The Container Database — Life-Cycle Management of Container Inventories at the Hanford Site – 15131

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ABSTRACT
Since 2011 the Department of Energy (DOE) Richland Operations Office (DOE-RL) and their contractor CH2M HILL Plateau Remediation Company (CH2M HILL) have worked together to develop a database that provides life-cycle management and control of all CH2M HILL-managed Department of Transportation (DOT) Type A and Industrial Packaging (IP) container assets at the Hanford Site. This powerful tool provides CH2M HILL with the capability to centrally manage container procurement specifications; maintenance requirements; certificates of conformance; certification and test reports; as-built drawings; and information on container status, location, and ownership; and any special characteristics of container assets. The database was originally developed to provide ready access to Type A and IP container supplier and manufacturer Certificates of Conformance (CoCs) and related certification documentation to support onsite shipments in compliance with the Hanford Site Wide Transportation Safety Document (TSD), DOE/RL-2001-0036, as well as regulatory or other requirements. The information is accessed through active links to these documents within the database itself. The database has grown to include links to external supplementary information to support onsite shipments, such as links to authorized tie downs for each package type, approved packaging and transportation commodities, and approved shipping authorizations, and packaging management procedures and checklists. The database is a living databank that is easily tailored to meet user- and site-specific needs as they are identified. It is currently being expanded to include the inventories of all Hanford contractors, as well as other packaging assets, such as specialty drums and packaging commodities. Each upgrade brings efficiencies and cost savings, not only in container inventory management, but also in the areas of work control, waste packaging, waste transportation, and regulatory compliance.

INTRODUCTION
A series of assessments of the CH2M HILL Transportation and Packaging Program conducted in 2009 and 2010 identified several issues in configuration management of container assets and supporting documentation. While most were readily resolved, it was later noted that some of the "resolved" issues had reoccurred. Indeed, several self-assessments conducted between 2010 and 2011, revealed recurring issues that significantly hindered the ability to provide container-specific information such as CoCs to support onsite shipments and highlighted significant gaps at each stage in the container management process.

Gap 1 – Container Procurement – With more than 20 active Type A and IP procurement specifications prepared or revised by numerous site subcontractors over nearly 15 years, many inconsistencies were found to exist in the data submittals required from (and provided by) the vendor for each container delivered. Further, the procurement process for radioactive materials did not require the container vendors to provide sufficient information to demonstrate all regulatory requirements were met.

Gap 2 – Container Receipt – Quality Assurance Inspection Plans (QAIPs) were not sufficient to ensure the container vendors met all contractual requirements, including requirements from the Procurement Specifications. They were not consistent in the information that was being verified, did not require that container serial numbers be tracked to Hanford barcodes and often promulgated incorrect container

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information.

Gap 3 – Container Information Management – Documentation provided by container vendors such as container CoCs, material test reports, drawings, maintenance requirements etc., was stored in multiple electronic storage locations which led to retrieval of out-of-date and inaccurate information. No controlled configuration baseline had been established for the containers.

Gap 4 – Container Inventory Management – There was no accurate, centralized accounting of the container inventory. Individual Projects maintained their own inventories and often overstocked to ensure adequate supply was available. The inventory was tracked by barcode using the Solid Waste Inventory Tracking System (SWITS) and there was no mechanism to trace containers back to their original serial numbers and associated certification documentation.

Each of these gaps alone led to difficulties in demonstrating compliance during onsite shipments, and combined, they almost assured non-compliances that ranged from not being able to provide container-specific CoCs, through using containers with gaskets that had exceeded their shelf lives, to not having the appropriate spare parts or commodities on hand for the type of container being used.

