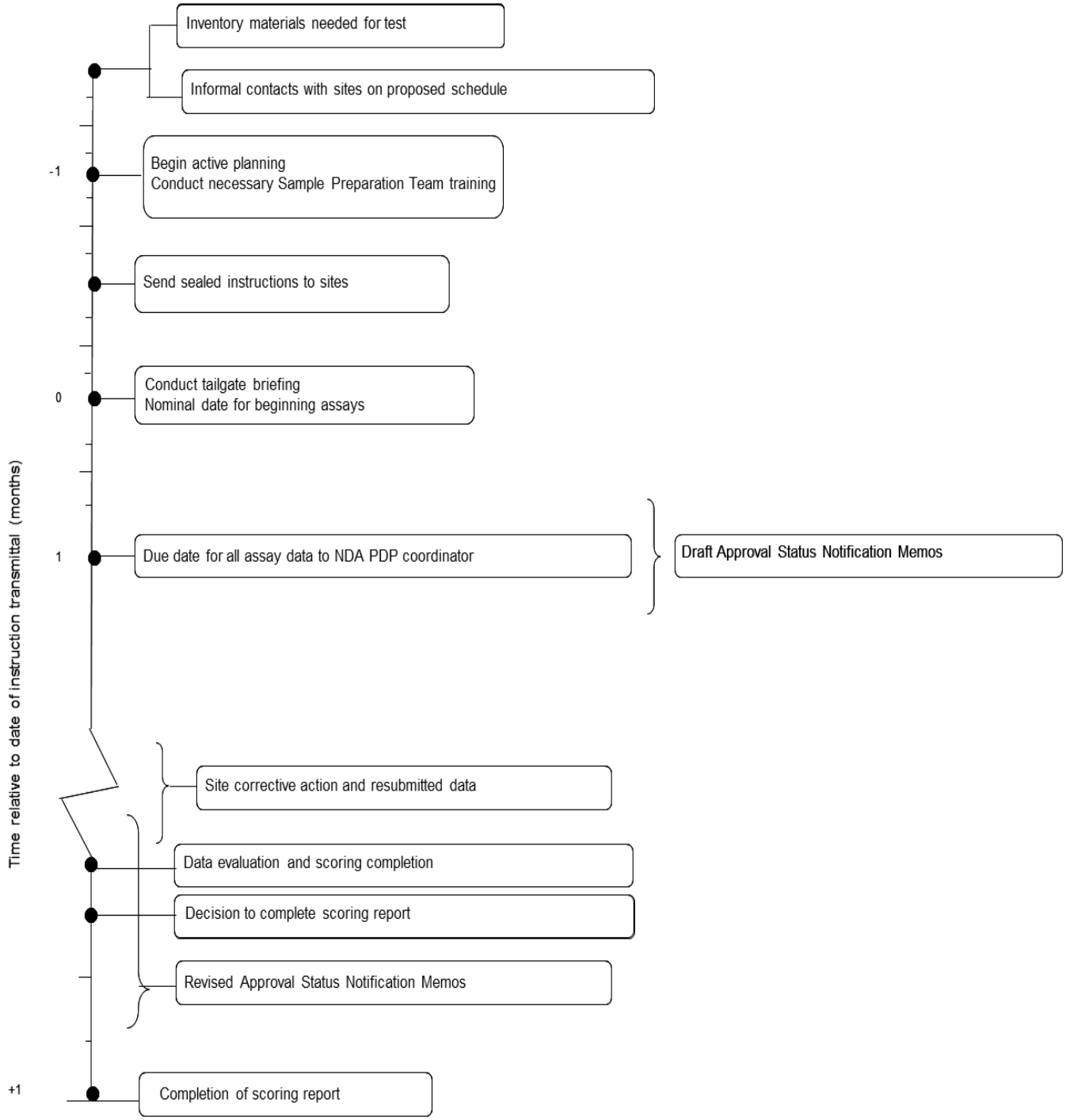

Figure 1. Event timeline for a primary cycle of the NDA PDP.

2.0 ORGANIZATION AND RESPONSIBILITIES

This section discusses the organizations involved in the NDA PDP and the responsibilities of each of these organizations. Figure 2 depicts the organizational flow of communications for the NDA PDP. Other responsibilities of the organizations involved in the CCO PDP are provided in the following sections.

2.1 Carlsbad Field Office

The CBFO is the review and approval authority for the CCO PDP. Programmatic direction and oversight of the PDP are performed by the NTP. The CBFO NTP Assistant Manager designates a CBFO NTP employee to be the PDP Appointee.

The CBFO implements the PDP by designating a Program Coordinator (currently the CBFO Technical Assistance Contractor [CTAC]), and by providing program oversight.

The CBFO is responsible for the specification and procurement of PDP standards. A PDP standard is defined as a radioactive source specifically designed, prepared (or acquired), and certified for the NDA PDP. The PDP standards have pedigrees traceable to nationally recognized reference bases such as the National Institute of Standards and Technology. To date, all standards used in the NDA PDP have been manufactured at the Los Alamos National Laboratory. However, sources with appropriate traceability and certification from other programs or commercial sources may be used with the CBFO approval. The types of radioactive PDP standards presently in the NDA PDP inventory are listed in section 5.2, Table 2.

The CBFO also has responsibility for the CCO PDP surrogate matrix and associated components for use in the CCO PDP.

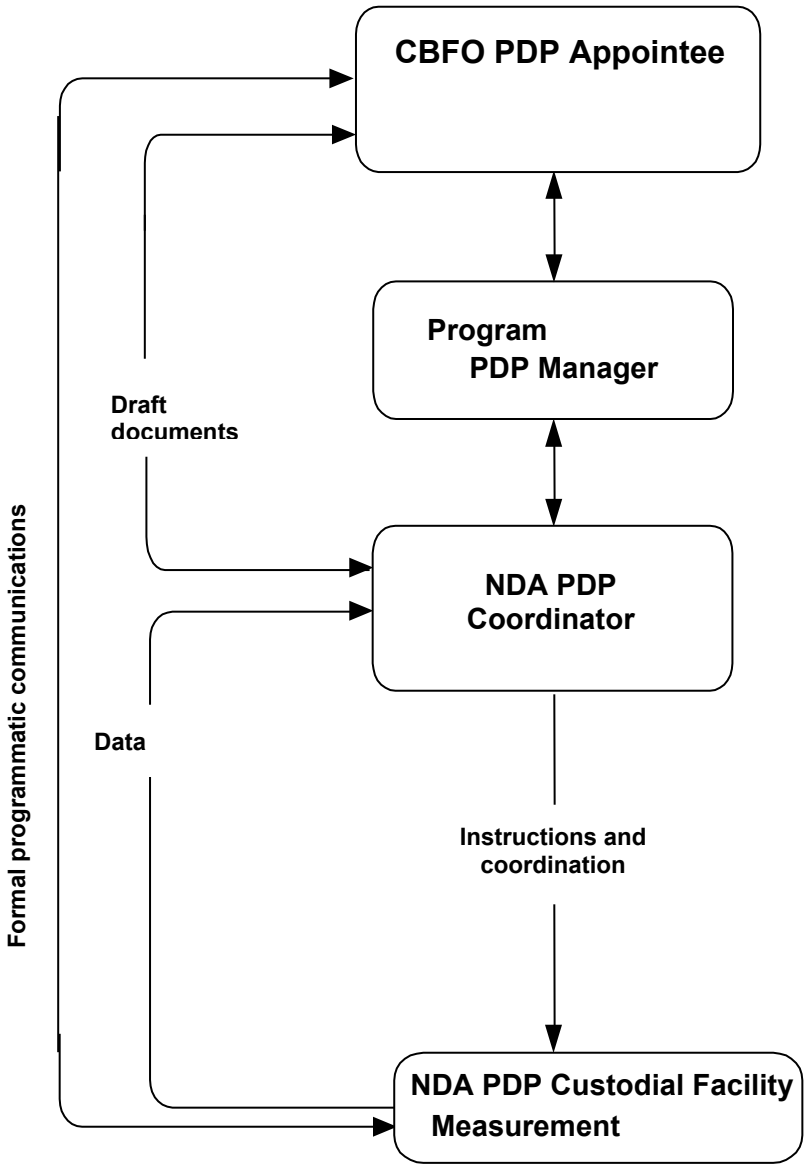

Figure 2. Organization and Communication Flowchart for the NDA PDP

The NDA PDP is routinely assessed for utility and effectiveness by the CBFO through several interrelated activities. These activities include the CBFO review of the test results for each NDA PDP cycle; approval of this plan; consideration of the reports and observations of the Program Coordinator, PDP Manager, and NDA PDP Coordinator; feedback from program participants; and comments from other parties such as independent QA assessors. Records of comments, decisions, or proposed actions resulting from the CBFO assessment may take any documented form, including routine program correspondence, meeting minutes, action items, formal review of program documents, assessment reports, and corrective actions.

2.1.1 CBFO PDP Appointee

The PDP Appointee is an NTP CBFO employee responsible for the oversight and designated with review and approval authority for the PDP. The CBFO PDP Appointee is responsible for

ensuring the implementation of each of the PDP plans by concurring with the designation of the Program Coordinator and by providing technical oversight and coordination for the program.

2.1.2 PDP Program Coordinator

CTAC is a CBFO-designated organization that functions as the PDP Program Coordinator and technical advisor to the CBFO. The Program Coordinator designates the PDP Manager.

2.1.3 PDP Manager

The PDP Manager is responsible for overall management of the PDP and ensures that all PDP responsibilities identified in the PDP Plans and those implemented through DOE/CBFO-01-3107 and the applicable CBFO and CTAC procedures are met. The PDP Manager assigns the NDA PDP Coordinator to administer and coordinate the NDA PDP functions such as PDP sample component preparation, subcontractor oversight, scheduling, scoring, preparation of PDP cycle scoring reports for the CBFO approval, and generating draft approval status notification memoranda for the CBFO signature.

2.1.4 NDA PDP Coordinator

The NDA PDP Coordinator must comply with the responsibilities stipulated in this plan in accordance with the requirements of DOE/CBFO-01-3107. The NDA PDP Coordinator is responsible for the following activities:

- Distributing and tracking PDP standards and CCO surrogate matrix and components as appropriate to implement the program and to safeguard and secure the PDP materials.
- Maintaining documentation and reconciled inventories on all NDA PDP standards and CCO matrix and associated components.
- Confirming with the CBFO and the CFAC the schedule of a primary CCO PDP cycle approximately two weeks before the planned start date.
- Ensuring training for the on-site SPT members is in accordance with this CCO PDP Plan.
- Distributing CCO PDP sample preparation instructions and associated materials to each participating CFAC.
- Conducting a tailgate briefing meeting with the Sample Preparation Team and competent individuals who will witness the loading to review the instructions, resolve any questions, and identify all necessary materials to assemble the sample as outlined.
- Collecting and scoring CCO PDP sample data reports from the measurement organization.
- Drafting the CBFO approval status notification memo for the CBFO authorization of WIPP waste characterization by NDA measurement systems based on their performance in an NDA PDP cycle.

- Drafting the CBFO approval documentation for the CBFO authorization of use of (or revisions to) NDA measurement procedures prepared by the participating measurement organization (when the new procedure or revision potentially impacts the PDP approval at the facility).

- Preparing cycle-specific scoring reports that provide NDA measurement system-specific and CCO sample-specific scoring results for facility measurement organization participating in a cycle.

- Ensuring that records of participation and results of all NDA PDP cycles are adequately maintained in a retrievable condition and meet appropriate QA requirements.

- Reviewing changes in the QAPD and WAC that may potentially affect this plan and provide recommendations for revising the plan as appropriate, with the CBFO direction and approval.

- Assisting in the resolution of disputes related to NDA PDP measurement results, test sample configuration, operational restrictions, and other issues that may arise during a CCO PDP test cycle.

- Developing technical recommendations to the CBFO regarding conditional NDA characterization approvals, when warranted, based upon a system's NDA PDP performance.

- Maintaining a current register of participating measurement organizations and their NDA measurement system registrations. The registration documentation contains information on each assay system, including a unique identity, measurement principles and modes, the NDA PDP test combinations permitted under facility-specific or measurement organization/system-specific calibration, and administrative limits.

- Ensuring the NDA PDP test material inventory at each site is sufficient to support cycle implementation.

- Initiating and orchestrating, through the Program Coordinator, the procurement of NDA PDP components to meet programmatic requirements and to replace lost or damaged parts as necessary.

- Ensuring the responsible parties from each host site and other NDA PDP stakeholders are notified in writing when revisions to this plan are available on the National TRU Program Documents area of the WIPP website: http://www.wipp.energy.gov/Documents_NTP.htm

2.2 Custodial Facility

The custodial facility is the physical and organizational entity responsible for CCO PDP activities at the SRS associated with the conduct of the CCO PDP cycles and the storage, care, and proper handling of PDP materials before, during, and after cycle activities. It is essential that close contact be maintained between appropriate custodial facility personnel and the NDA

PDP Coordinator. The CCO PDP Participating Facility Contacts Form, found in Appendix A, must be provided to the NDA PDP Coordinator by an appropriate custodial facility manager. The form must be updated and forwarded to the NDA PDP Coordinator when contact information changes.

Each custodial facility is required to provide the NDA PDP Coordinator, in writing or by e-mail, with the name, telephone number, and address of a CFAC responsible for on-site administration and conduct of the NDA PDP (e.g., execution of cycle-specific schedules and instructions). The CFAC must be a full-time employee or subcontractor stationed at the host site where the NDA measurement system(s) to be assessed is/are located. The CFAC may be a part of the SPT if he or she meets the qualifications described below. The CFAC must complete NDA CCO PDP training as indicated in section 7.0, Training.

The custodial facility is also required to provide the NDA PDP Coordinator with contact information (e.g., name, telephone number, and address) for a PDP sample components custodian. The address provided must be suitable for freight and package delivery of the NDA PDP components and replacement parts. This information shall be supplied in writing or by e-mail every time the contact information changes. The PDP sample components custodian may be part of the SPT if he or she meets the qualifications described below, or may remain separate, with responsibility for the proper care and storage of non-radioactive PDP components.

