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Revisions

This document has been revised according to the following schedule:

| Revision | Date Approved | Nature of Revision | Prepared by |
|----------|----------------|---|---------------|
| 00 | 19/05/2021 | First Issue | ML VAN STADEN |
| 01 | 16/08/2021 | Including of barcode readers | ML VAN STADEN |
| | | Changes to incorporate deviations on X-ray URS | |
| 02 | See title page | Including of X-ray images into database | ML VAN STADEN |
| | | Removing of requirement specifications that is covered in NLM-SPE-00042 | |
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REQUIREMENT SPECIFICATION FOR WTS UPGRADE TO INCLUDE X-RAY AND WSRF MODULES

1.0 PURPOSE

The purpose of this document is to specify the required changes and upgrades needed on the Waste Tracking System (WTS) as after the rewrite of the current WTS as specified in NLM-SPE-00042: *Requirement Specification for WTS Rewrite*. This program/system is used to manage the Low Level Solid Waste (LLSW) processes of NecsA and consists of various sub program modules. The upgrade needs to incorporate new sub modules to manage (data/information recording and processes) for new processes which are introduced to inspect the content of the drums using an X-ray system and a system (WSRF) to remove any wet waste and/or freestanding liquid identified by the X-ray system.

The WTS uses barcode readers (BCR) as an integral part of the system which is also true for the new processes. Therefore the purpose of this document is also to specify the requirements related to the use of the new BCR(s) for the new processes. . Therefore the requirement for the upgrade also includes:

- Recommendation of minimum requirements of suitable barcode readers
- Programming of the barcode readers if needed
- Programming of the WTS/Barcode reader interface in the WTS

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 DEFINITIONS:

| | |
|------------------|--|
| Historic drum | Any drum that is already under the management of PDO at a date to be specified in the WTS. |
| Original barcode | This is the barcode that was on the waste drum containing the liquid and which was repacked at the WSRF. After repacking this barcode will be physically removed from the drum but it will stay in the WTS to maintain traceability. |
| Interlinkable | Possibility to track the barcodes of repacked drums/containers from the original barcode as well as to track the repacked drum/containers back to the barcode of the original drum. These links are also available in running queries. |

2.2 ABBREVIATIONS:

| | |
|-------|------------------------------------|
| WTS: | Waste Tracking System |
| LLSW: | Low Level Solid Waste |
| PDO: | Predisposal Operations |
| BNFL: | British Nuclear Fuel Limited (Pty) |
| SDS: | Segmented Drum Scanner |

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| | |
|---------|--|
| VRF: | Volume Reduction Facility |
| IAEA: | International Atomic Energy Agency |
| WSRF: | Waste Segregation and Repacking Facility |
| TBI: | To be Investigated |
| PLC: | Programmable Logic Controller |
| MS-SQL: | Microsoft Structured Query Language |
| FTP: | File Transfer Protocol |
| WSRF | Waste Segregation and Repacking Facility |
| BCR | Barcode Reader |
| DTC | Drum Transfer Certificate |

3.0 GENERAL OVERVIEW

All the print screens displayed in this section are as from the WTS before the rewrite (see NLM-SPE-00042) and all the new screens needed for the upgrade are only shown as examples and for demonstration purposes.

The WTS is used to track the movement and to specify the current position of each barcoded container with waste in terms of store, row number, block number and pallet height of every waste drum under the management of PDO. The BCR used for the tracking of the movement is a Motorola MM90 terminal (mobile 6 Operating System). The position of the drum is logged by the operator on the BCR before reading the barcode. The barcodes together with the position are then downloaded in the WTS by using the *Download Batch* and *Drum Move* menus (see Figure 1). A report can then be generated of the list of barcodes downloaded. For the *Download Batch* additional information is added to generate the DTC.

Other information of the drums which is also captured into a database include among others the drum type, the client, the content of the drum (description of waste and a top view photo) and the characterisation information. The user interface containing the modules through which the capturing is performed is shown in Figure 1. The *Drum View/Registration* module as shown in Figure 1 is the module that contains all the information of the drum.

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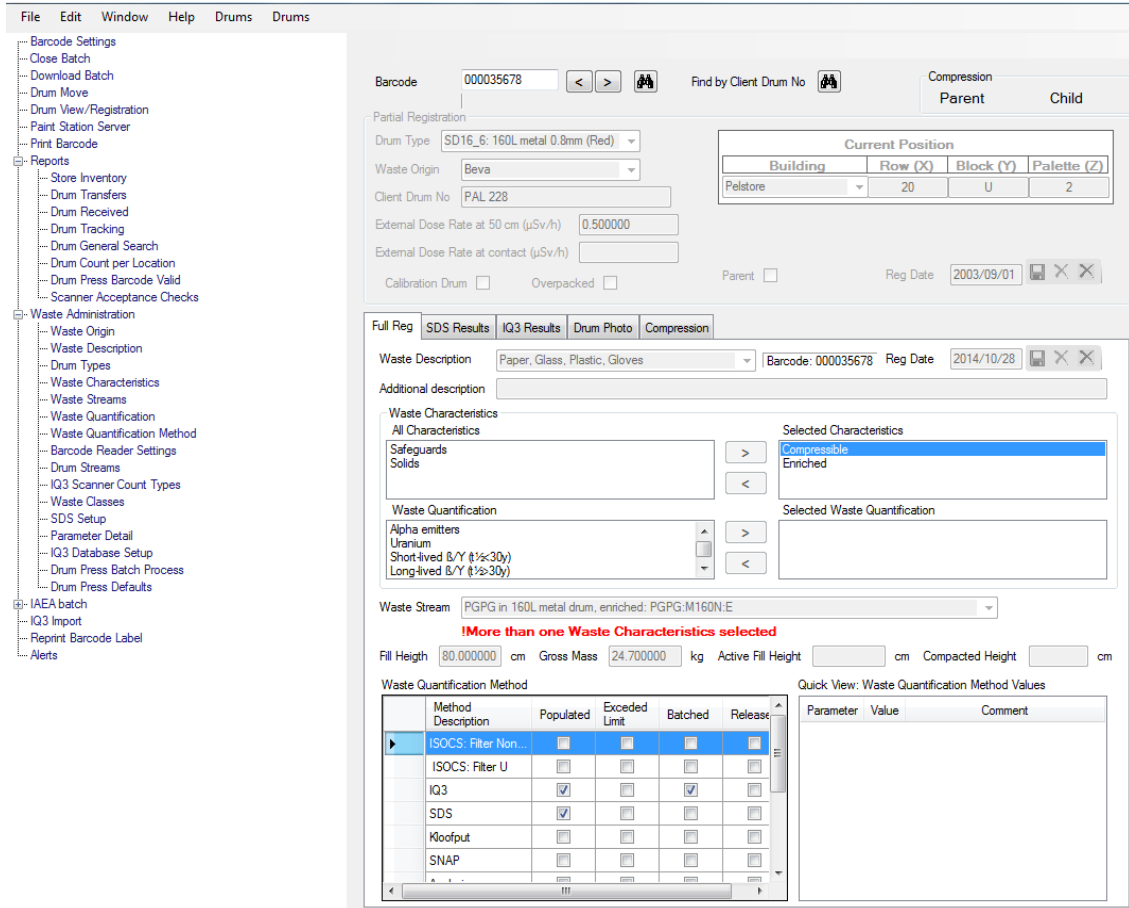


Figure 1: Print screen of Drum View/Registration module

As a security measure, specific sub modules and functions are allocated to specific user roles from the list of all the sub modules and functions in the WTS. Every user is given access to a specific user role.

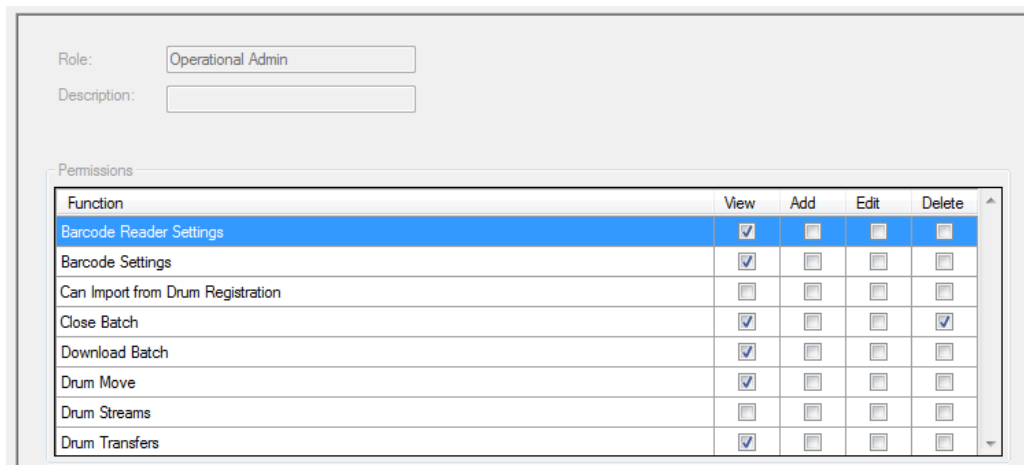


Figure 2: List of sub modules and functions as used in the WTS

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The characterisation (identification and quantification of nuclides) of the drums are done by two gamma-ray scanners namely the BNFL SDS and the IQ3 scanners. The results produced from these two external facilities are logged respectively into each system’s database. To incorporate the characterisation results of drums into the WTS -

- The results from the IQ3 scanner are manually transferred to the IQ3 backup database on the server through an administrator function (see Figure 3) from where the operator could import the data to the *IQ3 Results* tab through the *IQ3 Import* function (see Figure 1).