DISCUSSION

With an estimated inventory of more than 1,500 in-process containers to be tracked on the CH2M HILL Plateau Remediation Contract, it was clear that a systematic review of the entire container management life-cycle was needed to address the gaps that had appeared at each stage in the process. Figure 1 shows the simplified container life cycle along with a high-level plan to address each gap. The methods used to implement each plan are discussed in detail below.
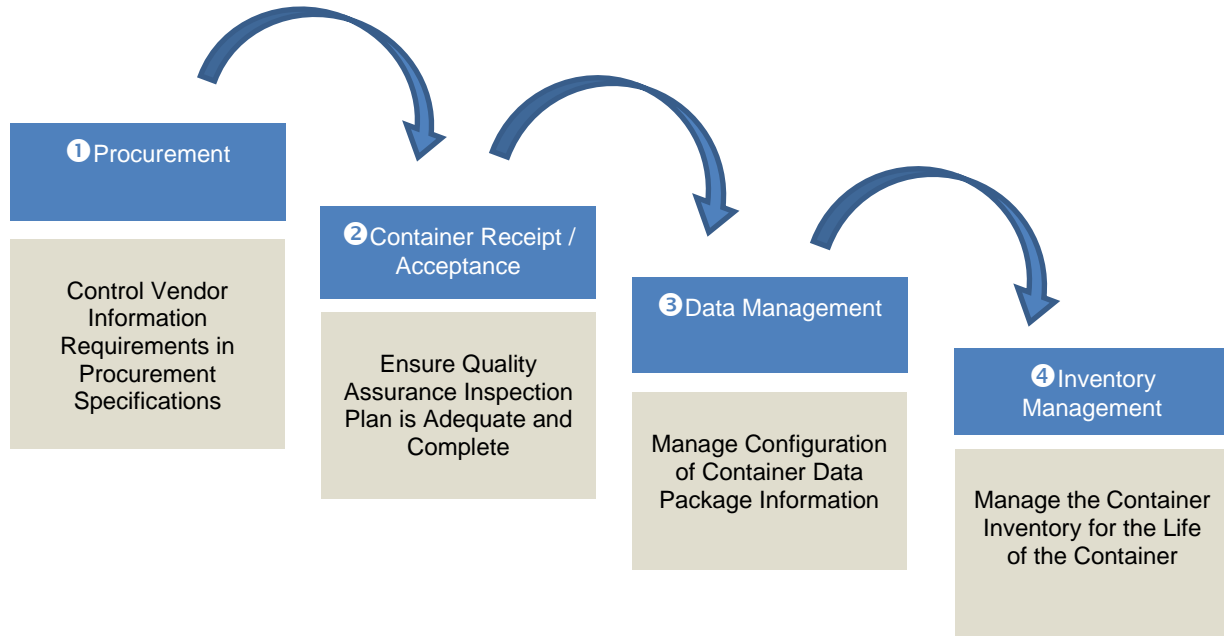

Figure 1. Gaps were identified at each stage in the container management life cycle and plans were developed to address each gap. The challenge was implementation.

Gap 1 – Container Procurement. The first step in managing procurement specifications was to agree upon a consistent set of vendor information submittals that would be required of each vendor. At the time there were more than 20 active specifications for various types and sizes of containers in the Hanford inventory. These specifications had been developed and subsequently modified by at least three site contractors over a period of fifteen years. For example, what had started out as one specification for a 9x5x5, Type A metal box, had morphed into three often dissimilar specifications, including:

- 9x5x5 metal box with hooks
- 9x5x5 metal boxes with grout port closures
- 9x5x5 metal box

Often, as regulations and requirements for vendor data submittals changed over the years, one specification might be updated to reflect the changes, while the others might not. The more time that had passed, the more disparate these specifications became. A major step in filling this gap was to determine the standard set of vendor information that would be required in every procurement specification. This information was standardized to include:

- Vendor Certificates of Conformance (CoCs)
- Completed Quality Assurance Inspection Plan
- As-built Drawings
- Mill Certifications and Test Reports
- Container Closure Instructions
- Spare Parts Listing
- Nonconformance Reports generated during fabrication
- Gasket Replacement Instructions
- Maintenance Requirements
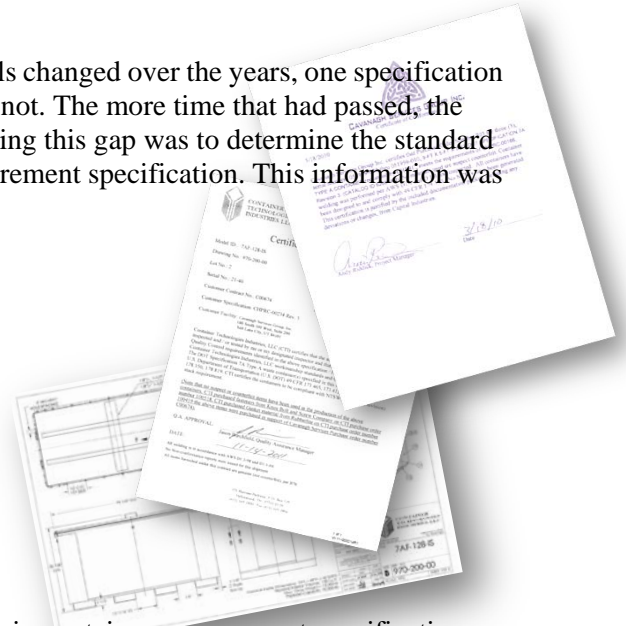
An additional initiative is just underway to further reduce errors in container procurement specifications. Under this initiative the container procurement specifications will be broken into four modules.