A two-person SPT consisting of a PDP standards custodian and a PDP standards configuration attestant shall be assigned by each custodial facility organization. The SPT members must, at a minimum, meet the following requirements:

1. Full-time employees or subcontractors of the facility where PDP materials are stored and maintained.

2. Independent of the measurement organization. That is, the individual does not participate in assay measurements, reduction or analysis of the assay data, data validation activities, or data reporting. In addition, the individual must not report through the same management chain or work organization structure.

3. Trained to applicable site QA requirements in accordance with the training provided in section 7.0 of this plan.

4. Qualified to handle radioactive materials (PDP standards custodian only).

2.2.1 Custodial Facility Assay Coordinator (CFAC)

The CFAC is responsible for the following NDA PDP cycle activities throughout the year:

- Ensuring timely completion of necessary and requested communication, verbal and written, with the NDA PDP Coordinator regarding all aspects of the conduct of a given CCO PDP cycle.

- Overseeing and managing schedules and PDP sample transfers between the various assay measurement systems at the site.

- Receiving and distributing cycle materials and documents to the SPT in a timely manner.

- Ensuring properly executed SPT documentation, including completed configuration and chain of custody forms, is submitted to the NDA PDP Coordinator within two weeks of the return of the final cycle sample to the SPT.

  NOTE: **The proper approval of NDA measurement systems cannot be completed without the SPT documents (i.e., properly signed Sample Configuration Forms and Sample Custody Forms) being in the possession of the NDA PDP Coordinator. The completed Sample Custody Forms and Sample Configuration Forms are QA records.**

- Providing notice and contact information for changes in personnel as soon as possible when changes have occurred.

- Coordinating the training needs of the SPT with the NDA PDP Coordinator.

- Ensuring that the NDA PDP Coordinator is provided, in writing or by e-mail, the documented inventory, condition and location of all PDP materials (standards, CCOs, and parts) annually and as requested.

- Disseminating information from revisions to this plan to all affected members of the SPT and affected managers of those members.

  NOTE: **The NDA PDP Coordinator will notify the CFAC when revisions to this plan have been posted to the National TRU Program Documents area of the WIPP website.**

- Forwarding all relevant communications originating from the SPT to the NDA PDP Coordinator.

2.2.2 PDP Sample Components Custodian

The designated PDP sample components custodian has the following NDA PDP responsibilities:

- Ensuring all PDP components are properly stored and controlled to prevent unauthorized use, loss, or damage. Proper storage includes indoor protection from exposure to water and protection from physical damage (e.g., stacking on top of boxes, drums, or other CCOs, and unnecessary exposure to forklifts). The components must be maintained in a condition consistent with that in which they were provided to the participant. The PDP CCO matrix and components must be kept within the DOE free release limits for radioactive contamination.

  NOTE: **PDP matrix CCOs are only to be used for NDA PDP purposes unless written permission has been granted by the CBFO PDP Appointee for other purposes. Questions concerning permissible use shall be directed to the CBFO PDP Appointee or the NDA PDP Coordinator.**

- Completing a thorough inventory, documenting the condition and location of all PDP materials (standards, CCOs, and parts) annually and as requested.

  NOTE: **The NDA PDP Coordinator will request the inventory from the PDP sample components custodian annually. The inventory submitted shall include a description of the condition of the PDP sample components (e.g., tamper indicating devices [TID], source insert fixtures, and packing can lifting tool). Digital images of the NDA PDP sample components can be submitted in addition to condition descriptions.**

- Notifying the NDA PDP Coordinator of the need for replacement or repair of any PDP components. If minor repairs to CCOs and related materials are needed, the CFAC may make those repairs with NDA PDP Coordinator approval. This notification must be in writing and approved in writing prior to work being performed. Written notification and approval is preferably by e-mail.

- Returning the CCO or component in accordance with instructions provided by the NDA PDP Coordinator when requested. Replacement parts will be provided by the NDA PDP Coordinator.

- Ensuring proper loading, securing, and packaging of the PDP CCOs and components prior to shipping (see Appendix B for information on shipping and receiving of PDP CCOs).

2.2.3 Sample Preparation Team (SPT)

The SPT is a two-person team consisting of a PDP Standards Custodian and a PDP Standards Configuration Attestant with the following NDA PDP responsibilities:

- Upon initiation of sample preparation for an NDA PDP cycle, participate in a tailgate briefing meeting (or telecom) with the NDA PDP Coordinator or PDP Manager to review instructions, resolve any questions, and identify all required PDP sample components (e.g., insert fixtures, locating pins, PDP standards, and matrix spacers) listed on the CCO PDP Sample Configuration Form (found in Appendix A) prepared by the NDA PDP Coordinator. The purpose of the pre-load examination is to determine if any components are missing or damaged.

- Notifying the NDA PDP Coordinator of any PDP component loss or damage. If the component is a consumable item (such as a TID, form, or matrix spacer), determining if a spare component is available from the site inventory. If so, replacing the missing or damaged component with the spare, documenting the replacement as appropriate, and notifying the NDA PDP Coordinator of the replacement. If no spare is available, contacting the NDA PDP Coordinator for a replacement. Notification must be made in writing, preferably by e-mail. The notification may be made directly to the NDA PDP Coordinator or through direct communication to the CFAC, who will then communicate the notification to the NDA PDP Coordinator.

- Selecting the proper serial-numbered matrix CCO for installation of NDA PDP standards. The PDP Standards Configuration Attestant shall verify that the proper CCO is selected for PDP radioactive standard loading.

- Identifying the correct NDA PDP standards using the applicable NDA CCO PDP Sample Configuration Form (found in Appendix A). The PDP Sample Configuration Form provides the SPT with the PDP standard placement within the CCO.

- Coordinating the placement of the PDP matrix CCO, matrix spacers, NDA PDP standards, and related equipment (such as TIDs) into a designated sample preparation area.

- Assembling the matrix CCO sample following the instructions of the CCO PDP Sample Configuration Forms.

- Emplacing the PDP standards (Source Custodian) and then independently verifying (Attestant) that the source positioning is correct by initialing the PDP Sample Configuration Form. If a PDP sample component is damaged, missing, or misplaced, this information must be reported to the assay coordinator, who will notify the NDA PDP Coordinator.

- Placing a copy of the configuration form inside the imprinted manila envelope and sealing it with a tamper-indicating security seal, inserting the manila envelope into the provided transparent plastic envelope and affixing it to the PDP matrix CCO sample with one of the provided TIDs, and recording the TID number on the NDA CCO PDP Sample Custody Form (found in Appendix A).

- Completing the CCO PDP Excess Standards Form (found in Appendix A) (Source Custodian) and verifying (Attestant) the sources that remain are in storage and are not used as part of the CCO PDP test sample.

- Sealing the Excess Standards Form inside the imprinted manila envelope enhanced with a tamper-indicating security seal; inserting the manila envelope into the provided translucent plastic envelope; securing the plastic envelope at the storage location with one of the provided TIDs; and recording the TID number on the Excess Standards Form. The envelope can be affixed to the outside of the storage location, or inside with the sources, depending on facility protocol. A site-specific security system may be used in place of the supplied TID as long as the prevention of unauthorized access to the unused standards or storage-related documentation can be ensured and documented. The site-specific security system must be approved by the CBFO.

- Affixing (Source Custodian) and then independently verifying (Attestant) the appropriate serialized TIDs on the PDP matrix CCO sample, thereby sealing and securing the test sample for the measurement process. A serialized TID is fed through a hole and affixed to the torque bolt on the CCO locking ring.

- Maintaining the integrity of each prepared NDA PDP sample from the time it is sealed until disassembly. Other than the SPT, no observers are permitted during the PDP

sample preparation process without the prior permission of the NDA PDP Coordinator. The SPT and any observers shall not divulge any information regarding the loading and configuration of the PDP matrix CCOs test sample until the measurement results are released by the CBFO or as indicated by the NDA PDP Coordinator.

- Preparing an NDA CCO PDP Sample Custody Form (found in Appendix A) for transfer of the sample to the facility measurement organization.

- Returning in a free release condition any unused CCO PDP materials to storage and securing the NDA PDP standards storage area with a TID. A site-specific security system may be used in place of the supplied TID as long as the prevention of unauthorized access to the unused standards or storage-related documentation can be ensured and documented. The site-specific security system must be approved by the CBFO.

- Maintaining all records of PDP sample preparation in strict confidence until the CBFO distributes a final report, or as notified by the NDA PDP Coordinator.

- Retrieving the appropriate NDA CCO PDP Sample Custody Form for each PDP sample to be disassembled from the measurement facility at the time the PDP samples are returned for disassembly.

- Determining the condition of the TID that seals the copy of the NDA CCO PDP Sample Configuration Form (found in Appendix A) attached to the CCO sample when the sample is returned from the measurement organization.

- Determining the condition of the TID on the CCO lid locking bolt and of the seal around the locking end cap and the source insert fixture to check for any indication of tampering with the matrix CCO source insert fixtures.

- Disassembling the PDP samples as soon as possible after the return of the samples from the measurement organization, or as instructed by the NDA PDP Coordinator.

- Documenting the sample integrity and correct positioning of PDP standards utilizing the NDA CCO PDP Sample Disassembly Form (found in Appendix A) during disassembly of the sample.

- Submitting completed SPT documents to the CFAC. The CFAC should receive documents and materials within two weeks of the SPT's receipt of the last NDA PDP sample for the cycle from the measurement organization. Submission of these documents is a QA records requirement essential to the successful completion of the cycle.

- **Ensuring that under no circumstances are any modifications performed on the NDA PDP standards or associated equipment.**

2.2.4 Competent Individuals

Competent individuals from K-area will be assigned to witness activities of the SPT in E-area, including the configuration and placement of the TID to secure the CCO prior to the transfer to the measurement organization within K-area. Competent individuals will also include anyone requiring access to paperwork containing information pertaining to the CCO PDP test samples. These competent individuals are required to provide written acknowledgement of their understanding and willingness to maintain the integrity of the single-blind nature of the CCO PDP test samples.

2.3 Measurement Organization

The measurement organization must interface with the NDA PDP Coordinator for all measurement and reporting activities of an NDA PDP cycle in which that organization is involved.

The measurement organization has the following NDA PDP responsibilities:

- Completing initial or updating any existing PDP registration forms for each NDA measurement system to be tested in an upcoming NDA PDP cycle, and sending the form(s) to the NDA PDP Coordinator. The form will include the system name, calibration range, operational limits, and other administrative information affecting NDA PDP testing. Appendix C contains the System Registration Form and instructions for registering a system for the NDA PDP.

- Responding in writing or email to requests from the NDA PDP Coordinator regarding measurement systems that will be participating in upcoming NDA PDP cycles.

- Accepting PDP samples, ensuring adherence to chain-of-custody protocols, and confirming the accuracy of each Sample Custody Form during transfer of the PDP samples from the SPT of the custodial facility.

- Inspecting the condition of the sample seals by checking the TIDs and ensuring they are intact. If a problem exists with the integrity of a TID, the measurement organization shall not accept the sample from the SPT member.

- Reviewing, signing, and dating the Sample Custody Form, provided that the TIDs are intact and the Sample Custody Forms are properly completed. This custodial signature means that the measurement organization accepts the PDP sample for analysis.

- Documenting on the PDP Sample Custody Form accompanying the PDP sample all subsequent transfers of the PDP sample within the measurement group and the return of the sample to the SPT.

- Ensuring that the final signature on the Sample Custody Form is made by the SPT when the PDP sample is accepted by the SPT from the measurement organization for disassembly at the conclusion of assay system measurements.

- Ensuring that the measurement organization performs **six (6) qualified measurements** of each PDP sample using the assay procedures that are implemented for routine waste assays and approved for use in the WIPP waste characterization program. These procedures must have been reviewed and approved by the CBFO.

  NOTE: **A qualified measurement is one that would be determined by the NDA operator to meet the specifications of the approved procedure and would thereby be accepted for review by the expert analyst (EA) as if the measurement were a single measurement obtained on a WIPP-bound waste sample. It is not permissible to select six (6) qualified measurements from a larger set of qualified measurements and submit them as the NDA PDP cycle measurement replicate set. If, during review of results by the EA or other data reviewing personnel, a measurement or other data problem is determined, one of the following must occur: 1) follow a general procedure (not one specified for NDA PDP samples only) that would also be followed for actual waste sample data to address the identified problem, or 2) the measurement organization notifies the NDA PDP Coordinator in writing about the problem for further determination of how to proceed.**

  Use of a secondary or additional measurement mode for obtaining isotopic or other necessary data as prescribed by approved procedure is part of the overall measurement. Thus, any measurement of this type must follow the same requirements noted above.

- Ensuring the PDP sample is completely removed and replaced between each sequential measurement.

- Completing and reporting analyses as soon as possible, except in cases where one or more of the six (6) measurements are judged by the NDA analyst to be non-compliant as a WIPP waste qualified measurement.

- Ensuring PDP equipment is returned in a clean condition that meets DOE free release standards. In the event PDP equipment is contaminated, the NDA PDP Coordinator must be notified in writing immediately. The expectation is that facility decontamination procedures will be followed allowing the PDP components to be returned to free-release condition. In such case that affected PDP components are not returned to free-release condition, the facility or responsible organizations are obligated to provide for the cost of replacement PDP components.

- Identifying instrument failure or operator error in accordance with the same procedure used when analyzing WIPP samples.

  NOTE: If a measurement is determined to be inadequate, contact the NDA PDP Coordinator. It is not acceptable to evaluate for measurement failure by reviewing NDA PDP data and determining the existence of precision problems. If instrument failure or operator error can be identified in accordance with approved procedures, the NDA PDP Coordinator is to be notified and a written summary of the causal factors and corrective actions must be submitted. Based on circumstances, the NDA PDP Coordinator may give permission to repeat one or more of the six-replicate

measurements in the set prior to submitting data on the Nondestructive Assay Performance Demonstration Program Report Form (found in Appendix A).