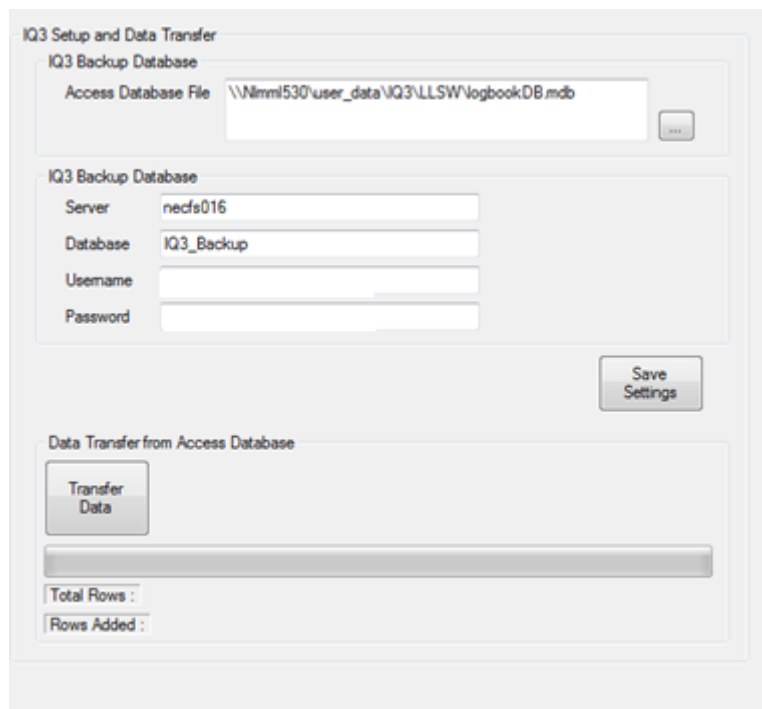


Figure 3: Print screen of the IQ3 Setup and Data Transfer function

- The results from the BNFL scanner are automatically transferred (during the night) to the SDS backup database. The measurement results of the BNFL SDS are not imported into the WTS database, but all the results of a drum are read from the SDS backup database and displayed in the *SDS Results* tab (see Figure 4) of the user interface of the WTS. Although the nuclide data is only read from the SDS backup database, the operation ID of the measurement and the waste class (as calculated from the SDS results) are automatically entered into the *DrumsTable* of the WTS directly after each successful measurement on the BNFL SDS.

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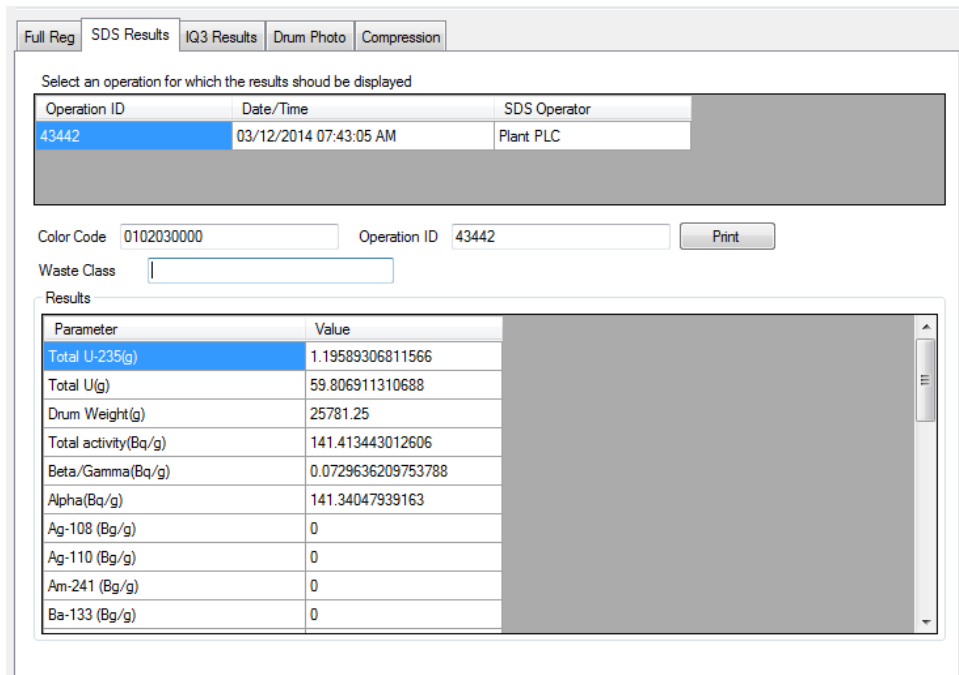


Figure 4: Print screen of displayed BNFL data

The final step in the conditioning process of a drum containing compressible waste is to compact it at the VRF into a small puck (defined in WTS as a child drum) and to pack about 5 pucks into a 200 litre drum (defined in WTS as a parent drum). Before a drum is compacted at the VRF, the barcode is read by the PLC and sent to the WTS where it is checked and validated against a list of requirements by the WTS to ensure that all the information of the drum is captured and that the characterisation results comply with requirements. The outcome of the validation is then sent back to the VRF as a code which indicates whether the drum complies or not to the VRF acceptance criteria. Appendix 1 lists the codes with the corresponding meaning for each code which is also displayed at the VRF. The requirements include amongst other the waste class, mass of the drum, status of declaration to the IAEA and the waste description.

Since only dry waste is allowed to be stored in Pelstore, a need to inspect the content of the drums more thoroughly arose after liquid was pressed out of the drums during the volume reduction process at the Volume Reduction Facility (VRF). Two new facilities are planned to perform this function:

- The X-ray Facility to do a non-destructive assay of the drum content. New and historic drums will be scanned. Drums not containing liquid comply with the dry waste criteria and will be allowed to be compacted at the VRF. Drums containing liquid need to go, depending on the amount of liquid, to the liquid store or to the WSRF where it will go through a segregation and repacking process to ensure compliance. However, all the information (including characterisation results) as existing in the database for the drums that need to be repacked has to be kept unchanged and available for reference purposes.
- The WSRF where only historic drums containing liquid (as identified by the X-ray) will be segregated and repacked to ensure compliance. The new drums containing liquid have to be

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immediately sent back to the waste generator which is responsible for removing the liquid. This implies that the new drums need a flag/indicator to distinguish them from the historic drums till it is proven at the X-ray that they do not contain liquid.

4.0 GENERAL REQUIREMENTS

- The contractor is required to assess the existing/new WTS system. The existing system and the details specified in this document shall be regarded as the specification for the newly to be developed system
- The source code of the current WTS shall be made available to the contractor by NECSA. The original as well as any previous upgrade user specifications shall also be supplied to the contractor.
- A declaration of secrecy must be signed by all potential suppliers before access to the source code and a test database of the current WTS system will be given. Current WTS system's source code shall be accessible from an FTP site.
- The contractor is required to assess the existing system, and add the additional functions as specified. Possible additions shall be made on the existing MS-SQL database to add the required extra functions/data fields. A test database (copy of current database containing minimum data) shall be made available to the contractor.
- All existing data must be migrated to the new database to ensure continuity.
- All the reports must be migrated to either MS-SQL reporting Services or Crystal reports and users must be able to view these as either PDF or Excel files, as specified in Appendix B.
- All files, photos, images, scans and other documents must be saved to the database using a suitable format and user must be able to retrieve these easily.
- No 3rd party add-ins, web services or any other external functionality to be used or included.
- NECSA users will perform end-user testing and supplier shall be responsible for resolving all issues identified during end-user testing.
- A formal handover to NECSA's IT staff of all source code and other development outputs shall be included.
- All source code and development outputs of the upgraded system must be directly accessible and maintainable by NECSA after handover to NECSA.
- All source code and other development outputs of the migrated system shall become NecsA's intellectual property after handover.
- NECSA staff shall deploy the signed-off system to all client computers.
- NECSA shall be responsible for updating the content in all user manuals on the migrated system.
- If required, the supplier's developer can be provided with a work space at NECSA to be in close proximity with the WTS system administrator for faster resolution of queries, etc.

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- Contractors must include in their quote a detailed breakdown of development milestones and which percentage each milestone contributes to the total order amount. These shall be as far as possible be based on Necsa verifiable outputs (e.g. completed modules/sub modules/functions)

5.0 TECHNICAL REQUIREMENTS

The drum will be X-rayed (1 to 4 images per drum) at the X-ray Facility where the operator will determine a *Drum Status* for each X-ray image according to different *Drum Status* types that are defined in the X-ray system database for example compressible, non-compressible and back to generator.

