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MATERIAL TRACKING USING LANMAS

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ABSTRACT

LANMAS is a transaction-based nuclear material accountability software product developed to replace outdated and legacy accountability systems throughout the DOE. The core underlying purpose of LANMAS is to track nuclear materials inventory and report transactions (movement, mixing, splitting, decay, etc.) to the Nuclear Materials Management and Safeguards System (NMMSS). While LANMAS performs those functions well, there are many additional functions provided by the software product. As a material is received onto a site or created at a site, its entire lifecycle can be tracked in LANMAS complete to its termination of safeguards. There are separate functions to track material movements between and within material balance areas (MBAs). The level of detail for movements within a MBA is configurable by each site and can be as high as a site designation or as detailed as building/room/rack/row/position. Functionality exists to track the processing of materials, either as individual items or by modeling a bulk process as an individual item to track inputs and outputs from the process. In cases where sites have specialized needs, the system is designed to be flexible so that site specific functionality can be integrated into the product. This paper will demonstrate how the software can be used to input material into an account and track it to its termination of safeguards.

CORE DATA STRUCTURES

Three tables related to material are maintained in LANMAS, All_Material, All_Element, and All_Isotope. The All_Material table contains attributes for the material itself such as account, location and description of the material. Each element for the material is contained in the All_Element table. The elements are tied to the material via a software-generated distinct material identification. Similarly, the isotopes for each element are contained in the All_Isotope table and are linked to the specific element record via a software-generated distinct element identification.

Each time a material is transacted on, a new record is input into the material tables to denote what type of action was taken against the item. These material tables contain CreatingXacID and InvalidatingXacID fields which are updated when the material is transacted on. For example, a receipt will create an entry in the material tables for an item. The CreatingXacID will be the transaction ID given when the receipt is completed. The InvalidatingXacID will be 0 and MatlStatus is X to denote the current record for an item. When the item is transacted on again, for example moved to another location, the receipt row will be invalidated by setting the InvalidatingXacID on the receipt row to the new transaction ID. A new row will be created with the CreatingXacID as the move transaction ID and an InvalidatingXacID of 0 (which denotes the current record). For items that are deleted, the InvalidatingXacID is set to the transaction ID that deleted the item and the MatlStatus is set to G. The record with an InvalidatingXacID of 0 is not created.

The transaction table lists pertinent information associated with a transaction such as userID, the terminal at which the transaction was entered, the type inventory change (description of the

transaction), system date, activity date and comment. The software can be configured to require that transactions be input in chronological order or information can be input as received and sorted by activity date.

MATERIAL MOVEMENTS

Material is tracked in LANMAS by the account and location. The account structure is Reporting Identification Symbol (RIS)/Material Balance Area (MBA)/ subMBA. The RIS is a Site designation and is the account for the material at the NMMSS. The material balance area is an account with defined geographical boundaries, used to identify the location and quantity of nuclear materials in a facility. The subMBA is a sub-account of a material balance area used to provide a more detailed accounting of materials and allow localization of inventory differences within a MBA.

The location structure is configurable by MBA and can be as generic as the site itself or as detailed as building/room/rack/row/position. LANMAS is capable of modeling up to five levels of locations.

Once material is received at a site, it can be tracked to its termination of safeguards. Materials are either created from a process or received from offsite. Tracking of materials created from a process is discussed in subsequent sections of this document. Materials are received from another facility via the "Receipt" function. The shippers RIS designates where the material came from. If materials are received from another LANMAS site, the detailed LANMAS data can be exchanged electronically via XML. LANMAS also accepts AL131 format electronically. The receiving site need only change the site specific information associated with the items such as project numbers or item description codes.

When materials are shipped from a RIS, the destination of the material is tracked via the receivers RIS on the DOE/NRC F 741.

Once a receipt is completed, the material is placed on the books in the account and location selected by the User. LANMAS can also be configured to allow the material to be received into an "in-transit" state where the appropriate account and location information for the material is assigned with a subsequent transaction. The materials are then tracked as they move within the MBA or as it is shipped to another MBA.