- Ensuring that a signed measurement report for each replicate analysis of each PDP sample is forwarded to the NDA PDP Coordinator. The Nondestructive Assay Performance Demonstration Program Report Form (found in Appendix A) shall be used to report the data to the NDA PDP Coordinator. Continuation sheets may be used if facility measurement organization comments exceed the allotted space. Completed forms shall be signed by a facility measurement organization staff member, generally the EA. Reports should contain any other sample measurement information deemed relevant by the facility measurement organization. Corrections to data, or data inadvertently omitted from the report form, will be accepted with adequate justification, if the NDA PDP Coordinator is notified before the CBFO approval status notification memorandum (see section 4.2) is issued.

- Ensuring that all analytical reports are received by the NDA PDP Coordinator within 28 calendar days after the cycle start date. The start date is provided in the cycle initiation letter sent to the CFAC by the NDA PDP Coordinator. The NDA PDP Coordinator will send a courtesy copy of the cycle initiation letter to the measurement organization at the same time the letter is sent to the CFAC.

- Completing and reporting analyses as soon as possible following all reviews called for in routine operating procedures. Should these reviews indicate the need for data manipulation commonly allowed by the routine operating procedure that could result in a delay in reporting the results of the analyses, the measurement organization should notify the NDA PDP Coordinator of the cause and duration of any delay. The notification must be followed by a written request for extension of the due date with a proposed new due date. If granted by the CBFO, the extension approval will designate a new due date.

- Ensuring that each NDA PDP report form contains, at a minimum, the following information for each determination:

  - the reporting facility measurement organization
  - system identification (ID) designated during the NDA PDP registration process
  - PDP cycle for which the data are being reported
  - NDA PDP Sample ID from the PDP Sample Custody Form for Nondestructive Assay
  - measurement system and method (including software/hardware configuration version) used for each isotope (measurement systems using constant isotope ratios are to be indicated on the report form)
  - NDA PDP sample measurement replicate number corresponding to the analytical data
  - activity in curies for each isotope identified and quantified from the list in section 5.2
  - total uncertainty for each identified isotope at one standard deviation
  - total ^{239}Pu fissile gram equivalent (FGE) (g) and associated total uncertainty at one standard deviation

- total TRU alpha activity and associated total uncertainty (curies) at one standard deviation
- thermal power and associated uncertainty at one standard deviation (W)
- elapsed counting time
- date and time of sample analysis
- the reason for no value when not reported (e.g., < minimum detectable concentration [MDC])

- Maintaining in a traceable and auditable condition all records generated by the measurement organization during the conduct of an NDA PDP cycle. All such records are QA records that must be maintained in storage conditions and for durations as required by the QAPD and other implementing QA documents and procedures.

3.0 EVALUATION OF PERFORMANCE DATA

3.1 General Criteria

In the NDA PDP, measurement system performance is evaluated using the measurement data precision and bias. Precision is defined as the percent relative standard deviation (%RSD); the standard deviation of the six sequential replicate measurements divided by the known value times 100%. Bias is the systematic error component of the total measurement uncertainty determined as the ratio of the mean of the measurement replicate set to the known value times 100%, or the percent recovery (%R).

The precision acceptance criteria vary as a function of the activity range of the sample. The bias acceptance range does not vary as a function of sample alpha (α) activity. Categorized α activity ranges that apply to the NDA PDP data acceptance criteria are listed in Table 1.

See Appendix D for an explanation of the origins and statistical basis for the precision and bias acceptance criteria.

Table 1. NDA PDP Activity Ranges and Associated Scoring Acceptance Criteria

			Bias Range[c]	
Activity range	Range of sample activity in α-curies[a]	Maximum Measured Precision[b] (%RSD)	Lower (%R_L)	Upper (%R_U)
Mid-High	> 0.2 to 2.0	12	40	160
High	> 2.0	6	40	160

%R = percent recovery
%RSD = percent relative standard deviation

a. Applicable range of TRU activity contained in a PDP sample; units are curies of alpha-emitting TRU isotopes with half-lives greater than 20 years.

b. Measured precision that must be met to satisfy the precision criteria at the 95% upper confidence bound, based on six replicates. The values are one relative standard deviation referenced to the known value for the test.

c. %R_L and %R_U values used in Equation 3 to determine the 95% confidence bound for the ratio of the mean of the measured values to the known value, expressed as a percent.

3.2 Scoring the Test Data Precision

Purpose: To demonstrate compliance with the NDA PDP data acceptance criteria for precision, NDA measurement results from six replicate analyses of an NDA PDP sample of known total TRU α-activity are used to determine measurement system precision.

Criteria: The results reported for total TRU α-activity from the six replicate measurements of an NDA PDP sample shall not exceed the allowable %RSD of Table 1.

Method: The analytical results from the six replicate measurements of an NDA PDP sample are used to calculate the %RSD:

$$\%\text{RSD} = 100\% \times \frac{1}{\mu_0}\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2} \qquad \text{(Equation 1)}$$

where:

x_i = replicate sample value
n = number of replicate measurements
μ_0 = actual known PDP sample value
$\bar{x}$ = replicate sample mean, defined by

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{(Equation 2)}$$

The measured %RSD is compared with the applicable limits listed in Table 1. If the %RSD value determined from the measurement data is less than or equal to the total TRU α-activity range-specific value in Table 1, the measurement system passes the precision test for that sample.

Actions: Any sample for which results exceed the appropriate acceptance criterion for precision will be scored as failed. The impact of failing an acceptance criterion is given in section 4.1. In accordance with section 4.1, the measurement organization is responsible for ensuring that appropriate corrective actions are taken.

3.3 Scoring the Test Data Bias

Purpose: NDA results for replicate analyses for NDA PDP samples of known TRU α-activity are used to determine the bias associated with measurement system determinations of total TRU α-activity. In the NDA PDP, the total bias determined using the six replicate measurement results includes components attributable to both variance and bias, including effects due to sample matrix configuration and nuclear material characteristics.

Criteria: The results reported for total TRU α-activity must make true Equation 3.

Method: Measurement system bias shall be evaluated by calculating the sample mean of the six sequential replicate measurements of the NDA PDP sample.

For evaluation of sample-specific measurement system bias limits, the Student's *t*-distribution

$t_{0.975}$ percentile value is used in conjunction with the sample mean ($\bar{x}$ as defined in Equation 2), the percent relative standard deviation (%RSD of the sample replicates as defined in Equation 1), and the appropriate lower and upper bounds (%R_L and %R_U) in columns 4 and 5 of Table 1. The equation that establishes the bias acceptance criteria is expressed as:

$$\left(\%R_L + 1.049 \times \%RSD\right) < \left(100\% \times \frac{\bar{x}}{\mu_0}\right) < \left(\%R_U - 1.049 \times \%RSD\right) \qquad \text{(Equation 3)}$$

where:

%R_L = low percent recovery limit specified in Table 1
%R_U = upper percent recovery limit, specified in Table 1
$\bar{x}$ = replicate set average (sample mean), defined in Equation 2
μ_0 = actual known PDP sample value

The measurement will pass the bias acceptance criterion if Equation 3 is satisfied and will fail if Equation 3 is not satisfied.

Actions: If any measurement system produces results that do not satisfy the appropriate acceptance criterion for bias, then that NDA system will be scored as failed for that sample. The impact of failing an acceptance criterion is given in section 4.1. In accordance with section 4.1, the measurement organization is responsible for ensuring that appropriate corrective actions are taken, if deemed necessary, initially by the measurement organization or subsequently by the CBFO.

4.0 WIPP QUALIFICATION BASED ON NDA PDP TEST PERFORMANCE

4.1 General Considerations

The primary purpose of the PDP is to independently acquire data from participating NDA measurement systems for the evaluation of the system and facility measurement organization's capability to produce data that meet the quality requirements for the WIPP, and to reveal any technical or QA-related deficiencies that may negatively impact the characterization of WIPP wastes. Through NDA PDP evaluations, information is gathered on system performance; NDA measurement organization management of quality processes; NDA procedural adequacy, effectiveness, and implementation; corrective action effectiveness; and overall data quality assurance. Finally, the NDA PDP functions to provide technical justification to the CBFO for approving (conditionally or without condition) or disapproving NDA measurement systems, procedures, and organizations for making qualified WIPP waste NDA measurements.

The procedures and measurement system parameters used to analyze NDA PDP samples are to be the same as those used in the analysis of WIPP wastes. Due to the fact that NDA PDP samples are analyzed six separate times (unlike WIPP waste samples), the procedure for conducting these replicates will be unique to the NDA PDP. Because count time determinations for NDA PDP samples are directly related to the precision of the results and are scored against NDA PDP criteria, the NDA PDP sample count times must have a direct, procedural correlation with count time determinations for WIPP waste samples. Acceptable Knowledge (AK) does exist with respect to NDA PDP samples (e.g., matrix type, nominal density, and fill height).

Thus, when the PDP sample AK corresponds to actual waste AK, in which count time protocol is specified or formulated, the count time protocol must also be applied to the NDA PDP samples. Any deviations from such protocol must either have a real waste sample procedural justification or specific and documented approval from the CBFO.

The CBFO determines the approval status of a measurement organization's NDA measurement capability for any individual measurement system based on passing or failing NDA PDP scoring criteria. A passing or failing score for a given criterion of the NDA PDP is related to the characteristics of the PDP sample analyzed and is therefore subject to evaluation based upon all of the following specifics of the test: 1) the measurement system; 2) the sample matrix; 3) the activity type; 4) the activity range; and 5) the particular scored parameter (bias or precision). Thus, a pass or fail in the NDA PDP has specific, though potentially broad, technical and programmatic ramifications.

Obtaining a passing score on all criteria for all samples presented to an NDA measurement system within an NDA PDP cycle provides the CBFO with the evidence and justification for not imposing any restrictions upon WIPP measurements made by that NDA measurement system during the approval period. Any restrictions that have not been addressed by the measurement organization through the CBFO-approved corrective action, recalibration, etc., continue as restrictions upon the system through the subject cycle approval period. Approval is based upon the use of the measurement organization's CBFO-approved procedures for samples that exhibit characteristics within the approved system's various parameter calibration ranges.

A failure of an NDA measurement system to meet one or more of the scoring criteria may require investigation of the cause of that failure. It is the responsibility of the affected measurement organization, with assistance and oversight by the NDA PDP Coordinator and other CBFO technical support staff, to establish the most likely cause(s) for its failure. The timeframe in which the cause(s) of failure investigation must be identified will be dictated by the circumstances and cause of the failure. Causal analysis must be conducted in accordance with procedure and entered into relevant issues management database to track through closure. Once the cause is reviewed and concurred upon by the CBFO, it must be evaluated for potential effect upon WIPP waste analyses. It is incumbent upon the participating measurement organization to demonstrate through technical justification the impact that an NDA PDP criterion failure has on WIPP waste measurements. The CBFO is the final authority on establishing this impact determination.

If the measurement organization can demonstrate that the cause of an NDA PDP criteria failure has no impact on routine WIPP waste analyses, no restrictions will be placed upon the system. Based on the cause of failure, the CBFO may determine that multiple measurement systems within the organization should be restricted. The timeframe for the restriction will be dictated by the circumstances and cause of the failure. Restrictions may include disapproval of all measurements made by the system or may involve conditional approval restricting the system from performing measurements for WIPP based on certain waste parameters such as waste types, activity types, activity levels, waste densities, measurement modes within an NDA measurement system, or any other reasonable restriction that is determined through the root cause process as technically justified for prevention of unacceptable data quality for meeting the WIPP waste acceptance criteria.

As specified in section 4.2, the CBFO will provide a written approval status notification memorandum documenting approval, disapproval, or conditional approval. The approval status notification memorandum will provide the basis for any restrictions. For conditional approvals, the approval status notification memorandum will specify the restrictions that are imposed by the CBFO.

If a system has been conditionally approved or not approved, the measurement organization may choose to take one of the following courses of action:

- Accept the conditional approval or disapproval with no further action.

  NOTE: Accepting disapproval will require the measurement organization to halt the use of the system for performing qualified NDA measurements on WIPP waste until the system can be approved or conditionally approved. Likewise, accepting conditional approval limits the system to making qualified WIPP measurements only on samples meeting the specified conditions of the approval.

- Challenge the conditional approval or disapproval with additional data and other technical justifications for a change in the CBFO approval status.

- Initiate a corrective action to eliminate the causes for the condition adverse to quality that resulted in the NDA PDP failure, and, if necessary, request a supplemental cycle.

If the measurement organization chooses to initiate corrective actions, it must:

1. Identify the basis of the failure that addresses all contributing components, technical and/or administrative, and submit them in a corrective action plan (CAP).

2. Obtain the CBFO approval of the CAP.

3. Implement the CBFO-approved CAP and provide evidence that the plan effectively addresses the deficiency and the actions are completed in a corrective action report (CAR).

4. Obtain final CBFO approval, conditional or otherwise, to process WIPP wastes after completion of the CAR.

The CBFO or the measurement organization may require, through the CAP, analysis or additional measurements of NDA PDP test samples as part of the verification that the corrective actions are effective.

If the CBFO determines that the measurement organization is not responsive or is not adequately addressing a condition adverse to quality that has been determined through its participation in the NDA PDP, the CBFO may formally request a corrective action.

4.2 Approval Status

Once the CBFO has determined a measurement organization's measurement systems and methods status as "approved," "conditionally approved," or "not approved," such status shall remain in effect until the CBFO is presented justification to change that status. All measurement systems must participate in the PDP cycle annually in order to remain qualified to perform WIPP analyses. Measurement systems obtaining approval status through a supplemental cycle must participate in the next regular primary cycle for reevaluation of their approval status. This participation could change the approval status of a system and will reset the 13-month approval period as stated below.

The approval period for a measurement system begins with the date that signed data reports from an NDA PDP cycle are received by the NDA PDP Coordinator. At the end of the 13th month, a system that has not yet successfully completed the analyses of NDA PDP samples to re-qualify may choose to proceed at risk with WIPP analyses, or to cease operations. Data generated at risk cannot be used for characterizing waste for shipment to the WIPP until:

- The system and methods used to collect and process the data satisfy the CBFO through successful NDA PDP sample measurement performance, and

- The data obtained during the "at risk" period have been reconciled through the disposition of a nonconformance report.

The CBFO approval status notification memoranda are sent to the corresponding DOE Operations Office involved, the participant measurement organization, the U.S. Environmental Protection Agency, and other relevant stakeholders as deemed appropriate by the CBFO.