If there is any uncertainty about the wet/dry condition of the content in a historic drum the drum will be flagged as such on the X-ray system and it will be sent to the WSRF where the contents will be inspected, segregated and repacked into a new drum (dry content) and into containers (liquid) as needed. Each of the repacked drums/containers will have a unique barcode which have to be interlinkable with the barcode of the original historic drum. The repacked drum also has to go through the X-ray to ensure a final acceptable *Drum Status* (compressible or non-compressible). The empty original (historic) drum will get a new barcode (the original barcode on the drum will be either removed and destructed, or physically made unreadable) and may then be re-used for other waste or the empty drum needs to be characterised by the BNFL before it will be compacted by the VRF.

The current acceptance criteria list for the VRF needs to be updated to include the *Drum Status* as determined by the operator utilising the X-rays of the drum. An additional acceptance list has to be implemented for the compaction of the empty drums which will be compacted on a campaign basis.

The flow diagram of the upgraded process from where the drum is inspected with the X-ray followed by the repacking (if needed), the gamma measurements and the volume reduction processes are shown in Figure 5. The new parameters are indicated in red text in the diagram.

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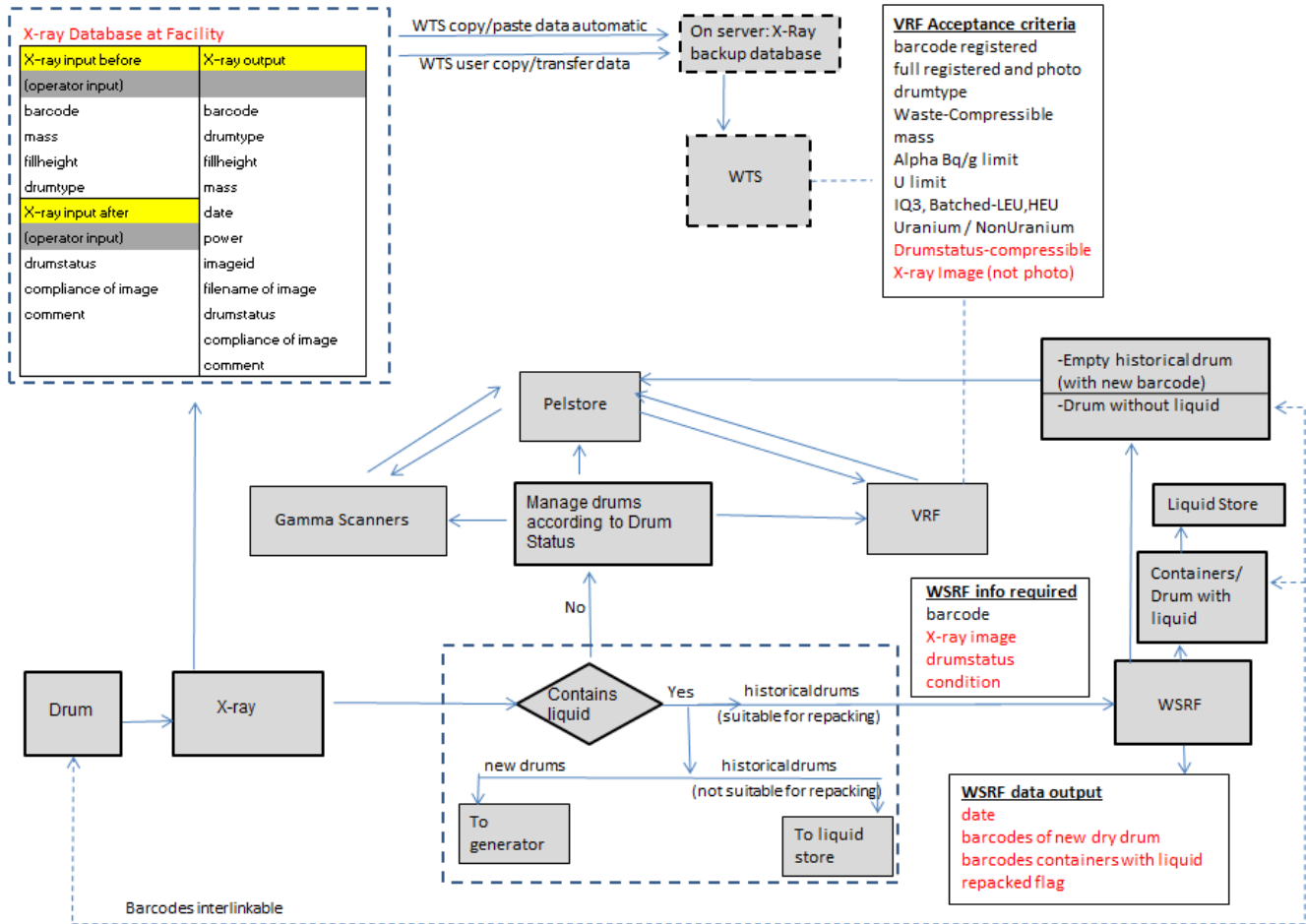


Figure 5: Flow diagram including the X-ray scanning and segregation/repacking processes

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Table 1 shows a summary of the changes and additions needed to manage the new processes

| Table 1: Summary of required changes | | |
|--------------------------------------|---|--|
| Group | Screens/Functions | Changes |
| General | VRF acceptance requirements | <ul style="list-style-type: none"> • Drum Status according to X-ray to be added as an acceptance requirement • Incorporate acceptance requirements specific for empty drums |
| | X-Ray / WSRF Screen | <ul style="list-style-type: none"> • Add X-Ray / WSRF Screen to display the results from the X-ray and to capture the segregation data |
| Drum View / Registration | Photo Screen / X-ray Image Screen | <ul style="list-style-type: none"> • Add the PhotoID on the current Photo screen (also populate <i>DrumsTable</i> with PhotoID) • Add new X-ray Image screen to display X-ray Image as well as the links to the X-ray images |
| | Barcode Reader functionality | <ul style="list-style-type: none"> • Add a function to use a barcode reader to open the drum's info |
| | IQ3 Results Screen | <ul style="list-style-type: none"> • Add function to populate Review flag from IAEA batch / IAEA batch update • Populate Information of original historic barcode if applicable |
| | Partial Registration | <ul style="list-style-type: none"> • Add a function to automatically flag a new drum from a location other than NLM facilities |
| | Drum General Search | <ul style="list-style-type: none"> • Incorporate the reporting of the X-ray Drum Status |
| Reports | Scanner Acceptance Check | <ul style="list-style-type: none"> • Incorporate the reporting of the X-ray Drum Status |
| | Drum Press Barcode Valid | <ul style="list-style-type: none"> • Incorporate the check for Drum Status and check X-ray image instead of photo • Incorporate the requirement validation for empty drums |
| | Tracking of segregation and Analysis of new Items | <ul style="list-style-type: none"> • Add a new report for the tracking of the segregation process and the status of the new items regarding the analysis and the IAEA batching |
| | X-ray Tracking | <ul style="list-style-type: none"> • Add a new report to track the drums scanned by the X-ray |
| | VRF Tracking | <ul style="list-style-type: none"> • Add a new report for the tracking of the compacted drums at the VRF |
| | Drum Progress | <ul style="list-style-type: none"> • Add a new report for tracking the progress of the |
| | | |

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Table 1: Summary of required changes

| Group | Screens/Functions | Changes |
|----------------------|---|---|
| | Tracking | drums through the different processes <ul style="list-style-type: none"> • Add a function to upload these results to the BCR |
| Waste Administration | Locations | <ul style="list-style-type: none"> • Add a new administration screen to add / edit / delete locations in existing Location Table |
| | Managing of X-Ray database and images | <ul style="list-style-type: none"> • Add an administration screen for managing the transferring of the X-Ray data and images |
| | Drum Status | <ul style="list-style-type: none"> • Add a new administration screen to add / edit / delete DrumStatus options |
| | Barcode Reader Settings | <ul style="list-style-type: none"> • Add new administration screen for defining new Barcode Reader settings |
| | Drum Press Batch Process | <ul style="list-style-type: none"> • Add an option for the empty drums on the current screen to allow for campaign compaction of empty drums • Add an additional acceptance list only applicable to empty drums |
| | Automatic registration of empty drums | <ul style="list-style-type: none"> • Add function to populate registration fields using a default empty drum registration template |
| | Automatic registration of WSR liquid containers | <ul style="list-style-type: none"> • Add function to populate registration fields using a WSR liquid container default registration template |

5.1 DRUMVIEW/REGISTRATION

All the new screens as displayed in the following paragraphs are only shown for demonstration purposes.

5.1.1 X-Ray and WSRF Screen

Figure 6 is an example of the screen for the new inspection and repacking (segregation) processes. The first screen indicates an example of the original drum containing the liquid after completing the segregation process, while the second screen indicates how the screen for the new items looks after the process.

