INTRINSIC TAMPER INDICATING DEVICE (TID) PROGRAM

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ABSTRACT

The Los Alamos National Laboratory (LANL) Intrinsic Tamper Indicating Device (TID) Program has recently been developed in conjunction with the regular LANL TID Program to assist groups who perform measurements using sealed sources or store difficult-to-measure items. The program was then expanded to include other types of sealed sources and items processed for long-term storage in the Nuclear Material Packaging and Repackaging Program. The Intrinsic TID Program encompasses both Special Nuclear Material (SNM) and Nuclear Material (NM) items that have intrinsic characteristics that would immediately indicate tampering upon visual inspection. Items determined to be intrinsically sealed do not need to be sealed with authorized tamper indicating devices. Under the program, an identified intrinsic item receives the same safeguards credits as other tamper-sealed items already in the TID Program. The major benefits of the Intrinsic TID Program include reducing verification measurements on intrinsically identified inventory items and reducing exposure to operators working in highly irradiated environments. Intrinsic TIDs should be combined with other safeguards requirements, and items should have defensible measurements as well as visual inspections. Several groups at LANL are already implementing the program and providing feedback so that we can tailor it to better meet the customers' needs.

INTRODUCTION

Department of Energy (DOE) programs and objectives for years have supported nuclear weapons development and production, but did not seem to be concerned with the long-term storage of nuclear material. However, the end of the Cold War and the new arms control agreements are leading to the retirement of large numbers of nuclear weapons, resulting in an excess of nuclear material in metal and oxide matrices. Consequently, DOE is beginning to reevaluate its role in the handling and storage of material at the facilities within the DOE complex.

To date, the material control and accountability (MC&A) procedures and safety requirements addressed only short-term storage, but because of the growing interest in long-term storage of NMs, DOE's attention has turned to readdressing these requirements. One requirement being researched is the required seals or TIDs that are applied to Category I and II quantities of SNM that are either shipped or placed in storage. In fulfilling this requirement, the DOE facilities have relied mainly on the low-cost, easy-to-apply, simple-to-verify and, unfortunately in many cases, easy-to-compromise seals. Such seals or TIDs as the E-series and prototype mylar seals were widely used. However, because of budget constraints and/or the odd shapes of many disassembled nuclear assemblies, development or the investment in newer types of TIDs has become questionable in implementing. Also, the long-term storage requirement for nuclear materials (i.e., the Plutonium Packaging Standard for the Plutonium Stabilization and Packaging Project (PuSAP) 3013 Container, which required 50 years) poses the following question: What type of tamper-indicating device would survive this timespan and the unique storage environment.

In response to this concern, the Los Alamos Material Control and Accountability Group (FSS-12), with the assistance of several other groups within the Laboratory, has implemented an amendment to the Laboratory's current TID Program called the LANL Intrinsic TID Program. This program is based on the packaging characteristics of several identified items within LANL's holdings that would immediately indicate tampering by visual inspection. With the use of radiography equipment and confirmation instruments, the verification of these items can be performed to meet the requirements of DOE Order 5633.3B, "Control and Accountability of Nuclear Materials."

PURPOSE

The Intrinsic TID Program has been developed in conjunction with the LANL TID Program, which complies with DOE Order 5633.3B, Chapter III, Section 5(a), "Tamper-Indicating Devices." The concept uses DOE's policy guidance addressed in several memorandums regarding measurement requirements

for items that have been difficult-to-measure and have "tamper indicating characteristics."

The scope of the Intrinsic TID Procedure encompasses both SNM and NM items within LANL's NM inventory that have intrinsic characteristics that would immediately indicate tampering during inspection. A visual inspection would indicate that their integrity has been violated.

As part of the program, items identified as intrinsic must also either have a defensible measurement (i.e., analytical chemistry results or calorimeter) or have been identified as a difficult-to-measure item. Because of these requirements, these particular intrinsically sealed items do not need to be sealed with either the currently required mylar or E-series TID, and they receive the same safeguards credits as the other tamper-sealed items that are already in the TID Program. Intrinsic TIDs must be used in accordance with the other graded safeguards required in DOE Order 5633.3B.