4.3 Scoring Report

The NDA PDP Coordinator shall review, evaluate, and score the reported data results for all facility measurement organizations and participating NDA measurement systems and compile them into a scoring report. The cycle-specific scoring report is normally scheduled for delivery to the CBFO within approximately four weeks after the final data are received from all participants in the cycle, including receipt of revised data as a result of corrective actions. The report shall include the values reported by the measurement organization, the reference activity values, the acceptance ranges, the pass-fail status of each individual NDA measurement system, and the CBFO approval status of each participating NDA system.

Copies of the scoring report are distributed to each of the DOE Operations Offices involved in the NDA PDP cycle being reported, each of the participating measurement organizations, and other individuals and organizations deemed appropriate by the CBFO. Distribution will be in an electronic format.

5.0 NDA PDP MATERIAL COMPONENTS

5.1 General

Without written permission by the CBFO, the CCO PDP matrix or NTP standards are not to be used for any activity other than the performance of the NDA PDP. Written requests for any other uses must be submitted to the CBFO specifying each use requested or requesting an ongoing protocol for usage after approval by the CBFO. If the request is for ongoing usage, a system for accountability must be submitted for the CBFO approval. The CBFO will provide written approval or disapproval of the request.

Under no circumstances are the NDA PDP standards to be used for measurement system calibration. **Under no circumstances are any modifications to be performed on the NDA PDP standards** (see section 2.2 for custodial facility responsibilities regarding the NDA PDP standards).

The custodial facility is responsible for assigning a secure storage area for all NDA PDP components and meeting applicable safeguards, security, and safety requirements (see section 2.2 for custodial facility responsibilities regarding the non-radioactive NDA PDP components). In addition, Appendices B and F contain details about the non-radioactive NDA CCO matrix components and provide details regarding shipment, receipt, and use of NDA materials.

5.2 NTP Working Reference Material (WRM) Standards of the NDA PDP

^{239}Pu is the primary isotopes evaluated under the NDA CCO PDP Plan and is subject to scoring as specified in this plan.

Refer to Appendix E for the general specifications of the NTP Working Reference Material (WRM) standards (also referred to as PDP standards) in the current NTP WRM inventory. Detailed information and data concerning the specification, design, fabrication, and traceability for each standard manufactured in each NTP WRM production phase is provided in its respective production plan document (LAUR-96-2277, LAUR-98-213, LA-CP-00-54, LA-CP-00-110, LA-CP-01-208, LA-CP-03-0072, and LA-CP-03-0763). The production reports are considered proprietary information for the NDA PDP. Seven different PDP standard production campaigns were completed. Each campaign produced NDA PDP standards with differing nuclear material content. As indicated in Table 2, only three of the production campaigns include NTP WRMs applicable to the NDA CCO PDP.

Table 2. NDA PDP Standard Inventory

	Type of Activity	Production Phase
1.	Weapons-grade plutonium (low mass set)	Phase I
2.	Weapons-grade plutonium (high mass set)	Phase II.A
3.	Large particle size weapons-grade plutonium	Phase II.B

6.0 PROCUREMENT

Procurement activities necessary for conducting the NDA PDP must comply with the QAPD. In accordance with the QAPD, the responsible purchasing organization maintains all procurement documents and performs all procurement activities.

7.0 TRAINING

Each organization involved in the implementation of the NDA PDP shall meet the training requirements of the QAPD. Organizations shall retain on file evidence that: 1) personnel have the necessary program documents (controlled or uncontrolled, as applicable) for their use, and 2) personnel have read and understand program-governing documents pertinent to their duties in support of the NDA PDP. At a minimum, these documents include applicable portions of the QAPD, the WAC, and this plan.

Training for the NDA PDP SPT will be conducted for the host site prior to their involvement. The training will be conducted using an approved training plan. Successful completion of the training will result in issuance of a Certificate of Qualification by the NDA PDP Coordinator that indicates the NDA PDP qualifications of the trained individual. The essential training elements for the SPT are as follows:

- Overview of the NDA PDP
- NDA PDP Program Coordination
- NDA PDP Participating Site Responsibilities
- NDA PDP Test Sample Description and Assembly
- NDA PDP Sample Control
- NDA PDP Sample Preparation Responsibilities
- NDA PDP Sample Preparation
- NDA PDP Test Sample Custody
- NDA PDP Test Sample Analysis and Reporting
- NDA PDP Test Sample Return and Disassembly
- NDA PDP Records

Reading material is provided for the initial training through correspondence with the NDA PDP Coordinator. A test is integrated into the training module and must be passed with a proficiency of 90% or better before proceeding. Upon successful completion of the initial training, the trainee will participate in hands-on cycle activity training at the respective site. This hands-on training is presented by the custodial facility PDP standards custodian or another individual who has successfully completed the training and has performed the function of an SPT member on a previous cycle. Once the hands-on training is successfully accomplished, the certificate is completed and signed by the NDA PDP Coordinator. Copies of the training certificate are distributed as QA records. Once the certificate is completed and signed by the NDA PDP Coordinator, the individual is qualified to conduct the NDA CCO PDP activities indicated on the certificate.

8.0 QA RECORDS

Records generated by the NDA PDP and participating sites during the conduct of a PDP cycle are QA records. All NDA PDP cycle documentation must be maintained in a traceable and auditable condition. Storage conditions and duration must meet the requirements of the QAPD and other implementing QA documents and procedures. The records generated during an NDA PDP Cycle are submitted to the CBFO for retention in the records repository after completion of the cycle. A working copy of files may be maintained for reference.

The minimum QA records for the NDA PDP are identified and listed below in accordance with the QAPD requirements. In addition, the CBFO and/or the NDA PDP Coordinator may determine that records of other program activities are QA records and enter them into the QA records system with the same level of control and maintenance.

These QA records may be organized by NDA PDP Plan revision, by NDA PDP cycle, or by other principle, as applicable. These records are nonpermanent records and shall be maintained in accordance with the QAPD requirements. Records disposition, when applicable, will be in accordance with the CBFO requirements, approved procedures, and work plans.

All QA records identified in this plan shall be stored in accordance with records storage requirements in the QAPD. Access to QA records will be limited to personnel involved in the program or having related QA or records custodian responsibilities.

The following documents will be maintained as QA records for the NDA PDP:

- PDP plans (all revisions)
- Procurement records
- Radioactive standard and matrix CCO design and production records (each CCO and PDP standard production phase)
- SPT training (training materials, test records, certificates)
- Assay System Registration Forms
- Records of cycle set-up (notification letters, shipping records, and other correspondence)
- Participant assay reports and supporting forms (assay data report forms, chain-of-custody records, and configuration forms)
- Scoring reports
- Reviews of corrective actions and supporting data and recommendations made to the CBFO

The following matrix of QA records provides a more detailed listing of records and designates responsibility for maintenance.

NDA PDP Documentation/Records List

Document(s)	QA Record	Storage Location	Comments
1. PDP Plan revisions	Yes	CBFO	For each revision.
2. PDP Plan revisions — comments and resolutions	Yes	CBFO	For each revision.
3. SPT training records - Tests - Qualification certificates	Yes	CBFO	Formally transmitted to the CBFO by NDA PDP Coordinator on completion of all cycle-specific activities.
4. Approval from the CBFO for schedule and participants	Yes	CBFO	Letter or hard copy of e-mail(s).
5. Participant NDA PDP program documentation - Procedures - Raw data - Calibration records - Training records	Yes	Participant	These should be exactly the same as are maintained/generated in waste characterization activities; required by the WAC and PDP Plans.
6.- Signed acknowledgement documentation by competent individuals	Yes	CBFO	Formally transmitted to the CBFO by NDA PDP Coordinator on completion of all cycle-specific activities.
7. Correspondence to participants providing instructions for execution of an NDA PDP cycle	Yes	CBFO	Copies to the CBFO and CTAC.
8. Sample configuration instructions accompanying notification	Yes	CBFO	Developed by the NDA PDP Coordinator. Confidential until completion of cycle.
9. Documentation of the tailgate briefing meeting	Yes	CBFO	Developed by the NDA PDP Coordinator.
10. Participant correspondence requesting time extension for submitting results	Yes	CBFO	As required by PDP Plans, printed copies of e-mails to the NDA PDP Coordinator.
11. Responses to extension requests	Yes	CBFO	Responses issued by the CBFO.
12. Participant data packages with cover letters (including any revisions and corrections to data) - Assay data report forms - Chain-of-custody records - Configuration forms - Disassembly forms	Yes	CBFO	Formally transmitted to the CBFO by NDA PDP Coordinator on completion of all cycle-specific activities.

Document(s)	QA Record	Storage Location	Comments
13. Scoring report	Yes	CBFO	Formally transmitted to the CBFO/CTAC file copy. The CBFO approves distribution by the NDA PDP Coordinator.
14. Records of QA review of scoring report	Yes	CBFO	Formally transmitted to the CBFO/CTAC file copy.
15. Memoranda issued by the CBFO to provide status notification to participants	Yes	CBFO	CTAC maintains a file copy.
16. Transmittal letter with cycle-specific records	Yes	CBFO	Transmitted upon completion and receipt of all cycle records.
17. Current document, software revision list, and software verification and validation documentation	Yes	CBFO	Required by the CBFO QAPD.
18. NDA PDP procedure	Yes	CTAC	CBFO reviews to ensure procedure meets the CBFO requirements.
19. Participants' reports of corrective actions	Yes	CBFO	Submitted to the CBFO.

9.0 GLOSSARY

BIAS – The systematic error component of the total uncertainty, that is, a constant positive or negative deviation of the method average from the correct value or an accepted reference value under specific measurement conditions. The percent recovery (%R) in the NDA PDP summary report includes both systematic (bias) and non-systematic (precision) uncertainty.

CONDITIONAL APPROVAL – Based on circumstances during a PDP cycle, CBFO may grant a "conditional approval" which stipulates conditions to be addressed. Measurement organizations with a conditional approval are at risk of being not approved if they fail to meet any of the conditions laid out by the CBFO.

CORRECTIVE ACTION – Measures taken to rectify conditions adverse to quality and, where necessary, to preclude their recurrence.

CUSTODIAL FACILITY – The physical and organizational entity responsible for the storage, care, and proper handling of NDA PDP materials during cycle activities and when not in use for NDA PDP activities.

CUSTODIAL FACILITY ASSAY COORDINATOR – The facility point-of-contact responsible for receipt of the cycle notification letter, proper sample preparation team (SPT) documentation, and return of the SPT documentation to the NDA PDP Coordinator in a timely manner. A CFAC can be an active participant in the NDA PDP cycle as an SPT member.

HOST SITE – The Savannah River Site (SRS) is the location for CCO operations, including PDP resources; DOE Office of Environmental Management (EM) provides oversight of SRS operations and the work performed by SRS contractors.

INACTIVE SYSTEM – A CBFO-approved and operational NDA system not being used to characterize WIPP wastes for the NTP at the time a primary NDA PDP cycle is conducted.

CCO MATRIX – One or two ten inch tall by five-inch diameter cans. These are subsequently placed into a six-inch stainless-steel pipe (the Criticality Control Container [CCC]) centered in a standard 55-gallon drum. Each CCO can be loaded up to a limiting value of 380 Pu-239 Fissile Gram Equivalent (FGE) per the WIPP Waste Acceptance Criteria which defines that limit as the measured value plus two times the total measurement uncertainty.

MEASUREMENT ORGANIZATION – The entity responsible for the assay of NDA PDP samples and TRU waste for disposal at WIPP. Frequently this entity is not the same company or entity that functions as the custodial facility or site facility contractor. Central Characterization Program (CCP) personnel are responsible for the measurement organization support to the Surplus Plutonium Downblend (SPD) at the Savannah River Site (SRS).

MEASUREMENT SYSTEM – The individual NDA instrument that has received a unique NDA PDP registration number. A measurement system may function with various independent modes of assay.

NDA PDP COORDINATOR – An individual responsible for coordinating the technical operations of the NDA PDP, including designation of NDA PDP cycle-specific sample component configuration, procurement of materials and services required for replacement and/or manufacture of new NDA PDP sample components (i.e., NDA PDP matrix CCOs, and consumables), SPT oversight, scheduling NDA PDP cycles, scoring NDA PDP data received from participants, summary report generation, and preparation of other NDA PDP-related CBFO documents as directed and for approval by the CBFO PDP Appointee.

NDA PDP SAMPLE – A blind sample prepared and sealed by the SPT for subsequent analysis by a measurement system for qualification under the PDP. A PDP sample for the NDA CCO PDP is comprised of a 55-gallon matrix CCO and PDP standards installed in accordance with instructions received from the NDA PDP coordinator. Sample matrix and source characteristics will representatively span nominal WIPP waste characteristics expected to be received for characterization by the measurement organization including, but not limited to, isotopics, plutonium concentration, (α,n) reactions, interfering matrices, and source distribution.

NDA PDP STANDARD – A radioactive source specifically designed, prepared, or acquired and certified for the NDA PDP.

NONDESTRUCTIVE ASSAY – Assay methods for waste items that do not affect the physical or chemical form of the material. NDA is a non-invasive technique relying on a measurement or series of measurements of emitted radiations from the waste container which are then correlated through calibrations or dynamic efficiency to provide a measure of the radionuclides present in the waste. Typical examples of NDA methodologies include gamma spectroscopy, passive/active neutron measurements, multiplicity or coincidence counting, dose-to-curie, and calorimetry. NDA for the PDP includes gamma and neutron techniques only.

PDP APPOINTEE – An individual within the CBFO designated for the oversight of the PDP and assigned individual review and approval authority for the PDP.

PDP MANAGER – An individual within the Program Coordinator organization responsible for overall performance of the PDP.

PDP STANDARDS CONFIGURATION ATTESTANT – A member of the two-person SPT responsible for verifying the proper configuration of the NDA PDP sample, including emplacement of NDA PDP standards and sample security-related procedures.

PDP STANDARDS CUSTODIAN – The lead member of the SPT responsible for coordination of on-site NDA PDP sample preparation activities and handling of PDP standards during sample assembly and disassembly.