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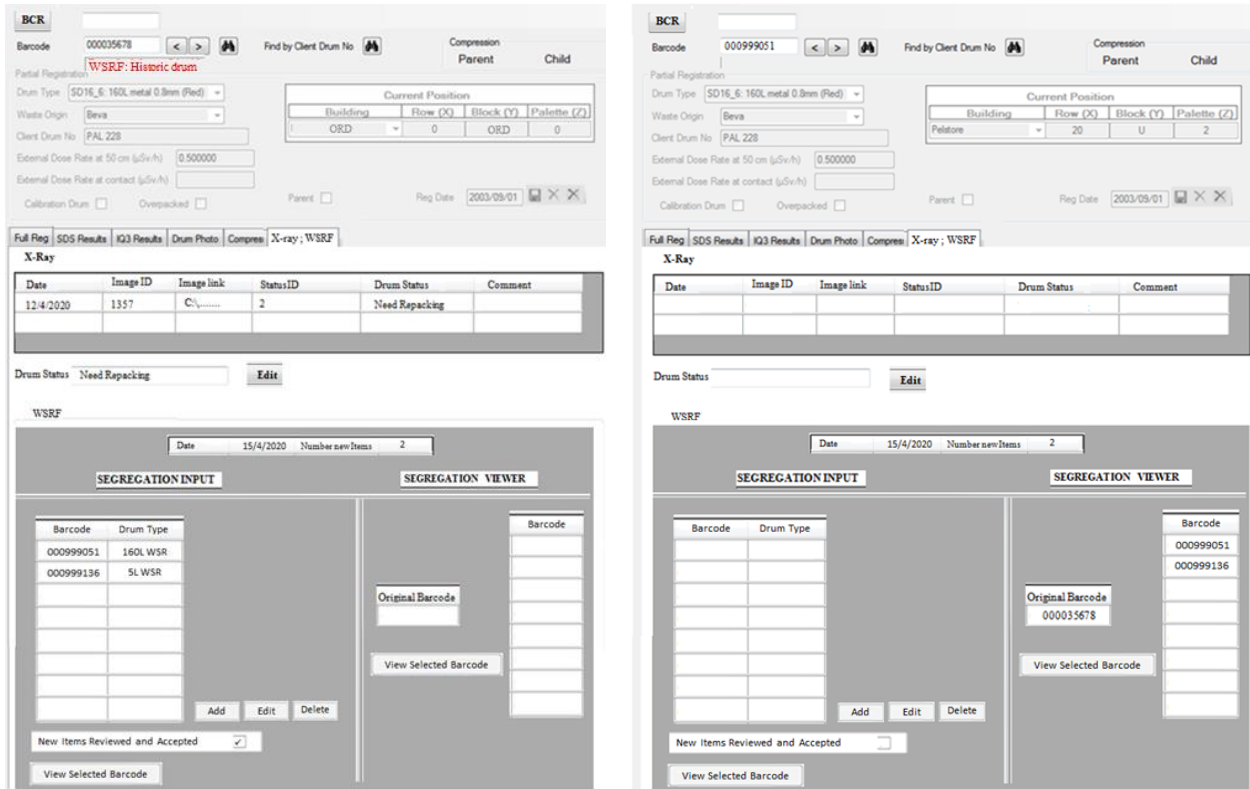


Figure 6: Possible screen to be used for the X-ray and repacking processes

5.1.1.1 X-Ray Section

- The X-ray data is read and listed for all the X-ray measurements of the barcode from the specified X-ray database on the NLM server. (All the images are stored with the barcode as part of the filename).
- Convert the names of the X-ray images to links from where the images are viewable as full screen images (The links for the last 4 scanned images are also listed on the X-Ray Image Screen –see paragraph 5.1.4).
- The final *Drum Status* as automatically displayed beneath the table could be only Compressible if all the entries of *Drum Status* for the last 4 X-ray images are Compressible, otherwise the final *Drum Status* is the *Drum Status* other than Compressible. The options for the *Drum Status* as defined in the X-ray database are also defined in the WTS through an administration function (see paragraph 5.3.6) for managing the WSRF section and the acceptance of the drum at the WSRF. Only a final *Drum Status* of Compressible will be accepted by the VRF.
- The final *Drum Status* can be manually edited by using a dropdown menu (by specified user roles) which will overwrite the automatically populated final *Drum Status*.

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- The *Drum Compliance* box is automatically populated using the format, *barcode_C1C2C3C4*, with C1, C2, C3 and C4 the compliances (Y/N) of the last 4 scanned images (if available in the X-ray database it may be used). Possible to open the combined image as a full screen image from this screen.
- The final *Drum Status* and the *Drum Compliance* (as in Figure 6) must be populated in the *DrumsTable* of the WTS database.
- The *Segregation Input* section is disabled by default and will only become activated/enabled for specific final *Drum Status* options (see paragraph 5.3.6) as specified.

5.1.1.2 Segregation Input Section

- After completion of the segregation and repacking process, the operator needs to activate an *Acceptance Flag* for accepting the information of the new items as correct.
- Original drum contents could be packed in up to 7 other containers, each having a unique barcode. Barcodes of new items are entered by using a pop-up window and a Barcode Reader to read and capture the barcode of the new item in the WTS. However, it must also be possible for the operator to enter the barcode manually. The *Drum Type* of each new item is also needed to be specified by the operator from the pop-up window using a dropdown menu. Only drum types containing a specified phrase (for example “WSR”) are available in the drop down menu.
- Only possible to capture barcodes if not already registered. Display an error message if a barcode already exists.
- Possible to edit or delete the information of a new item before the *Acceptance Flag* is activated
- As soon as the *Acceptance Flag* is activated the following actions are automatically performed on the original barcode:
 1. The date of repacking is automatically populated
 2. The number of new items is automatically populated
 3. The address in the *Partial Registration* section is changed as follows- Building –ORD; Row(X)-0; Block(Y)-ORD; Palette(Z)-0
 4. *Barcode Status* is indicated as “WSRF : Historic drum” by populating the current *Status* column in the *DrumsTable*
 5. Change all the info of the drum to be only viewable, except for the *View Selected Barcode* button of the *Segregation Input* section which needs to be still active for opening the new items from the original barcode
 6. The barcodes of the new items as in the *Segregation Input* section as well as the original barcode needs to be populated in the *Segregation Viewer* section of each of the new items respectively (barcodes 1 to 7 as shown in Figure 6).

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7. Possible to open barcodes of new items (drums/containers) from the original barcode.
 - As soon as the *Acceptance Flag* is activated the following actions are automatically performed on the *Drum View/Registration* module of the barcodes of the new items (drums/containers):
 1. Registering of barcode and corresponding drum type (as specified in the pop-up window during the capturing of the barcodes for the new items)
 2. Populate the *Waste Origin* field with the same *Waste Origin* as the original barcode
 3. Populate the *Client Drum No.* field with the same *Client Drum No.* as the original barcode
 4. Automatically populate the rest of the partial and full registration parameters for the liquid containers as specified in the *Default Registration-Liquid Containers* template (see paragraph 5.3.4.2).
 5. Populate *IQ3 Results* screen as specified in paragraph 5.1.5

5.1.1.3 Segregation Viewer Section

- Barcodes of new items as automatically copied from the *Segregation Input* Section of the original barcode
- Data not editable
- All the barcodes (original and new items) have to be interlinkable (original drum numbers to repacked drum/container numbers; and repacked drum/containers back to original drum number) – through the *View Selected Barcode* button

5.1.2 Barcode Reader (BCR)

- Add an option to scan the drum's barcode to populate the barcode field for opening the drum's information (see Figure 6)

5.1.3 Semi-Automatic Partial and Full Registration

- Add a function to populate the partial and full registration of empty metal drums (current 100 and 160L drums) according to the parameters as specified in the *Default Registration-Empty Drum* administration screen (see Figure 11a) as soon as the operator selects the *Drum Type* specified for empty drums during partial registration.
- Add a function to populate the partial and full registration of liquid containers (used for the liquid removed from the drum) according to the parameters as specified in the *WSRF Default Registration-Liquid Containers* administration screen (see Figure 11b) as soon as the operator at the WSRF activates the *Acceptance Flag* to indicate that the information of the new items are accepted.