The containers and tamper indicating device (TID) seals can also be input at the time of receipt. The software can track transactions against containers and TID seals such as removing a seal and/or unloading a container.

The movements of items between and within MBAs are tracked via the "Move Between MBAs" and "Move Within MBA" functions in LANMAS. For the "Move Between MBAs" function (see Figure 1) the User inputs the receiving MBA. The "Accept From MBA" function is used to place the material in the appropriate location in the receiving MBA.

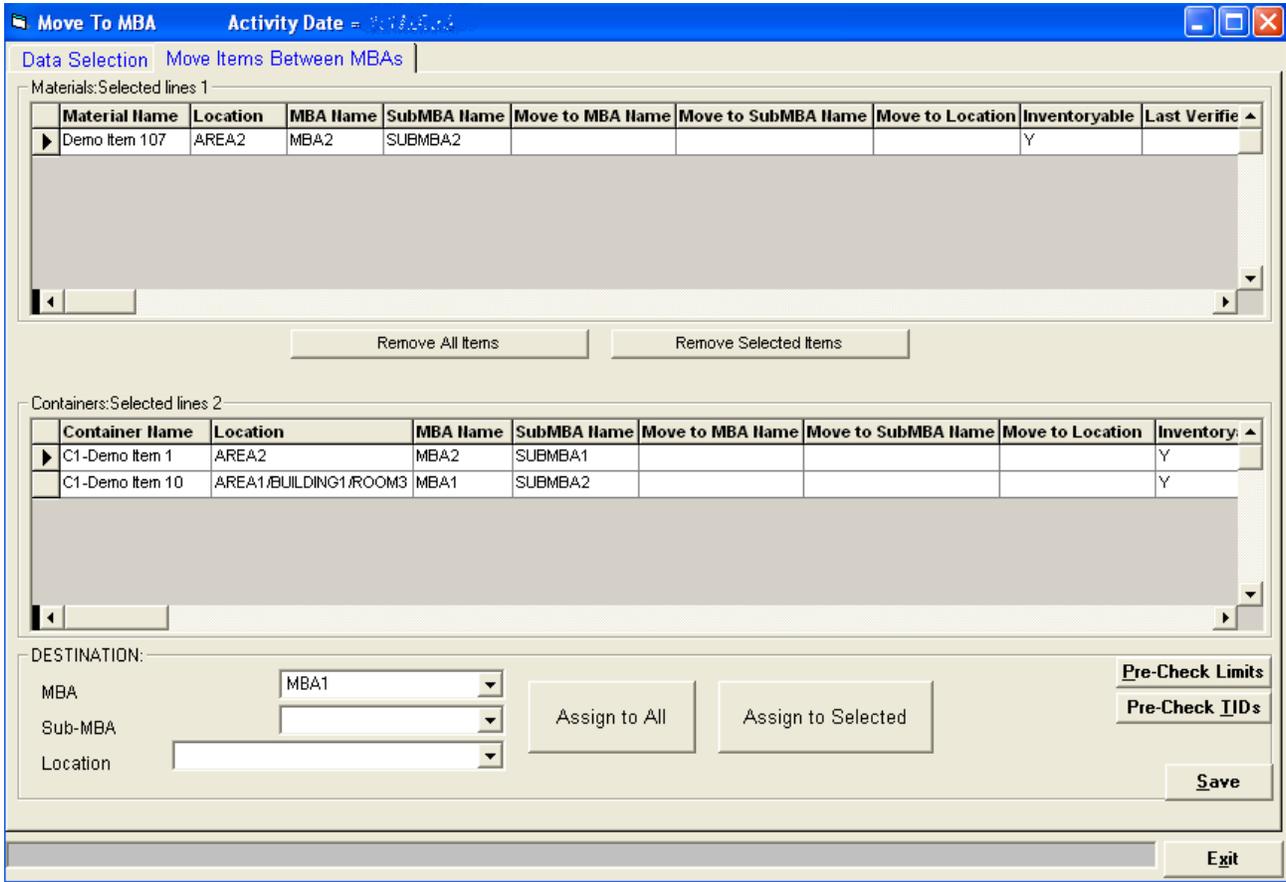


Figure 1: Screenshot of “Move To MBA” function

The “Move Within MBA” function (see Figure 2) can be used to move items between locations and/or subMBAs within a MBA.