The identification of items under this program as being intrinsically sealed simplifies the determination of items to be inventoried in accordance with the LANL Physical Inventory Statistical Sampling Plan. The Intrinsic TID Program aids the MC&A group by ensuring that the random sampling performed by the LANL Physical Inventory Statistical Sampling Plan selects more non-TIDed items than TIDed items. This process assists NM custodians and alternates, handlers, and TID custodians and alternates in eliminating the application of TIDs on certain SNM and NM items with high radiation readings to comply with as low as reasonably allowed (ALARA), while maintaining integrity checks on NM.

IDENTIFYING INTRINSIC ITEMS

The following guidance is given to the LANL organizations that use NMs to help their personnel identify any material in their inventories that could be intrinsic.

CATEGORIES OF INTRINSIC ITEMS

Special form of radioactive material – An item that meets the definition of a special form of radioactive material as defined in the US Department of Transportation (DOT) 49CFR (Code of Federal Regulations), which is required for the purpose of transporting hazardous materials. A special form item typically has registered documentation with manufacturer, test results, and any other pertinent information about the source on file. An item that meets all of the following specific conditions addressed in the DOT 49CFR is considered a special form.

1. The material is either a solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

2. The piece or capsule has at least one dimension not less than 5 millimeters (0.197 inch); and

3. The item satisfies the test requirements of DOT 49CFR, Subsection 173.469. This requirement involves date of creation and performance tests such as impact, percussion, bending, and heat.

Sealed Sources – Although DOE Notice 5400.9 and LANL's Administrative Requirement (AR) 3-4 are concerned with the activity of a sealed source versus Group FSS-12's interest in NM control and accountability, items identified under the notice and AR can be deemed intrinsically sealed. As specified in 5400.9 and AR 3-4, a sealed source is radioactive material encapsulated or strongly bonded enough to prevent loss or dispersal of radioactive material under the conditions of use and wear for which the capsule or bond is designed. In compliance with both the DOE notice and AR requirements, sealed sources are classed in one of the following four groups:

1. Nonregisterable source – a source that does not meet the registration criteria because its activity is less than the limits listed in 5400.9 (see Attachment A);

2. Registered source – a source that has high enough activities to meet the criteria in 5400.9;

3. Encapsulated (sealed) source – a source that is totally encased within a container [i.e., stainless steel capsules or plutonium/beryllium (PuBe) sources]; or

4. Strongly bonded source – a source that is not encapsulated but is chemically attached or otherwise bonded to nonradioactive material in such a way that dispersal from normal use is not likely (i.e., electroplated sources).

A source determined to be registered must have the required paperwork in Appendix C of LANL AR 3-4, completed and sent to the Source Register. The source is then added to the Sealed Source Database maintained by the Policy and Program Analysis Group (ESH-12).

The TID Program – The LANL TID Program defines intrinsically sealed items as having physical characteristics that, upon visual inspection, immediately indicate tampering and that their integrity has been

violated. Some items that do not meet the requirements already identified as intrinsic but that, after a visual inspection by FSS-12 could be deemed intrinsic, are as follows:

- Fuel rods
- Sealed sources, e.g., PuBe
- Sealed assemblies, e.g., Rocky Flats pits
- Uniquely identified machined components
- Weapon parts
- Welded containers with unique controlled serial numbers where violation of the containment vessel would easily be detected.

Nuclear Material Packaging and Repackaging Program – Welded containers designed by the Nuclear Materials Measurement & Accountability Group (NMT-4) for packaging plutonium metal, oxide, or residue for long-term storage. Items identified in this program have the following characteristics:

- An encapsulated stainless steel container that will prevent loss or dispersal of radioactive material under the conditions of use and wear and, if tampered with, would reveal tampering immediately with visual observation.

- Double-welded containment in compliance with LANL Standard Operating Procedure 604-NMT-4, "Fabricating Long-Term Storage Containers."

- Container system consisting of six components that carry the same container serial number. Throughout the container's fabrication, assurance is taken that each component has the correct serial number.

- Permanently marked, unique serial numbers controlled by the Packaging Project Quality Assurance Program.

- A container data package prepared for each container and kept on file by Group NMT-4.

When an item is being approved as intrinsically sealed, the selected item must be available for a visual inspection if requested by an FSS-12 NM Control Section member before any final determination and approval can be made.