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5.1.4 X-ray Image Screen

- Add a new X-ray Image Screen (Figure 7) to display the X-ray images (including the composite images) that were automatically imported into the database as soon as it is available after the drum is X-rayed. Images to be used during the segregation and repacking process (if needed) and the validation of the VRF acceptance requirements.
- List links for all the X-ray images available for the barcode (including the combined images) for viewing on full screen (new window).
- Add a function to delete selected older X-ray images from the screen in cases where a drum is X-rayed more than once

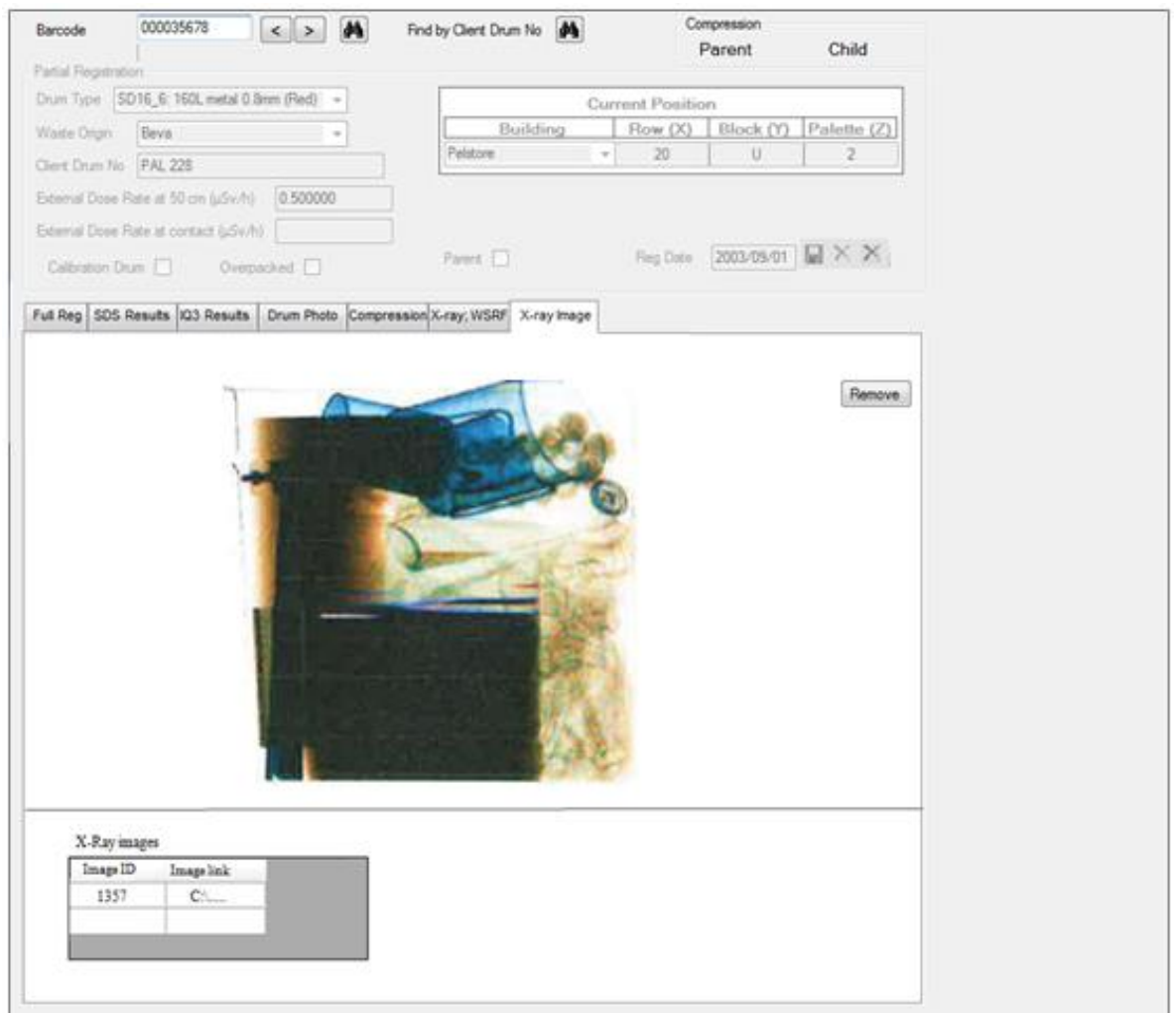


Figure 7: Print screen of the X-ray images with list of links

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5.1.5 IQ3 Results Screen

- If the IQ3 results of the original barcode were already IAEA batched with a LEU-, HEU-, DU- or NU- number, the IQ3 results screen of the new items needs to be automatically populated with the original drum’s barcode and Batch number in non-editable fields. This information has to be available in the IQ3 results table in the database.
- Add a function to populate the *Released Flag* for a batch of drums specified in terms of location, batch number or individually selected barcodes through the *IAEA Batch* modules/functions and which start with LEU-, HEU-, DU-, NU- or ZU- (this is a gap in the current system and plays no role in the new processes).

Figure 8: Print screen of the IQ3 Results screen with the Released field flagged

5.1.6 Partial Registration: Flagging of new drums

- Any new drum (registered after a date as specified – see paragraph 5.3.2) and which was received from a location other than a NLM facility will be considered as new. It has to be flagged with a populated field in the *DrumsTable* in the database together with a visible indicator (for example a red colour of the Full Registration (*Full Reg*) tab which will alert the operator that it is a new drum.
- The flag (populated field and the visible indicator) has to stay active until the *Drum Status* field in the *DrumsTable* is populated with a compressible or non-compressible status. As soon as the *Drum Status* field is populated with one of these two, the populated field in the *DrumsTable* needs to be deleted automatically and the visible indicator has to be changed back to normal.

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5.2 VRF ACCEPTANCE CRITERIA

The requirements as specified in the current system can be viewed in Appendix 1. It has to be changed to incorporate new requirements following from the X-ray process without the necessity of adding new reason codes -

- Add to the current acceptance requirement list for the VRF the Drum Status as determined from the X-ray images. To be accepted by the VRF the Drum Status has to be compressible. If the drum does not comply due to this criteria the reason code 0041 has to be allocated.
- Ensure that the current photo requirement is replaced with the requirement for the existence of X-ray images
- The waste class (determined from BNFL measurements) with colour code 0000030400 (Possible clear waste) to be added by current list of acceptable waste classes (identified as a gap in the current system)

However, another requirement list has to be created for the empty drums originated from the WSRF which could not be re-used for waste. This list needs to be only applied for batches of empty drums (as specified on the *Drum Press Batch Process* administration screen). The empty drum has to comply with the following requirements:

1. Valid barcode (empty drum with a new unique registered barcode and not the same barcode as the original drum, thus Barcode status (just below the barcode –see Figure 6) not populated with “Repacked due to liquid”)
2. Drum fully registered (photo or X-ray not required)
3. Container type “Allowed to Compress” (as specified on *Drum Type* administration screen)
4. *Waste Description* has to be ”allowed to Compress” (as specified on *Waste Description* administration screen)
5. Drum characterised by SDS/BNFL
6. BNFL measured U235 mass < 200g
7. Alpha activity < 400 Bq/g
8. The waste class (determined from BNFL measurements) to be LLW with colour code 0102030000 (previously LILW-SL), Possible LLW with colour code 0102030005 (previously Possible LILW-SL) or Possible clear waste with colour code 0000030400.
9. Mass of drum < 160 kg

The validation process for the acceptance requirement list of the empty drums needs to be incorporated into the existing WTS in such a way that no need is required for any program changes at the VRF. The following parameters with reason codes as from the list in Appendix 1 are applicable:

| | | |
|------|--------------|---------------------------------|
| 0022 | Drum Invalid | Not Fully Registered |
| 0041 | Drum Invalid | Drum Type or Waste Description* |

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| | | |
|------|--------------|--|
| 0051 | Drum Invalid | Drum Weight |
| 0052 | Drum Invalid | Drum Weight Null |
| 0061 | Drum Invalid | No BNFL/ISOCS results |
| 0071 | Drum Invalid | Waste Class or AlphaActivity or U235 not Valid |
| 0072 | Drum Invalid | Color Code empty |
| 0140 | Drum Valid | Process Waste Origin = Drum Waste Origin |

5.3 WASTE ADMINISTRATION

5.3.1 Barcode Reader (BCR) Settings

- Add new sections on the existing *Barcode Reader Settings* administration screen to incorporate and specify the parameters needed to connect to the WTS for
 - 1) The barcode reader used to read and open the information of the barcode of the original drum (paragraph 5.1.2)
 - 2) The barcode reader used to read and allocate the barcodes of the new items to the corresponding original barcode (paragraph 5.1.1.2)

5.3.2 Managing of X-ray database and images

- Add a function (administration screen –Figure 9) to specify the parameters needed to transfer (copy and add) the new data and X-ray images (manually and automatically) from the X-ray facility to the X-ray database and the X-ray image directory on the NLM server respectively. The specified directory of X-ray images will also be used for the required image links
- The automatic transfer will be performed at a specified time frequency (in minutes) starting from a specified time of the day.
- Add a section to specify a cut-off date that will be used to separate historic drums from new drums (see paragraph 5.1.6). This date will be used to determine if the drum needs to be flagged as a new drum.

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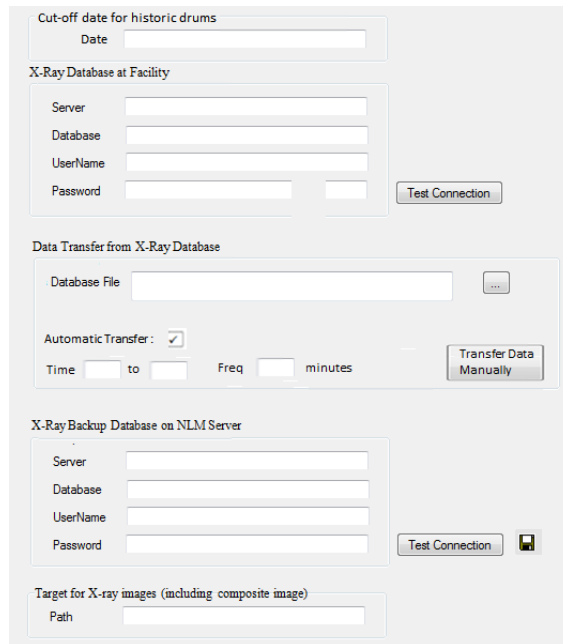


Figure 9: Possible screen for the managing of the X-ray database and images

5.3.3 Drum Press Batch Process

- Add an option on the current administration screen Drum Press Batch Process (Figure 10) for compacting empty drums. The Batch section is disabled for empty drums and only the shortened list of acceptance requirements (paragraph 3.2) is applicable to the empty drum batch.