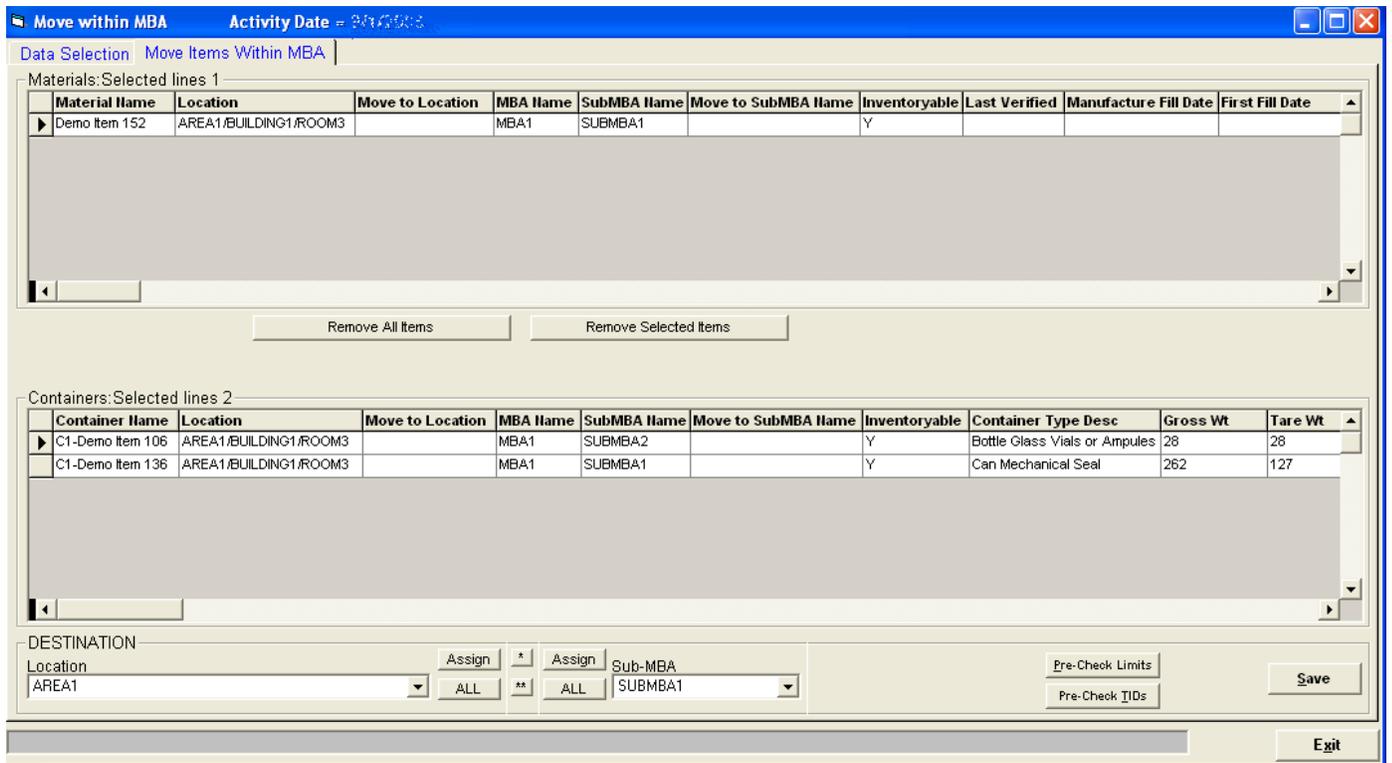


Figure 2: Screenshot of “Move Within MBA” function

MATERIAL PROCESSING

Materials that are processed can also be tracked. Additions to or from an item can be tracked via the Mix, Split and Transfer functions. Several options are available on these functions to ease data entry. The “Check Kill if Zero” button will remove an item from current inventory, if the value of the item goes to zero upon completion of the transaction.