PRECISION – A measure of the variance among individual measurements of the same property made under prescribed conditions. Precision is represented in NDA PDP summary reports as a percent relative standard deviation (%RSD).

PRIMARY CYCLE – The annual NDA PDP cycle. The primary cycle is included in the Program Coordinator's master project schedules for the NDA PDP and occurs at approximately the same time each year to ensure a site receives the opportunity to gain NDA PDP approval every 12 months.

PROGRAM COORDINATOR – A CBFO-designated organization that administers and coordinates PDP functions. The Program Coordinator will designate the PDP Manager.

SAMPLE PREPARATION INSTRUCTIONS – Paperwork generated by the NDA PDP Coordinator for each facility measurement organization for each NDA PDP cycle that provides instructions to the SPT on configuration of the NDA PDP sample (i.e., emplacement of NDA PDP standards within a specified configuration NDA PDP CCO).

SAMPLE PREPARATION TEAM – A two-person team, consisting of an NDA PDP Standards Custodian and PDP Standards Configuration Attestant, that prepares and certifies NDA PDP samples for a given custodial facility. The SPT is responsible for ensuring that each NDA PDP sample is prepared according to the NDA PDP sample preparation procedures provided by the NDA PDP Coordinator. In addition, the SPT ensures proper disassembly and return to storage of all NDA PDP components after analysis by the facility measurement organization.

SUPPLEMENTAL CYCLE – An NDA PDP cycle in addition to the annual primary NDA PDP cycle. Reasons that a supplemental cycle may be necessary include accommodation of measurement facilities unable to participate in the primary cycle, to support implementation of new or modified measurement systems, or to perform specific testing as directed by the CBFO. Additional supplemental cycles may be conducted on an as-needed basis at the CBFO direction.

TOTAL MEASUREMENT UNCERTAINTY – The propagated measurement error potential from all bias and precision sources including interference effects such as variable matrices, isotopic compositions, spatial distributions, contaminating radionuclides, and others.

10.0 REFERENCES

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Xymat Engineering Certificate of Conformance, Pantex PO 516193, drawing J21012-01, March 8, 2021.

Appendix A

NDA CCO Performance Demonstration Program Forms

Appendix A
NDA CCO PDP Forms

This appendix contains forms that are essential to the conduct and QA record of the CCO PDP cycles. Six forms are included – the purpose of each is described below. The forms are to be completed while performing the associated activities during the PDP cycle. Each of the forms is referenced in the body of this plan in section 2.0, Organization and Responsibilities.

1. The **Nondestructive Assay CCO PDP Sample Configuration Form** is the primary instruction document provided to the SPT by the NDA PDP Coordinator for the purpose of assembly and documented disassembly of a cycle test sample. This form is initiated by the NDA PDP Coordinator for instruction purposes but becomes one of the primary QA record documents as it is completed by the SPT during stages of the CCO PDP cycle. The signatures on the form confirm the correct source and positioning by the PDP Source Custodian and Standards Configuration Attestant. The PDP Standards Configuration Attestant independently verifies that the proper sources were selected and documents the correct positioning of each (either Top or Bottom packing can) by initialing each during assembly and signing the configuration form. The documentation on this form provides essential evidence that the proper PDP standards were placed in the positions as originally designated on the form. Any discrepancies from the original instruction discovered during disassembly must be documented for QA purposes. The completed form is a QA record that must be returned to the NDA PDP Coordinator upon disassembly of the sample as soon after the sample is returned to the SPT as is reasonable.

2. The **Nondestructive Assay CCO PDP Excess Standards Form** is used to identify the NTP sources that are not being used in the PDP measurement cycle and to account for that portion of the source inventory that must be secured in order to maintain the integrity of the sample. The documentation on this form provides essential evidence that the excess PDP standards are secured. The completed form is a QA record that must be returned to the NDA PDP Coordinator upon disassembly of the sample as soon after the sample is returned to the SPT as is reasonable.

3. The **Nondestructive Assay CCO PDP Sample Custody Form** is utilized by the SPT and the measurement organization to indicate the time during which each entity is in control of the sample. This document is initiated by the SPT and completed by the SPT upon disassembly. The measurement organization is responsible for the integrity of the CCO PDP samples during the time that the sample is in their possession. The custody form is to be signed and dated by a representative of the measurement organization for that period of sample possession. The completed form is a QA record that must be returned to the NDA PDP Coordinator upon disassembly of the sample as soon after the sample is returned to the SPT as is reasonable.

4. The **Nondestructive Assay CCO PDP Sample Disassembly Form** must be completed by the SPT. The completed form provides evidence that the sample was prepared and maintained in accordance with the instructions throughout the duration of the NDA testing process. The completed form is a QA record that must be returned to the NDA PDP Coordinator upon disassembly of the sample as soon after the sample is returned to the SPT as is reasonable.

5. The **Nondestructive Assay PDP Report Form** contains the headings and spaces for the essential information required by the NDA PDP for each measurement of a test sample. This form must be utilized by the measurement organization to present the information to the NDA PDP Coordinator once all data reviewed by the measurement organization is complete. One Nondestructive Assay PDP Report Form is required for each CCO PDP sample analyzed and for each NDA measurement system used to analyze the sample. The completed forms, signed and dated, are QA records of the CCO PDP cycle.

6. The **NDA PDP Participating Facility Contacts Form** is provided for convenience, to be utilized by the CFAC or supervisor thereof, to supply the NDA PDP Coordinator with the names and contact information of those individuals who have responsibility for the conduct and management of the NDA PDP at the WIPP waste packaging and measurement facility. Section 2.0, Organization and Responsibilities, in the CCO PDP Plan provides the activity expectations of the personnel assigned to the NDA PDP functional titles. In some cases, one individual could function in more than one titled capacity. Though this contact information is essential to the conduct of the NDA PDP, the completed document is not an NDA PDP QA record.

NDA CCO PDP Sample Configuration Form

Facility Name:		
PDP Cycle No.:	PDP Distribution (Mo/Yr):	PDP Sample ID:
Matrix Drum Serial No.:	Matrix Type: CCO	TID No.:

Authorized: _____ _____
NDA PDP Coordinator Date

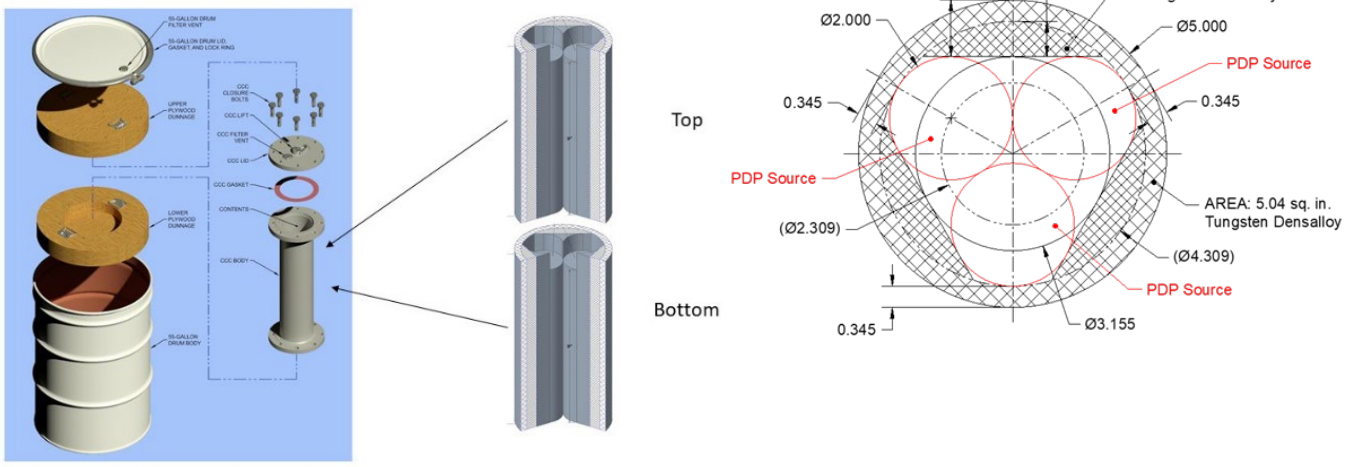
PDP Standard ID	Contents of Standard			Placement	SPT Attestant Initials
	Primary Nuclear Materials	Mass (g)	Units	Packing Can Position. (Top or Bottom) [a]	
				Bottom	
				Bottom	
				Bottom	
				Top	
				Top	
				Top	
Total:			g		

Notes: a. CCO is comprised of a Top packing can and a Bottom packing can, each of which will accommodate up to three PDP sources. (See figure below.). Radial placement of each source is not specific. For purposes of the PDP, the CCC lid may be secured with 4 bolts and the gasket is not necessary.

Signatures:

Standards Configuration Attestant: _____ _____
Printed Name / Signature Date

PDP Standards Custodian: _____ _____
Printed Name / Signature Date



NDA CCO PDP Excess Standards Form

Facility Name:		PDP Sample ID:
PDP Cycle No.:	PDP Distribution (Mo/Yr):	TID No.:

PDP Standard ID	Contents of Standard			SPT Attestant Initials
	Primary Nuclear Materials	Mass (g)	Units	
Total:				

Signatures:

Standards Configuration Attestant: _____ _____
Printed Name / Signature Date

PDP Standards Custodian: _____ _____
Printed Name / Signature Date

NDA CCO PDP Sample Custody Form

CCO Serial No.: _____ Preparation Area _____

PDP Sample No.: _____ TID Serial Number(s):_____

Distribution Cycle Number: _____

Comments: _____

_____

_____

_____

Sample Preparation

_____ _____
PDP Standards Custodian Date

Attestant Initials

Standards properly placed: _____

Matrix CCO TID properly sealed: _____

Sample information form attached and sealed: _____

_____ _____
Standards Configuration Attestant Date

Relinquished by:	Date/Time	Received by:	Date/Time

Final Disposition by:	Date/Time	Disposition
Signature_____ Printed Name_____		Disassembled

White: NDA PDP coordinator copy on final disposition
Canary: SPT copy on final disposition
Pink: NDA PDP coordinator copy
Gold: SPT copy

NDA CCO PDP Sample Disassembly Form

PDP Cycle No.:	PDP Sample ID:
CCO Serial No.:	TID Serial Numbers:

Sample Disassembly Record

Sample Disassembly Date: _____

Condition of Seals and Standards

Configuration Form attached and sealed: Yes ☐ No ☐
Container TID(s) properly sealed: Yes ☐ No ☐

Standards properly placed (Cross out if not applicable):

Top Packing Can

Source 1 Yes ☐ No ☐ PDP Standard ID: _____
Source 2 Yes ☐ No ☐ PDP Standard ID: _____
Source 3 Yes ☐ No ☐ PDP Standard ID: _____

Bottom Packing Can

Source 4 Yes ☐ No ☐ PDP Standard ID: _____
Source 5 Yes ☐ No ☐ PDP Standard ID: _____
Source 6 Yes ☐ No ☐ PDP Standard ID: _____

Comments:

_____
_____
_____
_____

Signatures:

PDP Standards Attestant: _____ _____
Printed Name / Signature Date

PDP Standards Custodian: _____ _____
Printed Name / Signature Date

Nondestructive Assay Performance Demonstration Program Report Form

Assay Facility: _____ NDA System:_____

PDP Cycle: _____ Replicate: _____ of _____

CCO Serial No.: _____ PDP Sample ID: _____

Final Result Summary

Parameter	Final Result	Total Uncertainty (One Standard Deviation)
Total ^{239}Pu fissile gram equivalent (g)		
Total TRU alpha activity (curies)		
Thermal Power (W)		

Method Summary

	Identification	Classification	Associated SOP Identification (Including Revision No.)	Count Time (min)	Analysis	
					Date	Time
Method 1						
Method 2						
Method 3						

Individual Isotope Data

Isotope	Activity Result	Uncertainty (1sd)		Quantification Method				Method Number (From Summary)
		Count	Total	Direct	Ratio	Scaling Isotope	Ratio Value	
^{238}Pu								
^{239}Pu								
^{240}Pu								
^{241}Am								

Comments:

_____

_____

_____

Approval: _____ _____ _____
Signature Title Date

_____
Printed Name

Example NDA PDP Participating Facility Contacts

NAME	MAIL ADDRESS	PHONE / CELL / E-MAIL	NOTE
DOE Contacts			
Custodial Facility Management Contacts			
Operations		Phone: E-mail: Cell:	
Special Nuclear Material Custodian		Phone: E-mail: Cell:	
Custodial Facility NDA PDP Function Contacts			
Assay Coordinator			
		Phone: E-mail: Cell:	
Components Custodian			
		Phone: E-mail: Cell:	
PDP Standards Custodian			
		Phone: E-mail: Cell:	
PDP Standards Configuration Attestant			
		Phone: E-mail: Cell:	

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Appendix B

Shipment and Receipt of NDA PDP Materials

Appendix B
Shipment and Receipt of NDA PDP Materials

This appendix describes the policies and some processes of shipping and receiving of NDA PDP materials. This appendix is not meant to be all inclusive of the requirements that will be encountered for movement of NDA PDP materials. In addition to these policies and process guidelines, the shipment and receipt of all NDA PDP materials must meet federal, state, and facility requirements for both the shipping and receiving facility.

B.1 GENERAL

The NDA PDP Coordinator shall coordinate any transfers of NDA PDP materials between sites and no transfers will occur without written approval from the CBFO. The NDA PDP Coordinator will provide the transferring facility with the necessary contact information (names, phone numbers, e-mails, and physical addresses) for the receiving facility. The current custodial facility will notify each receiving site contact prior to the shipping date for NDA PDP materials. The materials will be sent to the address and individual designated by the receiving facility.

The CFAC at each facility shall notify the NDA PDP Coordinator in writing (e-mail is acceptable) of any changes in contact personnel.

B.2 PDP SURROGATE WASTE MATRIX CCOs

The matrix CCOs are used with the PDP standards to create test samples containing matrix materials representative of surplus Plutonium downblend waste. These matrix materials are contained within the PDP matrix CCO in a manner replicating the nominal properties of an actual waste matrix type for material composition, density, and density distribution. In this manner, the CCO matrix surrogates replicate the physical properties of real waste forms and manifest perturbations in the response of NDA measurement systems, as do actual wastes.