- Module 1 will be the container description. Descriptions will be developed for every type of container used at the site. So, for the 9x5x5 Type A metal boxes described in three specifications above, one 9x5x5 specification will be developed that will describe the basic 9x5x5 box and any special configurations of the box. Likewise, one and only one specification will be developed for each of the other boxes at the site for a total of about 12 specifications.

- Module 2 will list applicable regulatory requirements. This will include a stand-alone list of regulatory requirements for each container type – currently Type A, IP-1, and IP-2 metal boxes. New lists will be developed for specialty metal boxes and drums, as needed.

- Module 3 will list the quality assurance requirements. This module will include stand-alone lists that detail the quality requirements that will be levied on the various types of containers, such as Commercial Grade or Quality Level 1, 2, or 3. It will also detail the vendor qualification, quality assurance program level, and in-process surveillances required.

- Module 4 will comprise the list of vendor deliverables. This list is a static list that includes the vendor data submittals discussed earlier, such as Vendor Certificates of Conformance, completed Quality Assurance Inspection Plan, As-built Drawings, Mill Certifications and Test Reports,

Container Closure Instructions, Spare Parts Listing, Nonconformance Reports generated during fabrication, Gasket Replacement Instructions, and Maintenance Requirements.

This modular approach will simplify the maintenance and upkeep of procurement documentation. For example, if packaging regulations or requirements change only the appropriate module will be reviewed for applicability and changed accordingly, where in times past every procurement specification had to be reviewed and revised. These actions (standardizing information required from the vendors and standardizing specifications to eliminate errors and contradictions) though not fully implemented, will significantly reduce the errors associated with the container procurement process.

Gap 2 – Container Receipt. The second gap centered on container receipt and acceptance and how containers were logged into inventory and tracked from receipt through disposition. Until recently the Hanford container inventory had been tracked coincidentally with the waste using the Solid Waste Inventory Tracking System (SWITS). At receipt, barcodes were applied to empty containers and entered into SWITS with no cross-reference between the barcode and the container serial numbers. The vendor's CoC is directly traceable to the container serial number, while the Hanford barcode is used to track waste. Because no effort was made to record the container serial numbers against the barcodes that were applied upon receipt, tracking the container pedigree was extremely difficult and became a significant roadblock in providing container-specific information to support waste shipments at the Site. In some cases it resulted in the selection and use of the wrong container type for the waste being transported or the use of the wrong hardware or spare parts for the container being used.

Another problem that occurred at receipt was simple human error or promulgation of errors in the procurement specifications as discussed above. Prior to receiving a shipment of containers the Packaging Design Authority (PDA) prepares the QAIP to include all the requirements which must be verified as satisfied by qualified verification personnel upon receipt of the container shipment. However, often the wrong purchase order number, catalogue ID, specification number, specification revision, drawing number, drawing revision, etc., were entered on the QAIP which made tracking back to the original procurement documentation or container certification documentation difficult.

Two changes were made to packaging management program to address these issues. First we revised the QAIP and appropriate procedures to require that the manufacturer's serial number and the assigned barcode be recorded for each container received. Line 14 of the QAIP now reads as follows:

14	Record cross reference information between container serial number and the SWITS barcode number applied to the container in Column 20 (or attached sheet) for each package.

The second change addresses the accuracy of the information on the QAIP. Again, changes were made to program procedures that require that the PDA review both the vendor submittals and the completed QAIP to ensure the accuracy and completeness of both prior to final acceptance of the shipment. Errors in the vendor data submittals are worked directly with the vendor. These often include the same errors discussed above. Errors on the QAIP are resolved with the receipt and verification organization.