The “Zero New Weights” button will set the value of the From Side Items in a transaction to zero. This is especially useful if several items are being consumed in a process, one click and the data entry is complete.

The “Advanced Weight Calculation” button can be used to distribute materials based on a change in net weight, by allocating a percentage distribution of material or by distributing the material equally. The data entry is on the “from” or “to” side items in the transaction depending on the type of transaction being entered.

Additionally, three radio buttons are located at the bottom of the Mix, Split and Transfer screens (see Figure 3). These radio buttons designate whether isotope weight should be calculated from the entered isotope weight percent (“Calc wt based on Iso%” option), the isotope weight percent should be calculated from the entered isotope weight (“Calc Iso% based on Wt” option) or no calculation should be done (“No Wt or % Calc” option). The “No Wt or % Calc” button is especially useful when data entry is in NMSS reportable units and a calculation could result in an incorrect detailed material type being assigned.

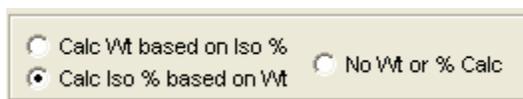
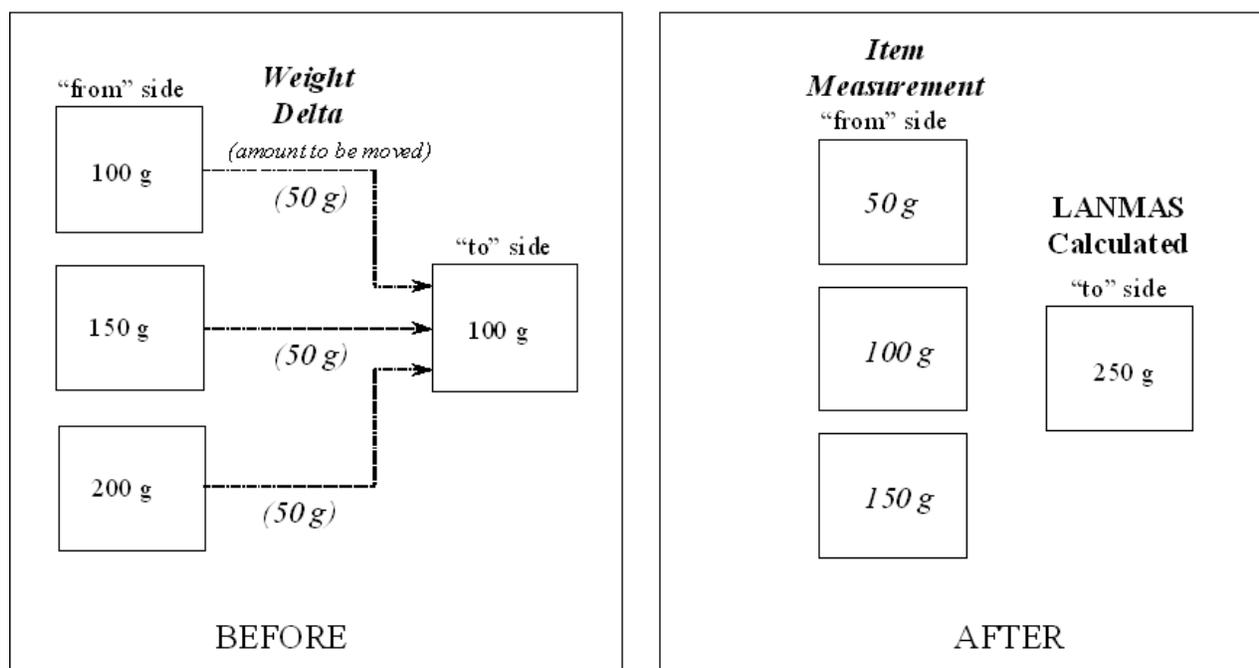


Figure 3: Screenshot of Isotope Weight Calculation Options

The Mix function is many items mixed into a single item (e.g. dissolution batches or combined aliquots into a single vial). The User selects the items to be mixed. The “to” side item is selected and the user enters the delta or new value in the from side items. The sum of the differences is added to the “to” side item in the transaction. The radio button selected determines whether isotope weight or isotope weight percent is entered. The element weight change is always entered. See Figure 4 for a high level overview of the Mix transaction.