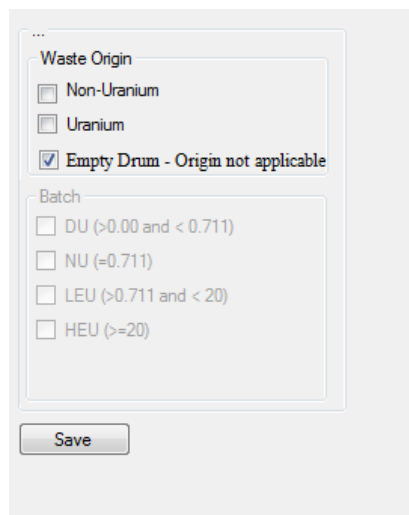


Figure 10: Print screen of the Drum Press Batch Process with the empty drum option included

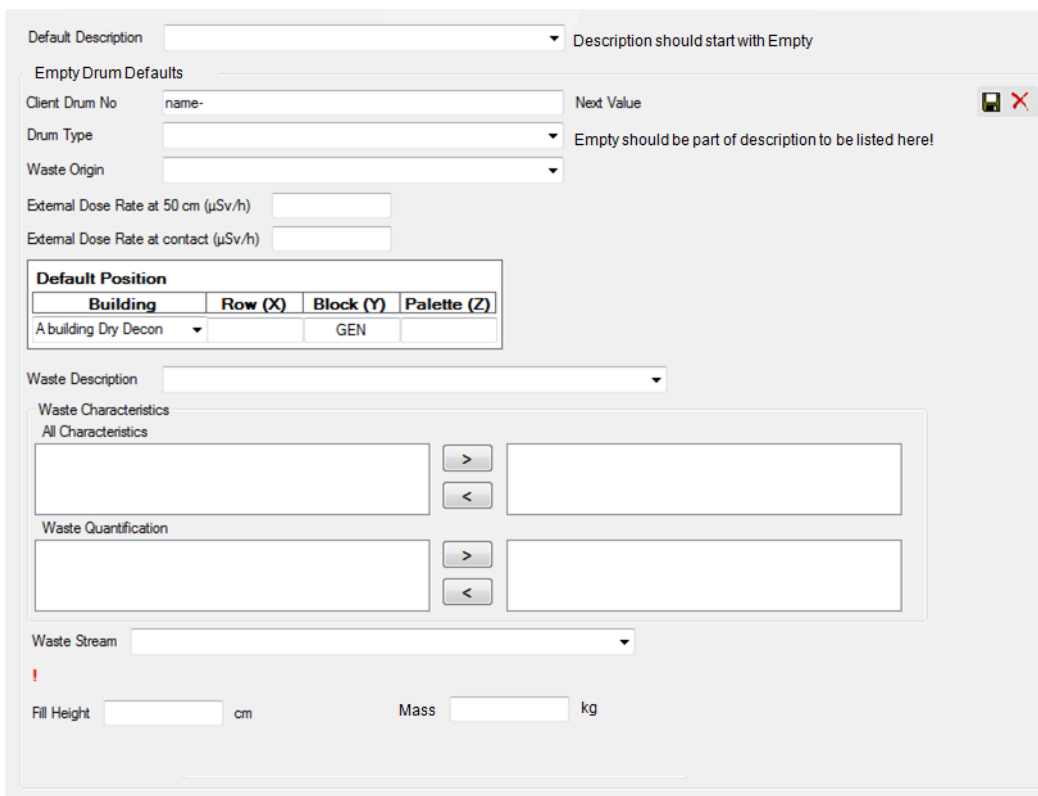
| | |
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5.3.4 Default Registration Template for Semi-Automatic Population

5.3.4.1 Empty Drums

- Add a *Default Registration-Empty Drum* template (administration screen-Figure 11a) to specify the parameters needed to populate the registration of drum types containing the word *empty* in the description field automatically. Registration information will be dependent on the drum type.



Default Description Description should start with Empty

Empty Drum Defaults

Client Drum No Next Value

Drum Type Empty should be part of description to be listed here!

Waste Origin

External Dose Rate at 50 cm (µSv/h)

External Dose Rate at contact (µSv/h)

| Default Position | | | |
|----------------------|----------------------|-----------|----------------------|
| Building | Row (X) | Block (Y) | Palette (Z) |
| A building Dry Decon | <input type="text"/> | GEN | <input type="text"/> |

Waste Description

Waste Characteristics

All Characteristics

Waste Quantification

Waste Stream

! Fill Height cm Mass kg

Figure 11a: Possible screen for the automatic population of empty drums

- List all the drum types with the word “empty” included in the name in the dropdown. The drum type (as selected by the operator when registering the drum) will be used to indicate which default template to use for the automatic population of the full registration of the drum.
- Allocate the following registration parameters as specified per drum type-
 1. Client Drum No
 2. Waste Origin as selected from dropdown menu
 3. External Dose Rate
 4. Default Position
 5. Waste Description as from dropdown menu
 6. Waste Characteristic

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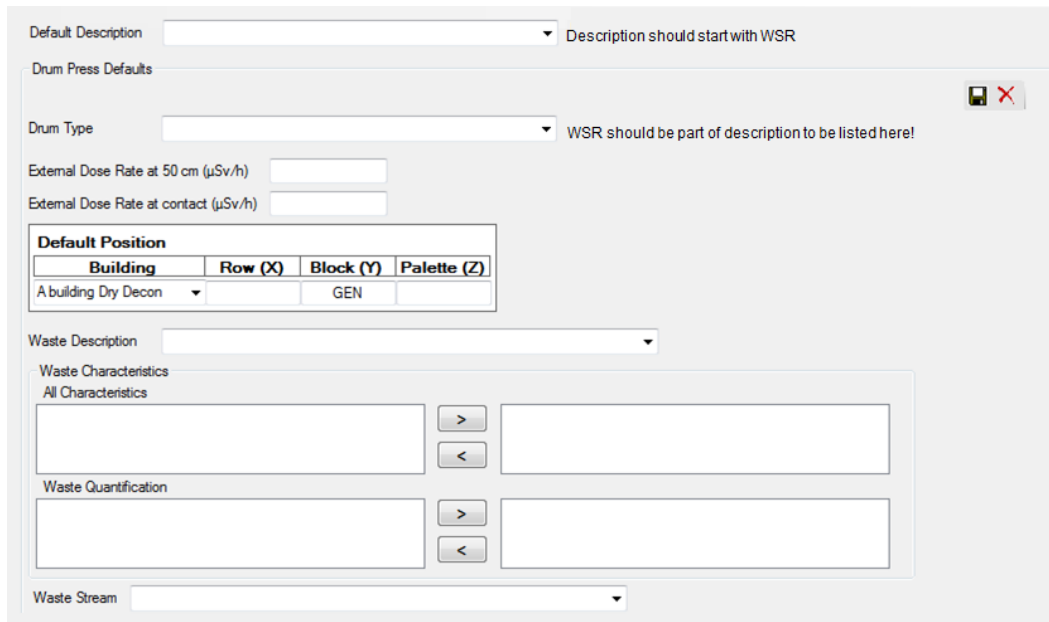
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7. Waste Stream from dropdown menu
8. Fill Height
9. Gross Mass

- The template will be completed in the same way as for the normal partial and full registration (the current *Drum Press Default* screen is the template used for the automatic registration for parent drums at the VRF)
- For the *Client Drum No* only the default part will be specified (for example WSRF) on the template. An index number will be added automatically every time an empty drum is added to the system.

5.3.4.2 *Liquid Containers*

- Add a *Default Registration-Liquid Containers* template (administration screen- Figure 11b) to specify the parameters needed to populate the registration of drum types containing the word *WSR* in the description field automatically. Registration information will be dependent on the drum type.



Default Description: [Dropdown] Description should start with WSR

Drum Press Defaults

Drum Type: [Dropdown] WSR should be part of description to be listed here!

External Dose Rate at 50 cm (µSv/h): [Input]

External Dose Rate at contact (µSv/h): [Input]

| Default Position | | | |
|----------------------|------------|-----------|-------------|
| Building | Row (X) | Block (Y) | Palette (Z) |
| A building Dry Decon | [Dropdown] | GEN | [Input] |

Waste Description: [Dropdown]

Waste Characteristics: All Characteristics

Waste Quantification

Waste Stream: [Dropdown]

Figure 11b: Possible screen for the automatic population of liquid containers

- List all the drum types with the word “WSR” included in the name in the dropdown. The drum type (as selected by the operator when registering the drum) will be used to indicate which default template to use for the automatic population of the full registration of the container.
- Allocate the following registration parameters as specified per drum type-

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1. External Dose Rate
2. Default Position
3. Waste Description as from dropdown menu
4. Waste Characteristics
5. Waste Stream from dropdown menu

5.3.5 Administration Screen for Locations/Buildings

Add an administration screen to manage (add/edit/delete) the locations/buildings (gap identified in current system) as listed in the Building dropdown list of the Current Position Block during partial registration (the building parameters are populated in the *Location* table in the database).