Refer to Appendix F for general information on the PDP matrix CCO design and configuration. Detailed information regarding the specification, design, and as-built data for the NDA PDP matrix CCOs is provided in the Nuclear Waste Partnership specification drawing CCO-DWG-001.

B.3 RECEIPT OF NDA PDP MATRIX CCOS AND COMPONENTS

On receipt of NDA PDP matrix CCOs and components, the PDP sample components custodian shall:

- Verify that the serial numbers and physical descriptions of the NDA PDP matrix CCOs and associated components received match those listed on the shipping manifest.

- Verify that the matrix CCOs and/or ancillary components have not been damaged during shipping. Where shipping manifest discrepancies are noted or damage is found, the assay coordinator and/or the SPT shall secure the items and the assay coordinator and/or the SPT shall notify the NDA PDP Coordinator. If no discrepancy or damage is found, the

assay coordinator shall notify the NDA PDP Coordinator in writing or by e-mail that the shipment was received in acceptable condition.

B.4 TRANSFER OF NTP WRM STANDARDS (PDP STANDARDS)

All transfers of NTP WRM standards must have prior written approval from the CBFO. Before shipment of PDP standards, each receiving custodial facility will make appropriate arrangements with the facility's safeguards and radiation safety organizations for storage and accountability. Generally, the designated PDP standards custodian will coordinate with the site safeguards staff to comply with all site special nuclear material (SNM) requirements. All shipping details and arrangements will occur between the trained staff of the DOE facilities of both the shipping and receiving entities. The NDA PDP Coordinator will assist in facilitating the transfer and should remain informed by the shipping and receiving facilities of communications and significant activities associated with the transfer.

At the time of receipt, the PDP CFAC and/or PDP standards custodian assigned by the custodial facility shall inspect, inventory, and secure the PDP standards. Documentation of these activities must then be provided to the NDA PDP Coordinator.

Appendix C

NDA CCO PDP Registration Form

Appendix C
NDA CCO PDP System Registration Form

This appendix contains the Registration Form that must be completed by the measurement organization, and revised when the information is no longer correct, for an NDA system to be authorized by the CBFO to participate in the NDA CCO PDP.

General Instructions

1. Registration Forms are to be completed and returned to the NDA PDP Coordinator as soon as possible, but at least one (1) week prior to participation in the PDP.
2. Separate registration is required for each NDA measurement system.
3. After initial submission, the forms need be resubmitted only when a change is made in the registration information.
4. The NDA PDP Coordinator will acknowledge all registration requests and assign a tracking identifier to each registered system.
5. The NDA PDP Coordinator will maintain a current list of all registered measurement systems.

Instructions for Specific Questions

Section A

1. Enter the full formal name of the measurement system.
2. Enter the acronym by which the system should be referenced.
3. Enter a number associated with this unit (if applicable).
4. Check the appropriate descriptor. "Fixed, Permanent" indicates that the system was intended to be installed permanently at the current location. "Transportable, Nonpermanent" indicates a long-term installation that can be relocated. "Mobile, Trailer" indicates measurement systems intended for routine movement between sites for short-term contracts.
5. Enter the DOE site where the system will be installed for NDA PDP cycle participation.
6. Enter the on-site location designator for the system.
7. Enter the name of the institution/facility/company that owns the system.
8. Enter the name of the institution/facility/company that operates the system.
9. Enter the name of the person who should be contacted for information on the system.
10. Enter the title of the person identified in box 9.
11. Enter the affiliation of the person identified in box 9.
12. Enter the mailing address for the person identified in box 9.
13. Enter the express package delivery address (i.e., street address, not a P.O. address) for the person identified in box 9.

14. Enter the e-mail address for the person identified in box 9.
15. Enter the phone number for the person identified in box 9.
16. Enter the fax number for the person identified in box 9.

Section B

1. Enter a description of the system, its principles of operation, and optional modes for assay.
2. Enter the identifier(s) for the written standard operating procedures (SOPs) that are used to operate the system for waste assay.
3. For each measurement mode of the system that may be used, enter the measurement principle (gamma, neutron), mode identification (active neutron, multiplicity, etc.), the procedure documenting selection criteria for selecting the subject modes, and the source of isotopic data used for that mode. Sources of isotopic data may be coded:

   P = isotopic data are measured as an integral part of the primary quantitative assay (e.g., gamma spectrometric methods used for both the quantitative and isotopic data).

   S = isotopic data are derived from a secondary method (e.g., the primary quantitation is by passive neutron assay, but isotopic ratios are obtained from an independent gamma spectrometric method).

   AK = isotopic data are obtained from acceptable knowledge of the waste stream or container.

Section C

1 through 5. Check "Yes" or "No" to each question. For each "Yes," indicate the applicable mode(s) from section B.3.

6. Enter the possible mode(s) from section B.3 for each combination of activity range and waste type. Enter "NA" for combinations for which the system will not be used. If explanatory information is required, enter a number in the comments column and add the number and explanation to section D. For example, a system may have a calibration cut-off that falls at the midpoint of a test range. This may be indicated by accepting the range, but specifying a numerical limit in the comment.

7 through 9. Enter the values and units for any limits on NDA PDP tests that, if exceeded, would prevent the system from assaying an NDA PDP sample.

Section D

Add any comments necessary to explain answers in any prior sections or supplemental information useful to the NDA PDP Coordinator in planning effective NDA PDP tests for the system. Attach continuation sheets as needed.

Section E

Enter the requested information for the person submitting the registration form.

Sign and forward the original form to the NDA PDP Coordinator.

NDA CCO PDP System Registration Form

A. SYSTEM IDENTIFICATION			
1. Official System Name:			
2. Acronym		Coordinator Use Only	
		System ID:	
3. Unit No. (this system):		Group No.:	
4. Mobility Type:	Fixed, Permanent ☐ Transportable, Nonpermanent ☐ Mobile, Trailer ☐		
5. Current Facility Location:		6. On-Site Reference	
7. System Owner:			
8. System Operator:			
9. Primary Contact Name:		14. E-mail:	
10. Title:		15. Phone:	
11. Affiliation:		16. Fax:	
12. Postal Address:			
13. Express Package Address:			

B. METHOD SUMMARY
1. Brief Description of Method:
2. Associated SOP Identification(s):
3. For each quantitative mode in which the system is used, complete the following:

	3a. Assay Measurement Basis	3b. Mode	3c. Criteria for Selection	3d. Source of Isotopic Data
Quantitative Mode 1				
Quantitative Mode 2				
Quantitative Mode 3				
Quantitative Mode 4				

C. SCOPE AND LIMITATIONS ON SYSTEM USE

	YES	NO	If YES, Mode No.(s):
1. Will the system be used to certify waste as TRU, for CCOs containing less than 0.01 curies of TRU isotopes?			
2. Will the system be used for wastes containing weapons grade plutonium?			
3. Will the system be used for wastes containing heat source plutonium?			
4. Will the system be used for wastes containing unknown isotopic ratios?			
5. Will the system be used for wastes containing uranium isotopes?			

6. Indicate the ranges and waste types (with similar nuclear interaction characteristics) for which the system intends participation in the NDA PDP. For measurement systems with multiple quantitative modes, be sure to indicate the applicable mode(s) for each case.

Activity range	Range in alpha-curies[a]	Surplus Pu Downblend				Comment No.
Low	> 0 to 0.02					
Mid-Low	> 0.02 to 0.2					
Mid-High	> 0.2 to 2.0					
High	> 2.0					

a. Range of TRU activity in a CCO; units are curies of alpha-emitting TRU isotopes with half-lives greater than 20 years.

7. Indicate the maximum activity permissible (including units) for testing the system due to calibration, radiological safety, or administrative limits:	Value:	Units:
8. Indicate the maximum weight permissible (including units) for testing the system due to calibration, safety, or administrative limits:	Value:	Units:
9. Indicate any other limitations on system tests: (Explanation in Comment No. _____.)	Value:	Units:

D. COMMENTS (Please add any information relative to participation of this system in the NDA CCO PDP)

E. Please register the system described in this application for participation in future cycles of the NDA CCO PDP. It is understood that system tracking, test design, approval conditions, participation requirements, and audit follow-up may be based on the information supplied in this application.

Printed Name:	Signature:	Date:
Phone Number:	E-mail:	

F. DISPOSITION (coordinator use only)

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Appendix D

Statistical Basis of NDA PDP Scoring Criteria

Appendix D
Statistical Basis of NDA PDP Scoring Criteria

This appendix provides the basis for the NDA PDP scoring criteria. It specifies how the criteria relate to the *Transuranic Waste Acceptance Criteria* (WAC) *for the Waste Isolation Pilot Plant* (DOE/WIPP-02-3122). It further explains the statistical derivation of the limits and bounds criteria of the precision and bias, respectively, for the NDA PDP scoring assessment.

D.1. DEFINITIONS

Limits and Bounds

This discussion describes two types of bounds or limits: (1) those that define the *acceptable* precision limits for a nondestructive assay (NDA) measurement system, and (2) the allowable bias range defined by the bounds of the 95% confidence interval. While the terms "limits" and "bounds" can be used interchangeably, to avoid confusion, the term "limits" is used here only in reference to the Performance Demonstration Program (PDP) precision criteria. Similarly, the term "bounds" is used only to describe the endpoints or bounding values of calculated 95% confidence intervals for the percent recovery.

Point Estimate

A point estimate is the best single numerical value that is a good indicator of the underlying parameter of interest. Point estimates contrast with confidence bound estimates, which are interval estimates (since they delineate bounds on confidence intervals). For bias, the point estimate is the mean calculated percent recovery (%R), relative to the known value. For precision, the point estimate is the percent standard deviation relative to the known value (%RSD).

D.2. PERFORMANCE CRITERIA

The NDA PDP criteria (Table D-1, column 2) specify acceptable limits for the measured precision of an NDA measurement system based on 15 replicate assay measurements. The NDA PDP criteria are derived from the calibration confirmation criteria for NDA measurement systems in the WAC. The precision criterion, defined as the maximum allowable %RSD for a non-interfering matrix and given in Table A-2 of the WAC, is 20.0% for 15 replicate assay measurements. This same precision limit of 20% RSD is given in Table D-1, column 2 for the lowest TRU alpha activity range.

The measured precision, based on 15 replicates, is only an approximation of the true system precision. Implicit in each limit for the measured precision is a corresponding 95% upper confidence endpoint value on the true system precision. These upper limits are stated explicitly in Table D-1. Precision criteria for NDA PDP tests for six replicate assay measurements, derived in relation to the upper confidence limits for 15 replicate assay measurements, are given in Table D-1.

The accuracy criterion for calibration confirmation, as specified in the WAC, section A.3, *Data Quality Objectives,* is a 100% +/-10% recovery. The WAC requires justification for accuracy outside of the 90% - 110% range to be documented. The WAC further stipulates that for gamma

measurement systems, the accuracy shall be calculated for each useable gamma energy line over the calibration range, and the accuracy for each line shall be 100% ± 10%. The justification for not using certain gamma lines due to matrix density, filter density, or attenuation is required to be documented. The PDP criteria for bias for the CCO matrices, shown in Table D-1, are less restrictive in consideration of the complexities involved with matrix interferences.

Table D-1. CCO PDP Performance Criteria

Activity Range in α-curies	Based on WAC %RSD UL[a] for Precision (15 Replicates)	Maximum Allowable %RSD (95% CB[b] of UL)	Criteria for Maximum Measured PDP Precision (%RSD) (Six Replicates)	Criteria for Bias (Values for $\%R_L$ and $\%R_U$ for use in Equation 11) (Six Replicates)	
				Lower	Upper
>0 to 0.02	20	29.2	16	40	160
>0.02 to 0.2	15	21.9	12	40	160
>0.2 to 2.0	10	14.6	12	40	160
>2.0	5	7.3	6	40	160

a – The WAC specifies an upper limit of 20% RSD based on 15 replicates in a non-interfering matrix. The UL values for the listed activity ranges were extrapolated on the basis of the capability of NDA measurement systems of meeting these limits.
b – Upper confidence bound for acceptable precision (expressed as %RSD) at the 95% one-sided upper confidence based on 15 replicate measurements.

Precision Criteria for the CCO Matrix

The true precision and bias of a measurement system are unknown. Estimates of the values of these parameters are acquired through the analysis of results of the total TRU α-activity parameter from a set of six replicate assay measurements of the same NDA PDP sample. The more measurements acquired, the better the precision and bias estimates of the NDA measurement system are for a given NDA PDP sample configuration.

The NDA PDP limits for measured precision of a CCO matrix, determined from six replicate samples, are given in Table D-1. The values for six replicate measurements were derived from the upper confidence bounds for 15 replicate measurements. The derivation results in a downward adjustment of the acceptable measured precision values compared to that allowable for 15 replicate measurements, as shown in column 2.

For example, when six replicates are used, a measured value of 18% for the RSD of an assay system in the low activity range, even though less than the 20% allowable using 15 replicates, does not mean the implicit limit of an upper confidence bound of 29.2% has been met. In fact, the 95% one-sided upper confidence bound for this six-replicate example is approximately 38%–considerably higher than the allowable limit. Hence, the allowable measured precision with only six replicates is lower than that for 15 replicates for each α-activity range.

Because the 95% confidence limit for relative standard deviation depends only on the standard deviation itself, it is possible, with a pre-specified fixed sample size, to determine ahead of time exactly how large the calculated NDA PDP precision-point estimate value can be and still have an associated upper one-sided 95% confidence limit that meets the criteria in Table D-1. The fourth column of Table D-1 tabulates these maximum measured relative precision point estimate values using six replicates. The limits in column 5 are used to compare the calculated NDA

system point estimate for relative standard deviation from six replicate measurements on NDA PDP sample matrices (exactly how the values were obtained is described below). Note that comparing the NDA system point estimate to the value in column 4 is equivalent to comparing the associated upper one-sided 95% confidence limit to the value in column 3. That is, an NDA PDP point estimate of the value indicated in column 4 using six replicates will have a 95% upper one-sided confidence limit equal to the value in column 3.