Mix (many-to-one)

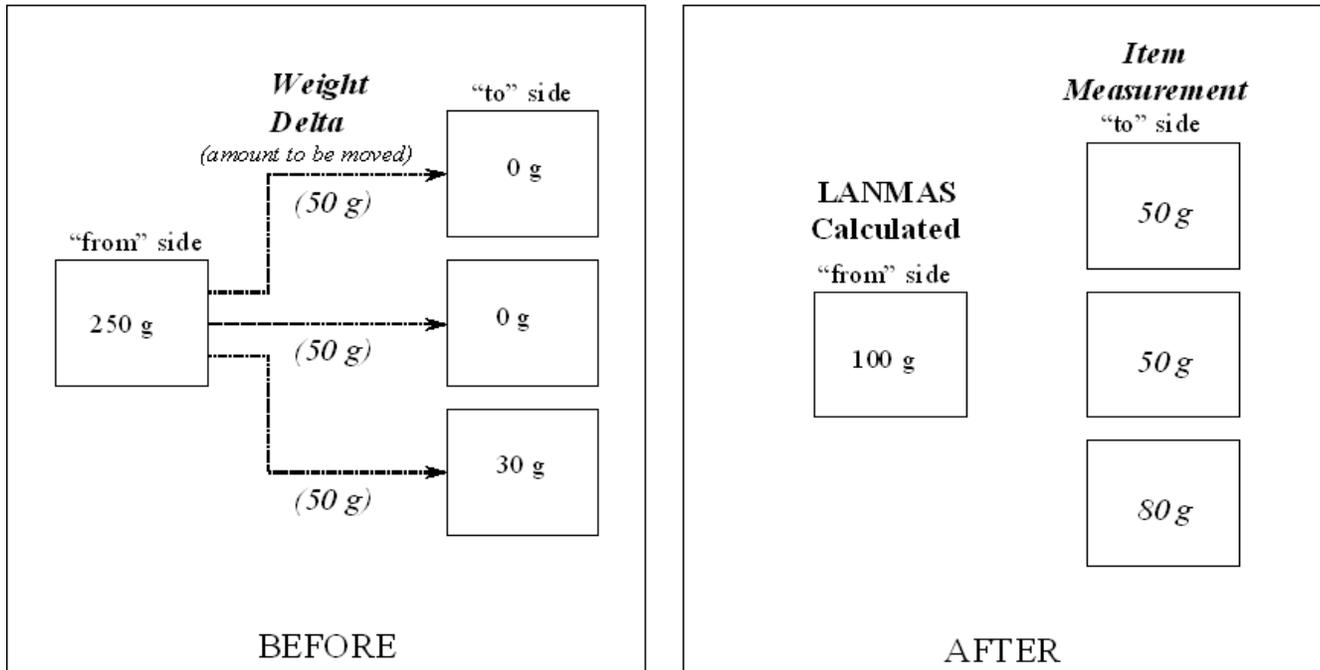


NOTE: You can enter either the weight differences (i.e., the weight delta) or the item’s new measured value.
You are able to create a new item for the “to” side.

Figure 4: General Overview of the Mix Transaction

The Split function is one item to many parts (e.g., sampling, creating daughter items). The User selects the items to be Split. A “from” side item is selected and the user enter the delta or new value in the to side items. The sum of the differences is subtracted from the from side item. See Figure 5 for a high level overview of the Split transaction.