5.3.6 Administration Screen for Drum Status

Add an administration screen to manage (add/edit/delete) the *Drum Status* options and to specify which *Drum Status* options will activate/enable the *Segregation Input* section (see paragraph 5.1.1.1) on the X-ray and WSRF screen. Only drums with a final *Drum Status* that will activate the *Segregation Input* section will be accepted at the WSRF, all other drums will be rejected.

5.4 REPORTS

All the reports (new and existing) must be migrated to either MS-SQL reporting Services or Crystal reports and users must be able to view these as either PDF or Excel files, as specified in Appendix 2.

5.4.1 Drum General Search

- Change current report to incorporate *Drum Status* (as determined from the X-rays) of the drum as well as to use the *Drum Status* as a filter.

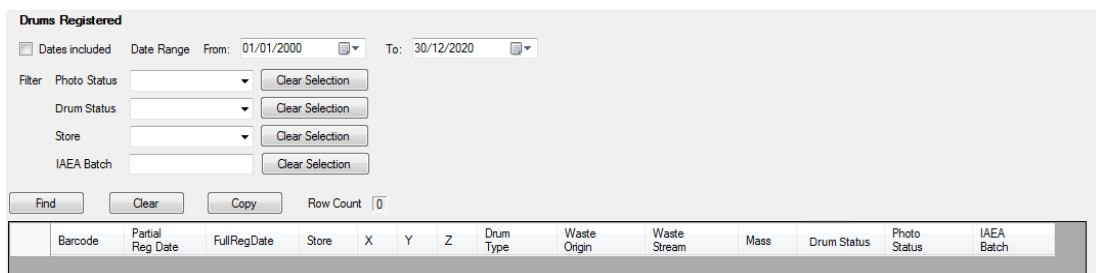


Figure 12: Print screen of the current *Drum General Search* report including the *Drum Status*

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5.4.2 Scanner Acceptance Check report

- Change current report to incorporate the *Drum Status* of the drum as determined from the X-rays.

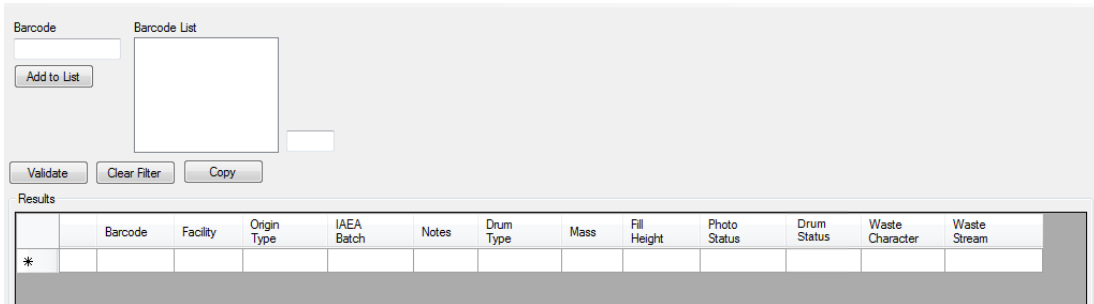


Figure 13: Print screen of the current *Scanner Acceptance Check* report including the *Drum Status*

5.4.3 Drum Press Barcode Valid

- Change current report to incorporate the new acceptance requirement for the final *Drum Status* as determined from the X-ray. This status has to be displayed in the table. The validation of the acceptance requirements for empty drums also needs to be incorporated into the report for validation.

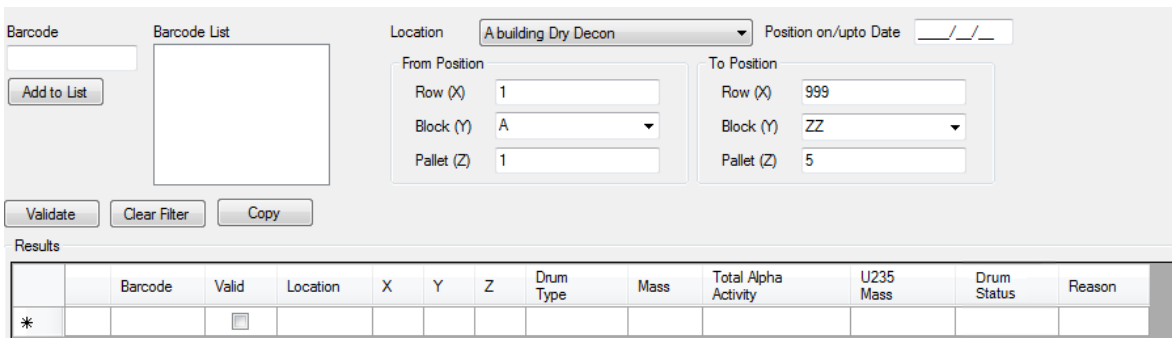


Figure 14: Print screen of the current *Drum Press Barcode Valid* report including the *Drum Status*

5.4.4 Tracking of Segregation and Analysis of new Items

- Add a new report for the tracking of the segregation process and the status of the new items regarding the analysis and the IAEA batching.

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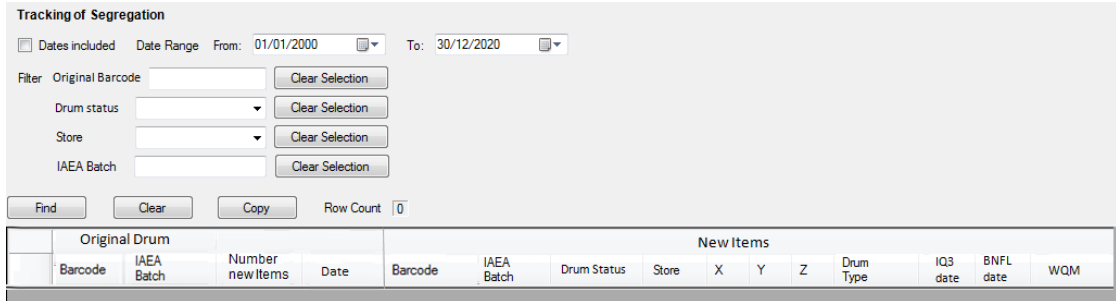


Figure 15: Possible screen for the *Tracking of Segregation and Analysis of new Items* report

The following information for the original drum has to be reported:

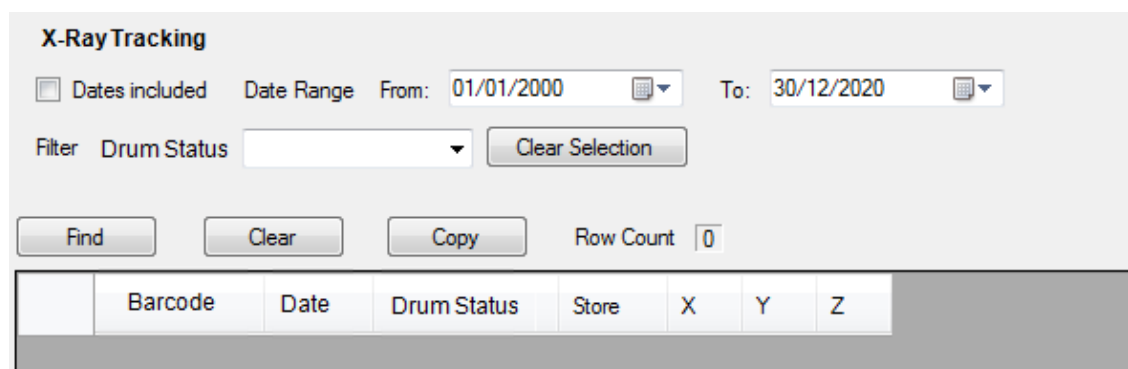
1. Barcode
2. IAEA Batch
3. Number new Items
4. Date of repacking

The following information for the new items has to be reported:

5. Barcode
6. IAEA Batch
7. Drum Status as determined from X-rays
8. Location in terms of Store, Row(X), Block(Y) and Palette(Z)
9. Drum Type
10. IQ3 and BNFL dates (analysis of new drum)
11. Waste Quantification Method used for liquid container (up to two methods are possible) – both must be displayed if applicable