Calculating Limits for Measured Relative Precision

The limits specified in column 4 for the PDP sample relative precision (standard deviation divided by the known value) are derived from confidence interval calculations for the variance (i.e., the square of the standard deviation) of a distribution. The derivation is described below.

General Derivation

Let σ^2 equal the true variance and let $1-\alpha$ equal the desired confidence value. Furthermore, let s^2 equal the sample variance, and $\chi^2_{\alpha,n-1}$ equal the critical value of a chi-square distribution with $n-1$ degrees of freedom above which α % of the distribution lies; that is, the critical value for the upper α% tail of the distribution. Then, assuming a normal distribution, a two-sided α % confidence interval for the true variance is (e.g., Anderson 1987).

$$\frac{(n-1)s^2}{\chi^2_{\alpha/2,n-1}} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_{1-\alpha/2,n-1}} \qquad \text{(D-1)}$$

Based on this formula for the two-sided interval, the upper one-sided $(1-\alpha)$% confidence limit is

$$\sigma^2 < \frac{(n-1)s^2}{\chi^2_{1-\alpha,n-1}} \qquad \text{(D-2)}$$

and the corresponding upper limit for the true percent relative standard deviation is calculated as

$$\frac{\sigma}{\mu_0}100\% < \sqrt{\frac{(n-1)\frac{s^2}{\mu_0{}^2}}{\chi^2_{1-\alpha,n-1}}}100\% \qquad \text{(D-3)}$$

where μ_0 is the reference (or true) value of the NDA PDP sample.

For the NDA PDP tests, $n=6$ and $\chi^2_{1-\alpha,n-1} = \chi^2_{0.05,5} = 1.145$ in Equation D-3. Substituting these values and the known value of the NDA PDP sample for μ_0 in this formula gives an approximate upper one-sided 95% confidence limit for the percent relative standard deviation for six replicates. If desired, this upper confidence limit can be directly compared to the numbers in column 3 of Table D-1 to determine if an assay system has met the relative precision criteria.

The numbers in column 4 of Table D-1 are derived by comparing the right portion of Equation D-3 to the appropriate number in column 3 of Table D-1 and solving for s/μ_0. As an example, for the low activity range this calculation begins with the required inequality

$$\sqrt{\frac{(n-1)\frac{s^2}{\mu_0^2}}{\chi^2_{1-\alpha,n-1}}}100\% < 29.2\% \tag{D-4}$$

Solving for s/μ_0 gives

$$\frac{s}{\mu_0}100\% < \sqrt{\frac{(0.292)^2\,\chi^2_{1-\alpha,n-1}}{n-1}}100\% \tag{D-5}$$

which, for six samples and 95% confidence as specified in the PDP, gives

$$\frac{s}{\mu_0}100\% < \sqrt{\frac{(0.292)^2(1.145)}{5}}100\% = 14\% \tag{D-6}$$

Again, substituting the reference (or true) value of the NDA PDP sample for μ_0 indicates that a calculated relative standard deviation of 14% or less meets the criterion for relative precision in the low activity range. Since the chi-square value and *n* are the same for all activity levels, the column 4 values for the other activity levels are obtained simply by substituting the appropriate value in place of 0.292 in Equation D-6.

Precision Criteria for CCO Matrices

The WAC limits (section A.3, *Calibration Confirmation*) are specified for a "non-interfering matrix"; in other words, a waste matrix that does not have attributes that manifest themselves in the NDA measurement system as significant complicating error elements. To determine rational precision scoring criteria for the interfering type waste form, it was desirable to establish some relationship to program objectives that can be used as a basis for the NDA PDP criteria for the CCO matrix drums. There are certain program-defined limits for which assay measurement systems are used to ensure compliance. In particular, there are the 200 FGE material limits for 55-gallon containers and the TRU waste α-activity definition used to discriminate TRU waste from low-level waste (LLW). At the high end, the precision of the assay system should be reasonable for waste containers approaching the 200 FGE limit to ensure that an excessive number of drums do not exceed the limit at the 95% confidence level. Similarly, the waste assay system should be sufficiently precise for containers of low TRU mass loading (i.e., in the vicinity of the 100 nanocuries per gram [nCi/g] α-activity criterion) to ensure that an unacceptable number of containers of TRU waste are not classified as LLW.

As a convenient base for determining precision criteria for interfering type waste matrix drums, the non-interfering compliance points in Table D-1 are used. For the low activity range, the nominal compliance point for meeting the WAC precision and bias criteria is 100 mg of weapons-grade plutonium (WG Pu). An acceptable assay system should be capable of detecting

and quantifying TRU waste in 55-gallon waste containers at a level of 35 mg WG Pu, approximately 75 nCi/g waste at 100 pounds of waste. When assaying a container at the compliance point of 100 mg WG Pu, we would like to be sure at the 95% confidence level that the assay system will not return a value less than 35 mg WG Pu. This provides reasonable protection against classifying TRU waste as LLW. Based on this rationale, two standard deviations would correspond to 65 mg (100 mg–35 mg). One relative standard deviation would therefore be 32.5mg/100 mg or 0.325. By substituting 0.325 in place of 0.292 in Equation D-6, we obtain a value of 0.155 (rounded up to 0.16) for the measured precision criterion for six replicate determinations of an interfering matrix drum in the low activity range.

Using similar reasoning, a precision criterion can be assigned to the high-mass region. In this case, the nominal compliance point used is 160 g WG Pu. When assaying a container at the compliance point of 160 g WG Pu, we would like to be sure at the 95% confidence level that the assay system will not return a value greater than 200 g WG Pu. This provides reasonable protection against mistakenly classifying a TRU waste drum as not shippable when in fact it does not exceed the limit. Based on this rationale, two standard deviations would correspond to 40 g (200 g–160 g). One relative standard deviation would therefore be 20 g/160 g or 0.125. By substituting 0.125 in place of 0.292 in Equation D-6, we obtain a value of 0.0598 (rounded up to 0.06) for the measured precision criteria for six replicate determinations of an interfering matrix drum in the high activity range.

No compelling programmatic objectives argue for specific precision limits for the low-middle and high-middle ranges, although some thermal limits will fall into these ranges for some waste forms. Therefore, it was felt that arbitrary limits based on consistency and continuity in the use of the assay measurement systems would be adequate for these ranges. The precision criteria for the low-middle and high-middle ranges were set at 0.12 for the RSD of six replicate determinations.

D.3 CALCULATING CONFIDENCE BOUNDS FOR BIAS

The comparison of an assay system's performance to the bias requirements for the NDA PDP samples requires calculation of the 95% two-sided confidence bounds for the true value, using the replicate measurement data set. Based on a *t*-distribution, the $(1-\alpha)\%$ two-sided confidence bounds for the true assay system mean are (assuming a normal distribution):

$$\bar{x} - t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}} \le \mu_0 \le \bar{x} + t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}} \tag{D-7}$$

In terms of percent recovery, the bounds are:

$$\frac{\bar{x} - t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}\times 100\% < 100\% < \frac{\bar{x} + t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}\times 100\%, \tag{D-8}$$

where μ_0 is the known (or true) value. The lower and upper bounds, calculated per Equation D-8, must be greater than or equal to $\%R_L$ and less than or equal to $\%R_U$, respectively, where

$\%R_L$ and $\%R_U$ are the appropriate lower and upper range-specific bounds from Table D-1. Equivalently, bounds for the point estimate, total TRU α-activity percent recovery, can be obtained by solving the required inequalities for percent recovery. The required inequalities are:

$$\frac{\bar{x} - t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}100\% > \%R_L \text{ and } \frac{\bar{x} + t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}100\% \le \%R_U \quad \text{(D-9)}$$

which, on solving for percent recovery, gives

$$\%R_L + \frac{t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}100\% \le \frac{\bar{x}}{\mu_0}100\% \le \%R_U - \frac{t_{1-\alpha/2,n-1}\frac{s}{\sqrt{n}}}{\mu_0}100\% \quad \text{(D-10)}$$

With six samples, $n = 6$, and the corresponding *t* value (for 95% two-sided confidence bounds) is 2.571. Thus, the equation simplifies to:

$$\%R_L + \frac{1.049s}{\mu_0}100\% < \frac{\bar{x}}{\mu_0}100\% < \%R_U - \frac{1.049s}{\mu_0}100\% \quad \text{(D-11)}$$

D.4 REFERENCES

Anderson, R. L. 1987, *Practical Statistics for Analytical Chemists*, New York, Van Nostrand Reinhold.

DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, current revision, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad, New Mexico.

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Appendix E

NDA PDP Standard Encapsulation Design

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NDA PDP Standard Encapsulation Design

This appendix provides information on the NDA PDP standard encapsulation design used to contain the radioactive material/substrate mixture that constitutes a standard. Seven separate NDA PDP standard production phases were conducted at the Los Alamos National Laboratory. Each production phase was designed to yield a set of standards with specific attributes reflecting the DOE radioactive material inventory. All NDA PDP standards use a dual cylinder encapsulation design and have identical internal and external dimensions. The encapsulation cylinders are fabricated from seamless stainless-steel tubing for all production phases except Phase III.A, which is fabricated from seamless zirconium tubing.

The PDP standard encapsulation is comprised of an inner and outer cylinder. The bottom end cap of each cylinder is laser-welded in place. The inner cylinder is then filled with the appropriate mixture of radioactive material and substrate. Once the mixture has been packed to a height specified in the production plan document (LAUR-96-2277, LAUR-98-213, LA-CP-00-54, LA-CP-00-110, LA-CP-01-208, LA-CP-03-0072, LA-CP-03-0763), a graphite-felt frit is installed, which presses the nuclear material/substrate assembly in place when the top cap is inserted and attached. The graphite frit also ensures that the radioactive material/substrate configuration does not change over time. The inner cylinder top cap is then welded in place using the tungsten inert gas (TIG) method. After the top cap is welded in place, the inner cylinder is inserted into the outer cylinder and the top outer cylinder cap is TIG-welded in place. An elevation view of both the inner and outer encapsulation cylinders is shown in Figure E-1. The final assembled NDA PDP standard encapsulation unit is shown in Figure E-2. Prepared assemblies of the stainless-steel and zirconium dual encapsulation, complete with the substrate matrix (no radioactive material) and helium fill, have been tested in accordance with American National Standards Institute/Health Physics Society (ANSI/HPS) N43.6-1997 and comply with ANSI Classification 97C43323.

The dimensional and material properties of the NDA PDP standard were derived as a function of NDA PDP objectives, nondestructive waste assay system response characteristics, and practicalities of fabrication. A complete NDA PDP standard specification with supporting analyses is provided in the document, *Performance Demonstration Program for Nondestructive Assay for the TRU Waste Characterization Program, Initial Cycle Source Design* (INEL-94/0104).

The as-specified PDP standard configuration complies with the following general requirements:

1. PDP standards must be physically stable and invariant with time in a defined geometry.
2. The PDP standard configuration must facilitate convenient loading of the standards into the PDP matrix CCO.
3. The PDP standard dimensions must allow for the production of multiple-source spatial geometries within the PDP matrix CCO.
4. The PDP standard encapsulation integrity must comply with all applicable standards and be acceptable for transportation to and storage at participating sites.
5. The PDP standard design must accommodate available fabrication technologies at a reasonable cost.