Gap 3 – Container Information Management. The third gap inolvolved the lack of a disciplined approach to managing container documentation. Over the years many approaches had been taken to

managing container data. Primary responsibility for managing the information resided with the PDA(s), each having specific preferences as to how the documentation was stored and retrieved.Over the years many approaches had been taken and processes implemented; however, no attempts had been made to establish a central, controlled repository for container information, nor was the configuration baseline established and subsequently managed for each container type.Container users depended upon the PDAs personal knowledge of data submittals to provide certification documents required for shipment, or completed haphazard searches of massive data repositories with the hope that whatever information they found was the most recent. Again using the 9x5x5 container as an example, the current 9x5x5 inventory includes three configurations of containers built by four manufacturers in accordance with nine different specifications or specification revisions and six purchase orders, each with varying requirements for vendor data submittals. A search of the data repositories for "9x5x5 CoC" yields 176 results, leaving you to sort through all results to find the CoC specific to the container in question.Combine this with the lack of any connection between the Hanford barcode and the manufacturer's serial number, which is cited on the CoC, and it becomes quite difficult to determine which of the 176 CoCs applies to your container.

Correcting this problem was a massive undertaking. First, data repositories, shared drives, PDA archives, and numerous other data storage locations (both electronic and hard copy) were searched to locate existing data submittals for the PRC inventory of Type A and IP metal boxes. Without regard to whether or not the information was complete, or whether or not the container was full, empty, or disposed for that matter, the information was categorized and entered into the Hanford Document Management Control System (DMCS) in accordance with CHPRC Engineering procedures for configuration management, establishing the configuration baseline for these containers. The vendor data submittal for each batch, or delivery, of containers was separated into individual files in accordance with the standard vendor submittals discussed above. These individual files were assigned VI (Vendor Information) numbers and entered into DMCS using an ECR (Engineering Change Request) form. The VI and ECR numbers are unique numbers that can be easily recalled through several data management systems used at the Hanford site.This effort required approximately one year to complete and resulted in the entry of approximately 100 ECRs and more than 2000 VI files (more than 20,000 containers) in DMCS. Remember, too, that this effort was simply aimed at finding and entering existing data. No effort was made to validate the data or to ensure that it was complete at this time. Table 1 provides an example of the information that was entered in DMCS for a batch of six 9x5x5 containers.

It was also during this time that some correlation could be made between the Hanford barcodes and the manufacturer's serial numbers. Until this time, the inventory was tracked by barcode using SWITS and there was no mechanism to trace containers back to their original serial numbers and associated certification documentation. However, this effort revealed that a SWIR525 Receipt Report had been generated for each batch of containers received at the site. This report, which is shown in Table 1 as VI-12-000356, lists the barcodes that are assigned to the specific batch, in this case six barcodes. While the report does not indicate which barcodes are assigned to which container serial numbers, VI-12-000358 and VI-12-000359 indicate the serial numbers for this batch. Based on this information, it is known that there are only two CoCs that could apply to the six assigned barcodes listed on the report. This is a significant improvement over having to wade through 176 search results as discussed earlier.

Gap 4 – Container Inventory Management. Now that the configuration baseline had been established, the next step was to determine the status of the containers – which were full and in storage, which had been disposed, and which were empty and available for use. At the time there was no accurate, centralized accounting of the container inventory. Individual projects maintained their own inventories and often overstocked to ensure adequate supply was available. A physical inventory was required to address this

Table 1. The Data Package From Each Batch of Containers was Separated into Vendor Information Files and Entered into DMCS.

ECR No.	VI No.	Description
ECR-12-000421	VI-12-000355	QAIP, SNs 839-001 thru 006
6 containers	VI-12-000356	SWIR525 Receipt Report
	VI-12-000357	NCR-09-FHAVS-0060
	VI-12-000358	CofC, SNs 839-001 thru 004
	VI-12-000359	CofC, SNs 839-005 & 006
	VI-12-000360	Spare Parts List
	VI-12-000361	HEPA Filter Installation Instructions
	VI-12-000362	Gasket Installation Instructions
	VI-12-000363	Bolting & Torque Instructions
	VI-12-000364	Materal Certs & Test Rpts, SNs 839-001 - 004
	VI-12-000365	Material Certs & Test Rpts, SNs 839-005 & 006
	VI-12-000366	CMP-09-007, Index
	VI-12-000367	Dwg. BM-1190, R6

gap. SWITS reports were used as the basis for the inventory. SWITS reports were run first for each container storage location, next for each project, and finally for each container type used at the site. Using these reports, a physical inventory was completed. Information collected during the inventory included container status (i.e., full or empty), barcode, serial number, and location.

Although SWITS provided an accurate inventory by barcode, status, and location, it did not include serial number references.And, while procedures were in place to require that serial numbers be recorded for each barcode on the QAIP upon container receipt, no provisions existed for in-process containers. In some instances during the inventory it was not possible to see the serial numbers to record them to the barcodes.