Split (one-to-many)

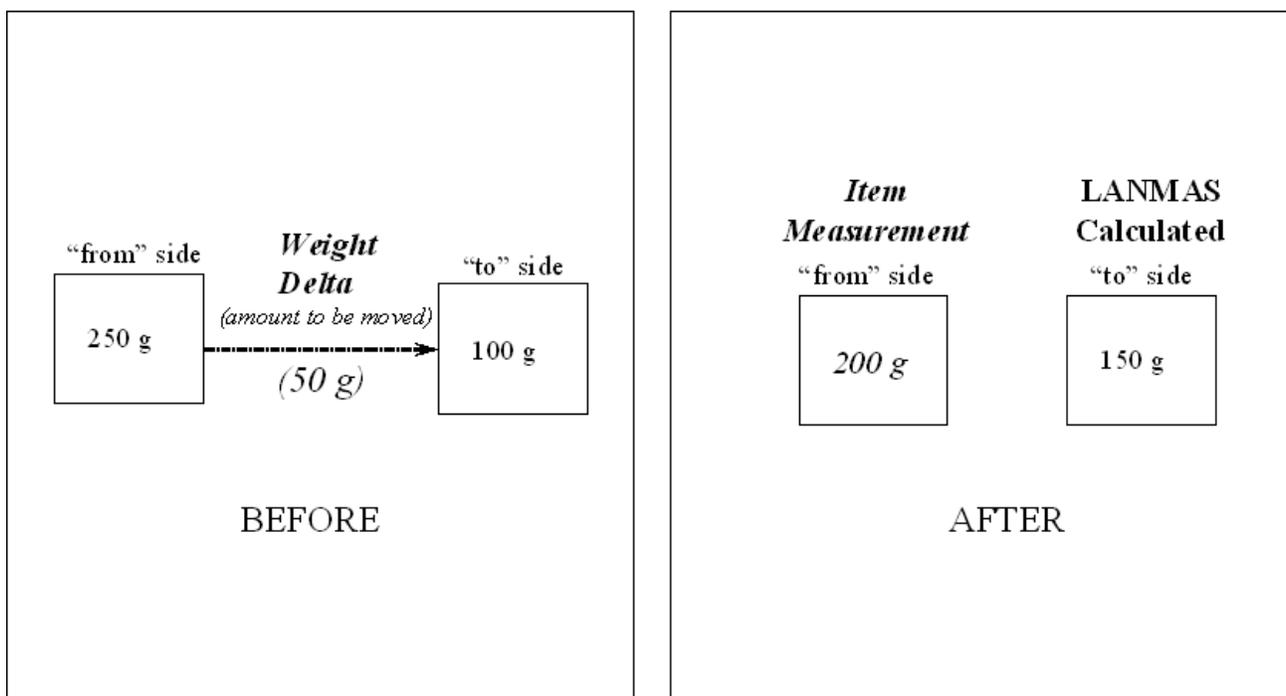


NOTE: You can enter either the weight differences (i.e., the weight delta) or the item's new measured value. You are able to create new items for the "many" ("to") side.

Figure 5: General Overview of the Split Transaction

The Transfer function is used to track one-to-one material movements. This function can be used to move bulk materials between MBAs. As the bulk solution moves between accounts, these movements can be tracked via the Transfer function. The User selects the items involved in the transfer. The "to" side item is selected. The user enters the delta or new value in the from side item. The differences are then added to the to side item. See Figure 6 for a high level overview of the Transfer transaction.

Transfer (one-to-one)



NOTE: You can enter either the weight differences (i.e., the weight delta) or the item's new measured value. You cannot create new items for a transfer.

Figure 6: General Overview of the Transfer Transaction

Once data entry is complete and the transaction is saved, the material tables are updated as described in section "Core Data Structures" for all of the items involved in the transaction. Using this structure, the history of the material and all of its constituent parts are maintained. This allows one to tell what transactions the current book value is based on, what transactions removed materials from the books, etc.

ADJUSTMENTS

Items may be entered into inventory, removed from inventory or the values altered via the Adjustment function. A user selects the item(s) to be adjusted. Data entry is made either as a delta to the item or a new weight is entered. The same radio buttons are available for isotope data calculations as are available in the Mix, Split and Transfer functions (see Figure 3). Once the data entry is complete, the reason for the change is selected. For example, the items may be changed based on remeasurements or they may be entered as a purchase (deuterium cylinders). Again, a transaction number is generated and the material tables are updated as described above.