COMPLETING THE INTRINSICALLY SEALED ITEM FORM

In using this guide, the following steps must be performed:

Identification – An individual within the organization that uses NM is assigned as an NM custodian or alternate. It is the custodian's responsibility to identify items within the organization's material balance area (MBA) inventory that could be intrinsically sealed using the following categories of items already identified as having intrinsic characteristics.

The MBA custodian or alternate identifies items within the MBA that would meet the requirements of an intrinsically sealed item (ensuring that items have either documented defensible measurement results or have been properly identified as difficult to measure). The PIO's responsibility is to assist the MBA Custodian/Alternates, at their request, to determine if the items being considered are intrinsically sealed. The individuals then must complete the required Intrinsically Sealed Item Form and submit it to FSS-12's Physical Inventory Officer (PIO) for approval.

Form Initialization – To submit an item to FSS-12 for approval, the MBA custodian/alternate must complete the following sections of the form.

- Item ID: Document the Material Accountability Safeguards System (MASS) LOT-ID, or tracking number.

- SNM: Enter the element weight of the item.

- MT: The item's material type—plutonium, americium, etc.

- Manufacturer of Item: If applicable or known, the company or laboratory that manufactured the item should be documented.

- Description of Item: Physical description of the item, what type of item it is (e.g., PuBe source, Rocky Flats pit, etc.), and any other pertinent information that help qualify the item as intrinsically sealed.

- Dimension of Item: the physical measurements of the item (i.e., length and/or radius).

- MBA: The MBA/Account that the item is currently located in.

- MBA Custodian or Requester: The custodian or individual who is requesting the designation or is responsible for the item.

- Group: The NM group that is responsible for the item's custodianship.

• Storage Location: the technical area, building number, room, or cabinet identifier.

When the custodian or alternate has completed and signed the form, it is then forwarded to the PIO.

FSS-12 Evaluation – Once the PIO receives the form, the evaluation begins, using the information supplied to determine if the item needs to be visually inspected or if it can be approved using the information from MASS (i.e., LOT-ID or IDES, item description). If the item needs to be inspected, the PIO will contact the custodian/alternate to set up a time to evaluate it. Results of the evaluation are documented on the form under the "FSS-12 Evaluation and Comments" section. Any questions or concerns about the item need to be resolved before the final approval can be given.

If a category of intrinsically sealed items (i.e., containers for the Nuclear Material Packaging and Repackaging Program or Rocky Flats pits) is identified as always being intrinsic, the PIO and MBA Custodian can issue a memo stating this fact and that visual inspection may not always be required on this category.

Approvals – After the evaluation, either "yes" or "no" is circled in the "Approval" section. If the item is rejected, an explanation for the rejection must be documented in the "Evaluation and Comments" section or attached to the form.

MASS – When an item is approved, the MBA Custodian/Alternate will be contacted by the PIO and instructed to enter "INTR" into the "SEAL" field in MASS. The custodian/alternate must then report the transaction number to the PIO so that it can be documented on the form. The INTR designator can be entered after PIO approval. If the designator is removed from MASS in error at any time, the MBA custodian/alternate must notify the PIO or another member of the FSS-12 NM Control Section before reentering it. If the custodian/alternate is an indirect MASS user, the FSS-12 Accounting Section can be contacted to enter the new designator.

Signatures – In both cases of approval or rejection, the remaining signatures of the FSS-12 NM Control Section Team Leader and Group Leader must be obtained; then one copy of the form is returned to the Custodian/Alternate for the MBA's files and the other copy is filed in the TID Administrator's records. The original form is kept indefinitely by the PIO.

MASS, which is maintained by the Safeguards Systems Group (NIS-7), generates a periodic report that lists those items with the INTR designator. This report is reviewed by the PIO (see Table 1) to ensure that only the approved items are listed. If any questionable items are on the listing, the PIO will contact the responsible custodian/alternate to have them investigated or validated.

PACKAGING STANDARD FOR THE PLUTONIUM STABILIZATION AND PACKAGING PROJECT (PuSAP) — THE 3013 CONTAINER

The use of intrinsic TIDs will benefit LANL within its current storage facilities as well as the future Nuclear Material Storage Facility (NMSF), which will be used for long-term storage. An example of the implementation of the intrinsic TIDs already being done at LANL can be demonstrated with the 3013 container.