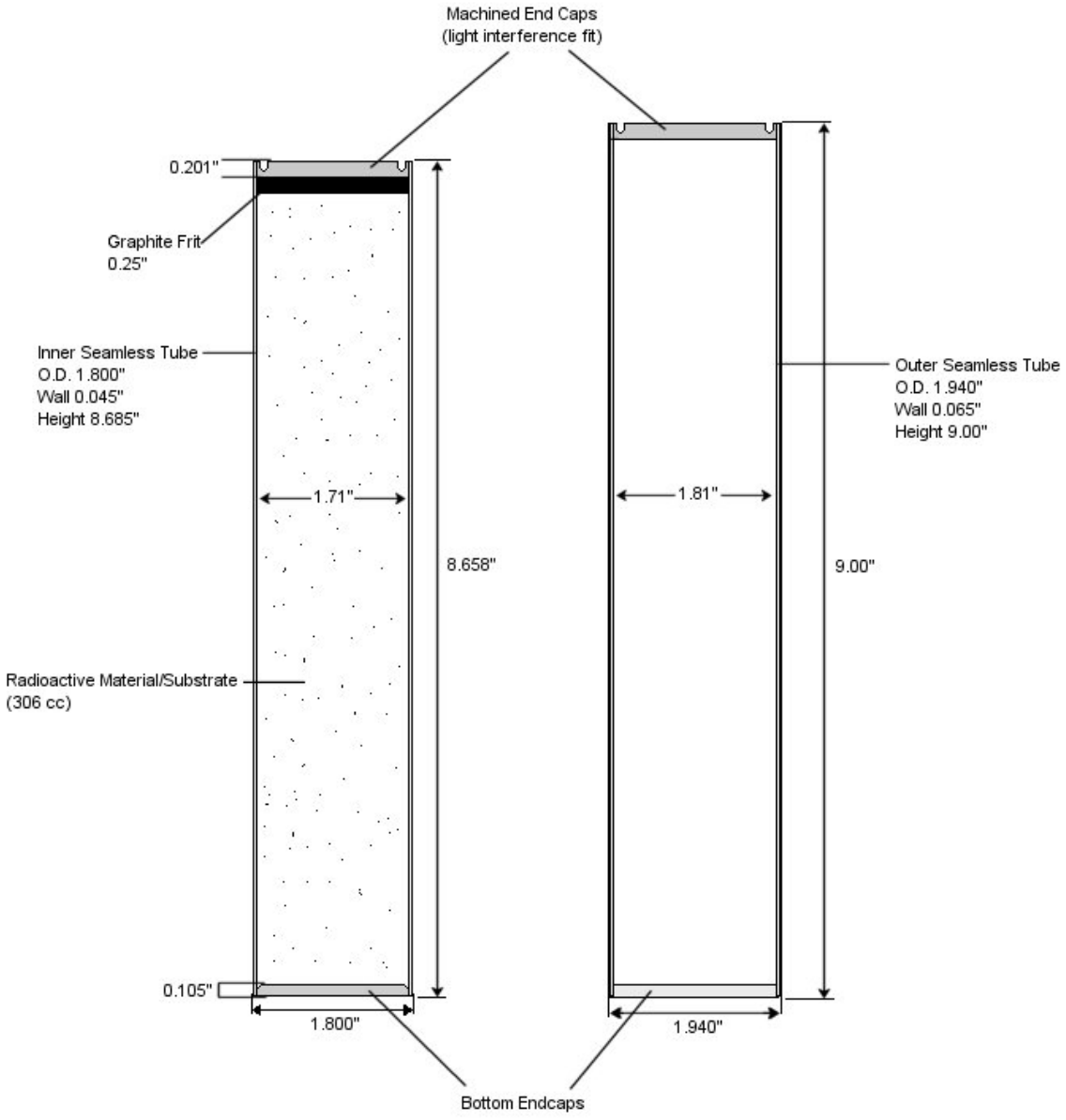

Figure E-1. PDP Standard Inner and Outer Cylinders, Elevation View

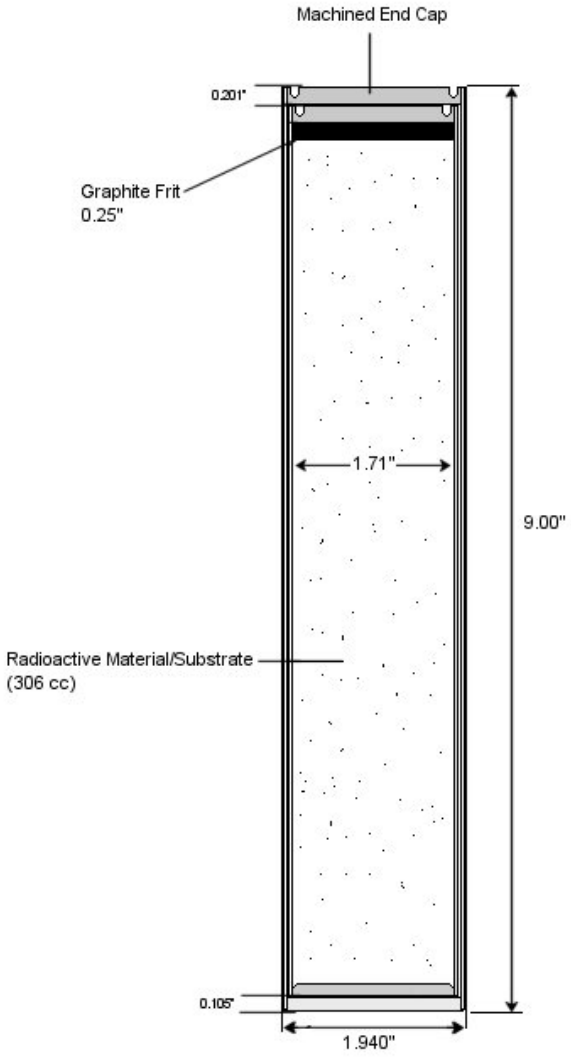

Figure E-2. PDP Standard Encapsulation Assembly, Elevation View

Appendix F

NDA PDP Matrix CCO Specifications and Descriptions

Appendix F
NDA PDP Matrix CCO Specifications and Descriptions

This appendix provides an overview of the NDA PDP matrix CCO, general specifications, design, and physical configurations. Additional technical detail on the design and fabrication of the NDA PDP matrix CCO set is provided in Nuclear Waste Partnership LLC, "Criticality Control Overpack Type A Evaluation Report (CCO-REP-0001)" and "Criticality Control Overpack Drawing (CCO-DWG-001)". The insert fixtures are fabricated as documented in the Xymat Engineering Certificate of Conformance (Pantex PO 516193, drawing J21012-01, March 8, 2021).

Use of the waste matrix surrogate CCOs in combination with the NDA PDP standards provides the CBFO with test samples useful in assessing the ability of DOE facilities to meet applicable acceptance criteria for radioassay of wastes intended for disposal at the WIPP. The CBFO uses data generated in the NDA PDP as part of the assessment and approval process for measurement facilities supplying services for the characterization of WIPP TRU waste.

The fabrication of the NDA PDP matrix CCO set is based on the actual CCO container used at SRS for the SPD project. Illustrations and pictures of the as-built construction of the NDA PDP matrix CCO are provided in Figures F-1 through F-3. The CCO container includes the following components:

- 55-gallon container and lid with locking ring
- The upper and lower wooden dunnage structures
- The Criticality Control Container (CCC) with bolt on lid (for purposes of the PDP, only 4-bolts are required to secure the lid)
- 2x source packing container assembly with lid (top and bottom)
- 2x source insert fixtures
- 2x source insert fixture cover ring

Insert fixtures were fabricated to position PDP standard(s) within the matrix CCO. The insert fixtures are fabricated from steel as shown in Figure F-3. The designed insert will fit inside a nominal 5.25 inch internal diameter by 10 inch tall packing can which is then placed in the internal Criticality Control Container (CCC) within the CCO. Each packing can with insert will hold three cylindrical PDP plutonium standards with dimensions of 9.00 inches high and an outer diameter of 1.940 inches. With two packing cans with inserts in each CCC, as many as six PDP standards may be loaded in a fixed geometry within a CCO. After the desired NDA PDP standard positions are achieved within the insert fixture(s), they are positioned into the designated Top or Bottom location with the CCO. In this manner, NDA PDP samples are configured as test samples for use in an NDA PDP cycle.

General NDA PDP specifications require the replication of the nominal waste matrix population parameters of interest, ensuring a stable non-variable matrix configuration and providing a convenient means to introduce and precisely locate PDP standards in the CCO. Additionally, the

NDA PDP matrix CCO must conform to a set of requirements to support the needs of the PDP Program. General specifications for an NDA PDP-type matrix CCO are:

1. The design must provide a means to introduce and locate PDP radioactive material standards (Appendix E) into the interior of a sealed CCO. The design must allow for positioning one or more PDP standards at internal CCO radii and at two vertical locations (i.e., top container and bottom container) sufficient to produce radioactivity distributions useful in performance assessments and instrument response studies.

2. The surrogate matrix CCO design must support the assessment of NDA measurement system function and performance in a consistent manner over time. In accordance with this, the matrix CCO must include design provisions that ensure stable, non-variable, and effectively inert matrices.

3. The surrogate waste matrix materials shall not necessitate periodic maintenance and/or inspections to validate their presence and configuration.

4. The matrix materials must be compatible with health and safety considerations such that they are not hazardous in nature, necessitating additional handling and storage precautions.

5. The CCO used to fabricate the surrogate matrix CCO is to be of the same design and construction as used for actual packaging of the down-blend material.

6. The overall outside dimensions of the surrogate matrix CCO shall be compatible with the waste NDA assay system chambers and transfer mechanisms.

7. The surrogate matrix CCO must have a unique identification number (alphanumeric identification and internal matrix code) and external placards such that the CCO container is readily identifiable from other CCOs.

8. The matrix CCO must be sufficiently robust in physical integrity to accommodate mechanical stresses encountered during handling and transportation. Integrity of the internal support structure and matrix must be considered in light of an expected service period of approximately 15 years.

9. The design must incorporate a means to affix an external TID for the purpose of providing control over CCO contents during a measurement series.

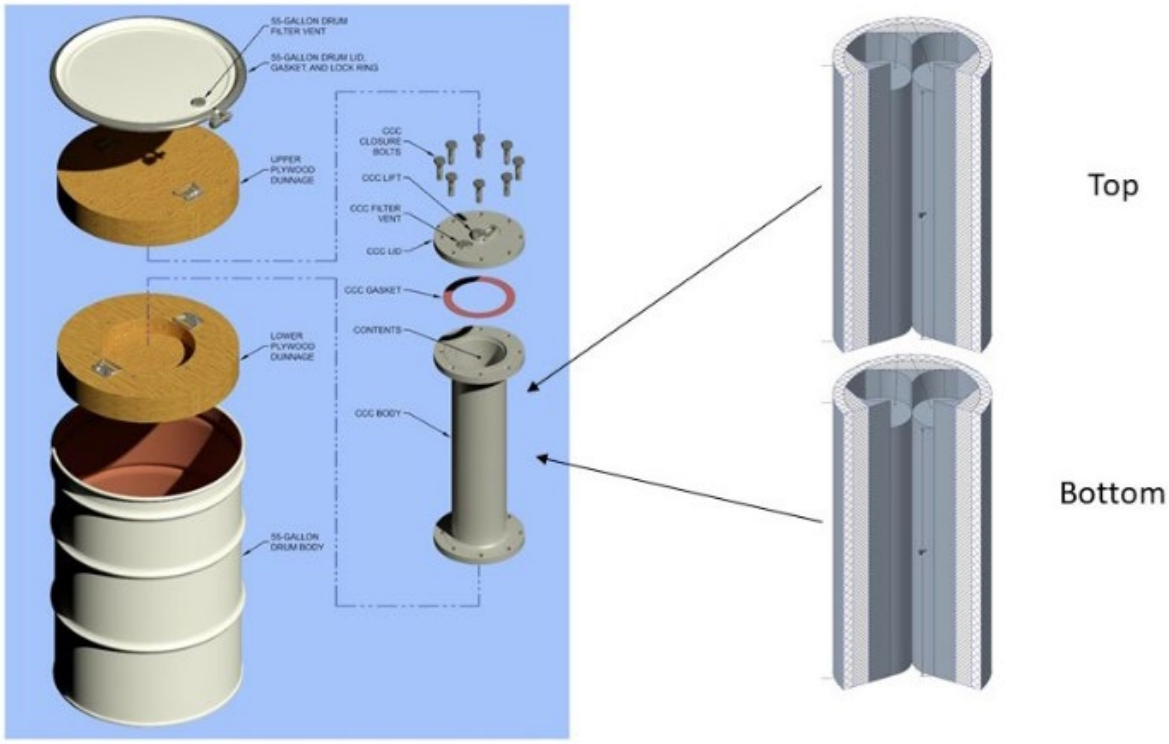

Figure F-1. Cut Away and Expanded View of Criticality Control Overpack.

Note: For purposes of the CCO PDP, the CCC lid may be secure with 4 bolts and the CCC gasket is not necessary.

Figure F-2. Packing Can With and Without Source Insert Fixture and Demonstration Source

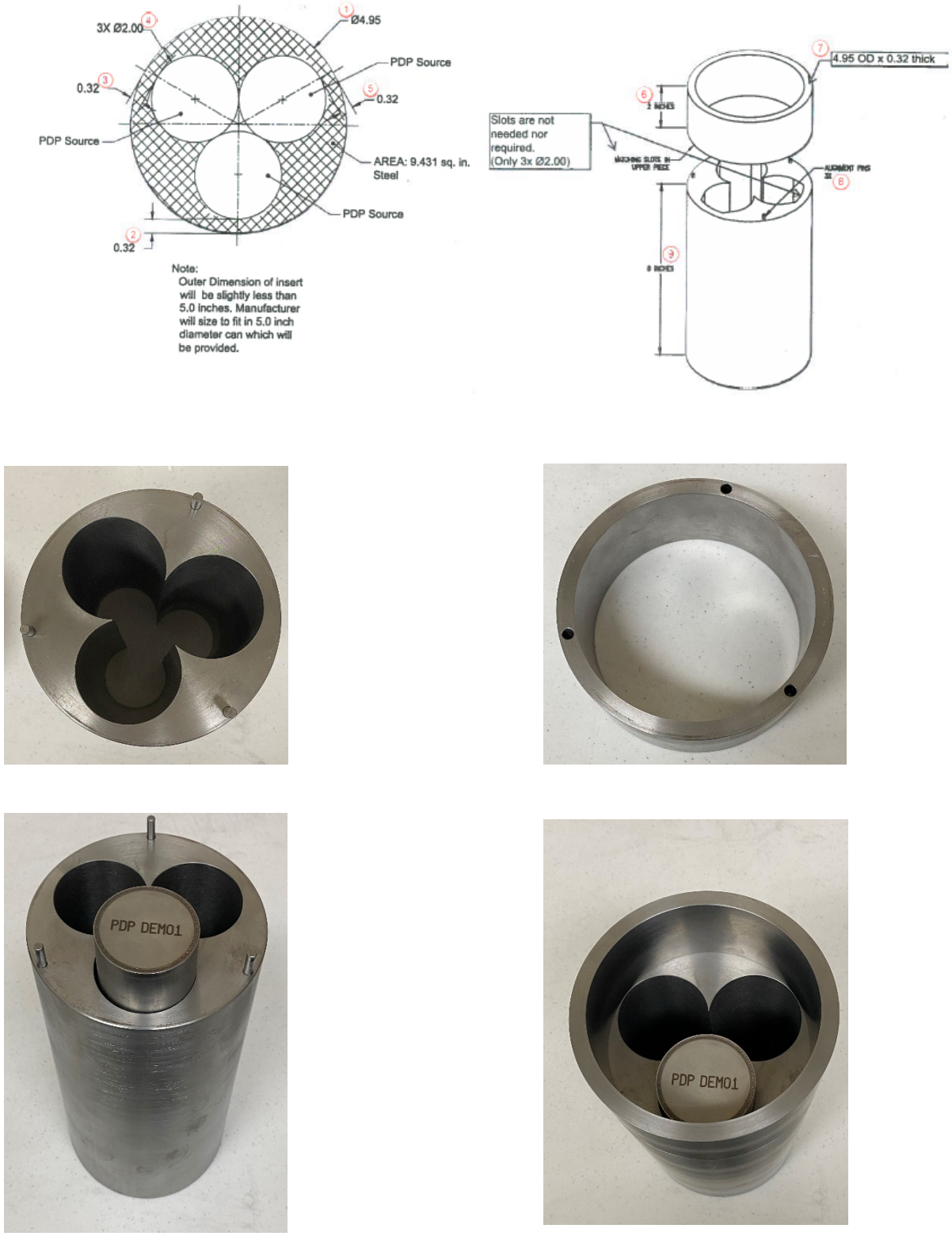

Figure F-3. Cut Away View and Actual Source Insert Fixture Assembly (Insert Fixture with Cover Ring and Demonstration Source)