DECAY

Nominally, data is entered into the accountability system decayed to the first of the accounting period month in which the activity occurred. There is a decay function available in LANMAS to decay the materials before an accounting period is closed to the first day of the next accounting period. There is also functionality in the Adjustment function to decay materials to the first day of the current accounting period. Isotopes are decayed to the precision input by the user.

LANMAS calculates a new decayed value for an item using the following formula:

$$\text{Decay value} = \text{Decay Start Iso Wt} * e^{(-\ln(2) * \text{elapsed time}/\text{half life})}$$

Decay is calculated for each material based on the DecayStartDate and DecayStartIsoWt fields in LANMAS. DecayStartIsoWt is the original isotope weight and DecayStartDate is the decay start date associated with that weight value. The elapsed time is calculated by subtracting the DecayStartDate from the first day of the accounting period in units of days. The decayable field on the isotope also has to be set to Y.

LANMAS will not book a decay transaction unless the difference between the current book value of the item and the decay value for the item is greater than or equal to the previously established threshold value associated with the isotope type. If it is determined that a material should decay, the difference is subtracted from both the isotope and the element weight values. The appropriate decay transactions are input into the transaction and material tables as previously described.

CONTAINERS AND TIDS

In addition to tracking quantities associated with materials, LANMAS is also capable of tracking containerization and tamper indicating device (TID) information associated with the site.

LANMAS provides a TID management function to record the receipt, issuance, application, destruction, and transfer of TIDs. LANMAS also provides the capability to generate various reports to track TID inventories and monitor TID activities. In LANMAS, TIDs can be applied to materials, containers or locations. The personnel associated with different types of TID transactions can also be managed and tracked.

LANMAS also supports the concept of containerization. A container may be a bottle, can, shipping cask, assembly, or any other configuration of items that you need to represent as a single unit. Physical containers may also contain packaging, an assembled part, another container, or individual items. LANMAS can represent most packaging configurations by allowing any number of groups within a container. All transactions performed on containers are tracked in a similar manner as those performed on materials. Some examples of available container transactions are creating containers, loading/unloading containers, moving containers and destroying containers. LANMAS also provides the capability to generate various reports to show the history and current status of containers.

FOREIGN OBLIGATION TRACKING

LANMAS also tracks foreign obligations for each RIS. The obligated material can be assigned to a "site bucket" or be tracked at the item level by associating the appropriate amount of obligation

with a particular item in inventory. LANMAS does not require that a single mechanism for tracking obligations be chosen. Therefore a site can choose to maintain both a “site bucket” for most of their obligation and track some obligations at the item level. LANMAS provides functionality to assign obligation to an individual item from the “site bucket” and also allows for obligation to be absorbed into the “site bucket” from individual items.

Obligations are removed from the “site bucket” when material is shipped offsite and an obligation is associated with the shipment. Obligations are added to the bucket when material is received from offsite and an obligation is associated with the receipt. Obligations transactions can also be generated based on processing materials such as down-blending.

SITE SPECIFIC FUNCTIONALITY

In addition to the core LANMAS functions, sites can generate plug-ins to automate data entry, to track additional information such as detailed measurement data, or to generate specific reports for the facilities. LANMAS exposes “hooks” that can be used by a site to initiate their plug-in from within LANMAS. Through the use of these “hooks” that are exposed in particular LANMAS functions, a site can choose to have additional functionality appended to a LANMAS function. This site-specific functionality can be accessed by a user through the use of menus or command buttons that initiate either the execution of a stored procedure, an application, or a Crystal Report. Site-specific functionality can also be initiated automatically by LANMAS on Save or on Cancel of the “hook-enabled” LANMAS functions.

SUMMARY

LANMAS can track materials from creation to termination of safeguards via several functions within the software. Movements as well as processing of materials can be tracked. Additional functionality is available to track information on TIDs, containers, and foreign obligations. Site specific functions can be added to augment the LANMAS data and functionality. This article has been an attempt to highlight a few of the many features available in LANMAS.