The 3013 container is a storage standard to provide packaging requirements for the safe, long-term storage of plutonium metals and oxides (in a recoverable form) for at least 50 years. This repackaging program also aids LANL in both helping to re-identify older material and correcting a safety concern involving replacing older sliptop, dressing cans, or steel food packed cans with new containers that have a longer shelf life.

The 3013 container (see Figure 1) used at Los Alamos was designed by DOE and Group NMT-4 for the repackaging of plutonium oxide and metal and is mass produced and relatively inexpensive. This packaging meets the following characteristics. (1) The materials are in an encapsulated, stainless steel, sealed container that prevents loss or dispersal of radioactive material under the conditions of use and wear and, if tampered with, would indicate tampering immediately by visual observation. (2) The items are processed in double-welded containment in

TABLE 1. INVENTORY REPORT WITHOUT REMARKS

ACCT	MT	LOT-ID	NM	ENR	ISO	NET	P/S	LOC	MEAS	IDES	SEAL	INIT	DATE
800	52	LM001	300	6.08	295	400 G	LTS	B16A	B41	M011	INTR	RAK	9/21/1995
		LM002	200	6.01	195	305 G	LTS	B16C	B41	M011	INTR	MKR	10/11/1995
		LM003	421	6.01	232	437 G	LTS	B16D	B41	M011	INTR	JJT	1/25/1996
		LM004	44	5.98	30	45 G	LTS	I01E	B62	M011	INTR	WEH	5/10/1996
	83	SN-G001	1718	88.99	1413	204.5 G	SRE	LA03	KXE0	C211	INTR	BEG	6/1/1996

FIGURE 1. THE 3013 CONTAINER

compliance with NMT-4's standard operating procedure (SOP) 604-NMT-4 "Fabricating Long-Term Storage Containers." (3) The container system consists of six components that carry the same serial number. Throughout the container's fabrication, assurance is taken that each component has the same serial number. (4) The permanently marked, unique serial numbers are controlled by the Packaging Project Quality Assurance Program.

In addition to these requirements, the material that has been repackaged has a documented radiochemistry performed by LANL's analytical groups that was used to establish their SNM amounts.

In some cases, the containers also had nondestructive assay (NDA) performed on them to verify the material. On MASS, each item has a balance measurement code to show that it has a verified measurement.

The container packaging is a uni-constructed, thick-walled (1/8- to 1/4-inch-thick), 304-L stainless steel vessel. It is designed to withstand internal pressure buildups based on initial pressure in the sealed container during packaging, plus the theoretical maximum possible pressure generated by decay of the contained plutonium over 50 years. The lid is robotically double-welded at the time of assembly.

Each welded container also has a data package prepared that consists of the following documentation: (1) Container Fabrication Data Record for the inner bottom weld, outer bottom weld, inner top weld, and outer top weld; (2) Long-Term Storage Container Helium Leak Test Data for inner and outer cans; (3) Alpha check, gamma/neutron readings and weight, the NDA measurement results (if applicable), and the chemistry results; and (4) Repackaging Records, oxide and metal checklist, and the FSS-12 Intrinsically Sealed Item Form.

After being compiled**,** each of the data packages is reviewed by Quality Assurance and then filed by NMT-4 indefinitely.

By utilizing the intrinsic TID identifier with these items, the items can be placed in an approved secured storage vault with the INTR designator. This helps to indicate that these items are in a measured state and helps prevent any unneeded radiation exposure to personnel in applying and removing TIDs.

VALIDATION AND VERIFICATION

Besides visual validation, other means of validation and verification of the seal are currently being explored, such as the following:

RADIOGRAPHY Radiography has been implemented at LANL to assist in the inspection of the packaging and validation of the material within the 3013 container and other items stored within the plutonium facility's vault. Comparing the current x-ray with the original one taken at time of packaging will assist the operator to determine if the item has been tampered with. In radiographing a container, the x-ray not only can help an operator "see" what is in the container, but it can also validate the density and the bellows dimensions. The x-rayed image of item can also help validate the integrity of the weld (see Figure 2).