5.4.5 X-ray Tracking

- Add a new report to track the drums scanned by the X-ray



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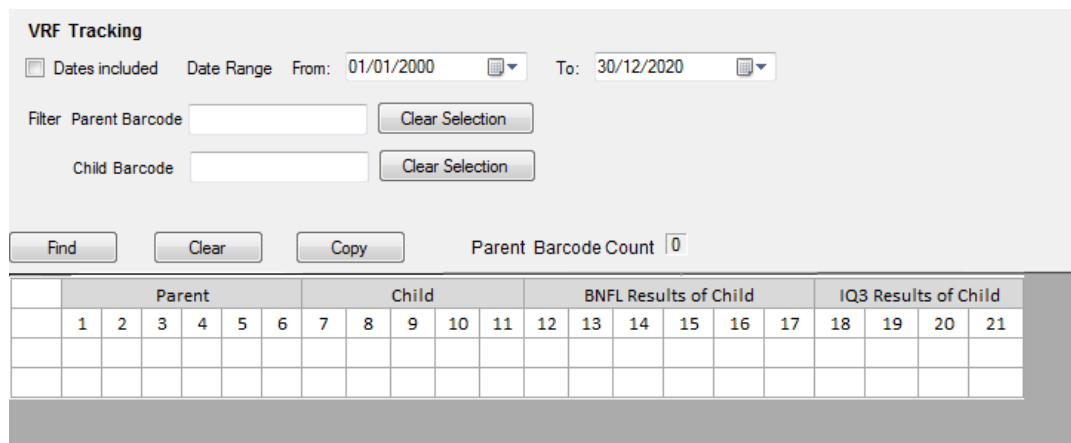
Figure 16: Possible screen for the Tracking of X-ray scanning report

The following information has to be reported:

1. Barcode
2. Date
3. Drum Status
4. Location in terms of Store, Row(X), Block(Y) and Palette(Z)

5.4.6 VRF Tracking

- Add a new report to track the drums compacted at the VRF



The screenshot shows a 'VRF Tracking' window with the following elements:

- Dates included
- Date Range From: 01/01/2000 To: 30/12/2020
- Filter Parent Barcode: [input field] [Clear Selection]
- Child Barcode: [input field] [Clear Selection]
- Buttons: Find, Clear, Copy
- Parent Barcode Count: 0
- Table with columns: Parent (1-6), Child (7-11), BNFL Results of Child (12-17), IQ3 Results of Child (18-21)

Figure 17: Possible screen for the Tracking of drums compacted at the VRF (column numbers refer to detail information below)

The following information has to be reported for the Parent:

1. ParentDrumID
2. Barcode
3. ClientDrumNo
4. Gross Mass
5. ActiveFillHeight
6. Location in terms of Store, Row(X), Block(Y) and Palette(Z)

The following information has to be reported for the Child:Barcode

7. Barcode
8. Compacted height
9. ChildPosition

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- 10. Date Added
- 11. Gross Mass

The following information has to be reported for the child regarding BNFL results

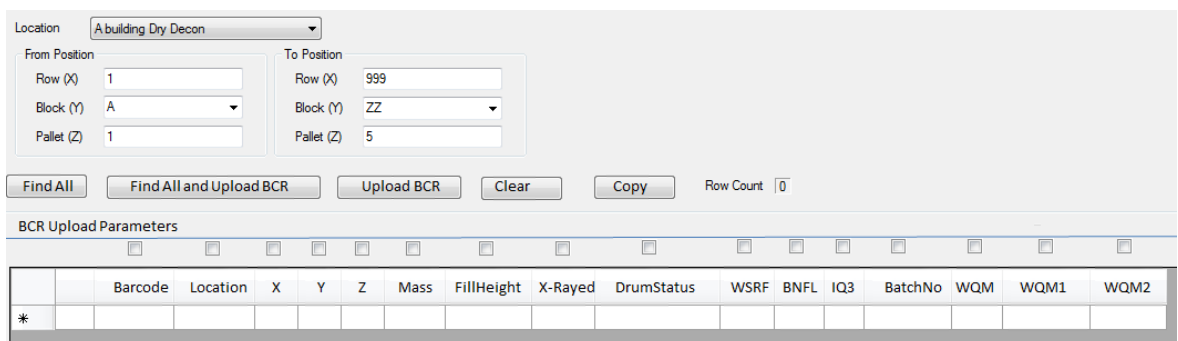
- 12. SDS OperationID
- 13. ColorCode
- 14. U235Mass (=U235DrumMassBest)
- 15. TotAlpha (=DrumTotAlphaBest)
- 16. TotBeta (=DrumTotBetaGamBest)
- 17. DrumWeight

The following information has to be reported for the child regarding IQ3 results

- 18. U235Mass
- 19. U238Mass
- 20. MGAU
- 21. IAEABatch

5.4.7 Drum Progress Tracking

- Add a new report to track the progress of the drums through all the different processes.
- Add a function to upload information (from the report output) to the BCR as specified by the operator to be displayed on the BCR when the barcode of the drum is scanned.



The screenshot shows a software interface for tracking drum progress. It includes a search area with a 'Location' dropdown set to 'A building Dry Decon'. Below this are 'From Position' and 'To Position' sections, each with input fields for Row (X), Block (Y), and Pallet (Z). The 'From Position' fields are: Row (X) = 1, Block (Y) = A, Pallet (Z) = 1. The 'To Position' fields are: Row (X) = 999, Block (Y) = ZZ, Pallet (Z) = 5. Below the search area are buttons: 'Find All', 'Find All and Upload BCR', 'Upload BCR', 'Clear', and 'Copy'. A 'Row Count' field shows '0'. Below the buttons is a section titled 'BCR Upload Parameters' with a grid of checkboxes. At the bottom is a table with the following columns: Barcode, Location, X, Y, Z, Mass, FillHeight, X-Rayed, DrumStatus, WSRF, BNFL, IQ3, BatchNo, WQM, WQM1, and WQM2. The first row of the table is marked with an asterisk (*) in the first column.

Figure 18: Possible screen for the Tracking of the progress of drums through the different processes

The following information has to be reported:

- 1. Barcode
- 2. Location in terms of Store, Row(X), Block(Y) and Palette(Z)

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3. Gross Mass
4. FillHeight
5. X-rayed (✓ / ✗)
6. Drum Status (see figure 6 paragraph 5.1.1)
7. WSRF (✓ / ✗)
8. BNFL (✓ / ✗)
9. IQ3 (✓ / ✗)
10. IAEA Batch (see figure 8)
11. Any Other Waste Quantification Methods (✓ / ✗)
12. WQM used (up to two methods are possible) – both must be displayed if applicable

5.5 RECOMMENDATION AND PROGRAMMING OF BARCODE READERS, AND THE INTERFACE WITH WTS

- Add a new module on the Barcode Readers (used for the *Drumload Batch* and *Drum Move* menus) to display the progress of processes as specified and uploaded by the operator by using the upload function on the *Drum Progress Tracking* report in the WTS (see paragraph 5.4.7) Recommend barcode readers that will be compatible with the WTS and which will be capable to perform the following functions:
 - 1) The opening of the original drum's information when scanning the barcode on the drum at WSRF (see paragraphs 5.1.2 and 5.3.1). Display the *X-ray Image* screen by default when opening the drum's information.
 - 2) The capturing of the barcodes of the new items (drums/containers) used during repacking in the WSRF (see paragraphs 5.1.1.2 and 5.3.1)
- Program the barcode readers to perform the functions as described.
- Change or redevelop the existing WTS-Barcode interfacing to ensure that all the BCRs will retrieve and download the required information between the WTS and BCR

5.6 SECURITY

Add all the new screens and new functions in the permission list as shown in Figure 2.

APPENDIX 1: Reason Codes used for validation of VRF acceptance requirements.

| | | |
|------|--------------|--|
| 0021 | Drum Invalid | No Photo |
| 0022 | Drum Invalid | Not Fully Registered |
| 0041 | Drum Invalid | Drum Type or Waste Description* |
| 0051 | Drum Invalid | Drum Weight |
| 0052 | Drum Invalid | Drum Weight Null |
| 0061 | Drum Invalid | No BNFL/ISOCS results |
| 0071 | Drum Invalid | Waste Class or AlphaActivity or U235 not Valid |
| 0072 | Drum Invalid | Color Code empty |
| 0081 | Drum Invalid | No IQ3 results |
| 0091 | Drum Invalid | IAEA Batch is Null |
| 0092 | Drum Invalid | IAEA Bacth is blank |
| 0101 | Drum Invalid | IAEA Released = No |
| 0102 | Drum Invalid | IAEA Released blank |
| 0131 | Drum Invalid | Process Waste Origin NOT Drum Waste Origin |
| 0140 | Drum Valid | Process Waste Origin = Drum Waste Origin |
| 0150 | Drum Valid | Selected Batch process = drum batch |
| 0151 | Drum Invalid | Selected Batch process NOT drum batch |

APPENDIX 2: Specified Output Formats of the Different Reports

| REPORTS | FORMAT |
|---|--------------------------------------|
| Drum Move Report (generated from the <i>Drum Move</i> function) | PDF (Portable Document Format) |
| Drum Transfer Certificate (generated from the <i>Download Batch</i> function) | PDF (Portable Document Format) |
| Store Inventory | Excel |
| Drum Transfers | Excel |
| Drum Received | Excel |
| Drum Tracking | Excel |
| Drum General Search | Excel |
| Drum Count per Location | Excel |
| Drum Press Barcode Valid | Excel |
| Scanner Acceptance Checks | Excel |
| Tracking of Segregation and Analysis of New Items | Excel |
| X-Ray Tracking | Excel |
| VRF Tracking | Excel |
| Drum Progress Tracking | Excel; Uploading to BCR as specified |
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