CONFIRMATION All items within the LANL inventory are subjected to confirmatory measurements during a scheduled physical inventory. If an item identified as intrinsic is selected to be validated during an inventory or for other reasons, a confirmatory measurement can be used as the validation. These measurements are currently being performed with the use of several different instruments such as the MCA 465 and the NAVI 2. Both instruments detect radiation characteristic attributes from the NM within the

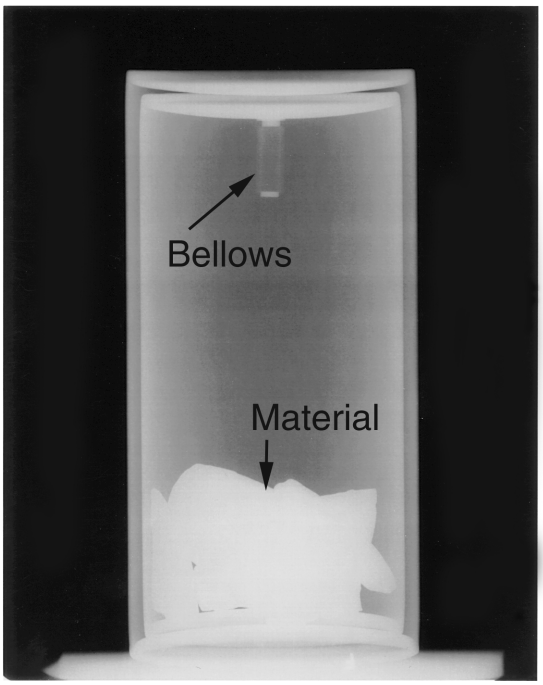

FIGURE 2. RADIOGRAPH OF 3013 CONTAINER

container usually confirming the dominant isotope of an item.

AUTOMATION LANL is currently investigating the automation of it's NM storage vaults with the potential use of robotic instrumentation. This instrumentation could be used to help validate intrinsic sealed items by bringing items to the window of a vault for visual inspection, or a means of validation associated with the instrumentation. Such automation will help eliminate the need for unnecessary handling of material and help these storage vaults meet LANL's ALARA objectives. The future automation of these storage areas and further implementation of the intrinsic seal concept could help in the modernization of TID and storage requirements.

SUMMARY

With the growing need for DOE facilities to place more of their materials into long-term storage environments, they need to explore new means of packaging to tamper indicating procedures. LANL has attempted to enter this area of TIDs with the implementation of the Intrinsic TID Program. Developed to complement the LANL TID Program, it is meant to assist groups who perform inventories, conduct measurements, and/or store NM material and to help reduce if not eliminate the need for unnecessary radiation exposure to Laboratory personnel in highly-irradiated environments.

By utilizing identified NM material packaging characteristics, such as the 3013 container, and combined with the other required security safeguards measures (i.e., the two-person rule, PSAP, and approved security repositories), the need to use mylar or other types of adhesive TIDs could be eventually eliminated. Visually or mechanically validating an item's packaging can give assurance that the NM involved is still contained in the packaging. At LANL, because these intrinsic items are given the same safeguards credits as other non-intrinsic TID items, this program also helps in achieving the goal of identifying items within the inventory that have defensible measurements and those items that don't.

The use of the intrinsic seal can also be one of the solutions to ensure the seal integrities of the items placed in long-term storage. As stated, the commonly used TIDs are not manufactured to survive in a radioactive environment for any lengthy period of time and the intrinsic seal concept can help ensure that the material in storage has some tamper-indicating capabilities. There are still some issues that may need to be answered, such as (1) is the proposed intrinsically sealed container designed for TID application, (2) does the double weld readily offer an inspector a visual indication of tampering, (3) is this a departure from the DOE concept for TID usage, and, if so, (4) does the intrinsic seal concept offer the opportunity for relaxing the two-person rule concept. However, the further advancements in technology in the areas of radiography, confirmatory instrumentation, and robotics may help to establish the increased credibility of the intrinsic seal concept.

At LANL, the Intrinsic TID Program continues to grow in use, and organizations who are involved are providing feedback so that FSS-12 can continue to tailor it to better meet the customers' needs.

REFERENCES

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