Therefore, there was still some missing information in this area. In order to address the barcode versus serial number issue, one additional step was taken. Procedures were revised to include provisions for recording container serial numbers against the barcodes each time a container was shipped. This practice would ensure that the needed information was captured at each stage in the life cycle of the container and would be discontinued when the current in-process inventory was accounted for.

As a result of the physical inventory it was determined that of the 20,000+ containers baselined in DMCS, approximately 15,000 containers had been permanently disposed, leaving approximately 1500 in inventory. This was a significant reduction in the information that had to be managed.

The Container Database. Information gathered to address each gap was carefully recorded as it was being generated. Initially information entered into DMCS was captured in the *DMCS Container Listing*. This 65-page document lists every ECR and VI file that has been entered into DMCS for the type A and IP metal boxes managed by CHPRC. Figure 2 shows the first page of the DMCS files for the 9x5x5 containers. As shown in the figure, in addition to the ECR and VI numbers, information is included on the catalogue identification numbers (CAT ID), container manufacturer, the number of containers in the batch, old reference numbers, and the purchase order number.

The *DMCS Container Listing* provided a clear picture of the information available for each container type, a subset of which is routinely needed to support transportation activities at the site. This, in turn, prompted thought on how to make this data subset readily available to container users contract-wide and the container database was conceived. Figure 3 shows the headings from the database and gives an indication of the depth of information available to database users. It also indicates the information that is accessible through hyperlinks directly from the database.

Misc. References	Qty	ECR No.	VI No.	Description
9x5x5 7A Type A Metal Box (CAT ID 626814, 656275)				
CMP-11-014	6	ECR-12-000393	VI-12-000188	QAIP, SNs 116 thru 121
Vendor	CTI		VI-12-000189	SWIR525 Receipt Report
PO	45306		VI-12-000190	CofC, SNs 116 thru 121
			VI-12-000191	Closure Procedure 7AF-225
			VI-12-000192	Dwg 970-178-02, R2
			VI-12-000193	Certification and Test Analyses
			VI-12-000194	In-Process Inspection Sheets
			VI-12-000195	Spare Parts List
CMP-11-012	20	ECR-12-000392	VI-12-000196	QAIP, SNs 101 thru 115
Vendor	CTI		VI-12-000197	SWIR525 Receipt Report, SNs 101 thru 115
PO	44714		VI-12-000198	CofC, SNs 101 thru 105
			VI-12-000199	CofC, SNs 106 thru 110
			VI-12-000200	CofC, SNs 111 thru 115
			VI-12-000201	QAIP, SNs 01thru 05
			VI-12-000202	SWIR525 Receipt Report, SNs 01 thru 05
			VI-12-000203	CofC, SNs 01 thru 05
			VI-12-000204	Container Closure Instructions, SNs 101 thru 105
			VI-12-000205	Certification & Test Analyses, SNs 01 thru 05
			VI-12-000206	Dwg. 970-178-01, R1, SNs 01 thru 05
			VI-12-000207	Inspection and Test Report, SNs 101 - 105
			VI-12-000208	Certification & test Analysis, SNs 101-105
			VI-12-000209	Container Closure Instructions, SNs 101 - 105
			VI-12-000210	Dwg. 970-178-01, R1, SNs 101 - 105
			VI-12-000211	NCR 003-2011 & CHPRC approval, SNs 111 thru 115
			VI-12-000212	Inspection & Test Report, SNs 111 thru 115
			VI-12-000213	Container Closure Instructions, SNs 111 thru 115
			VI-12-000214	Certification & Test Analyses, SNs 111 thru 115
			VI-12-000215	Dwg 970-178-01, R1, SNs 111 thru 115

Figure 2. There are 27 ECRs in DMCS that Capture information on the Inventory of 9x5x5, Type A Containers.

Figure 3. The Database Contains a Subset of the Information Contained in DMCS, with Hyperlinks to Files (as denoted by an *) that are Often Needed to Support Transportation Activities at the Site.

The container database is provided as an excel workbook. The workbook contains an index that is shown in Figure 4, that contains hyperlinks to each of the container types listed in the database. Also note that the containers are organized by type in the index, i.e., type A, IP-1, or IP-2, and can also be accessed via tabs at the bottom of the workbook.

Container Type Index

Type A Containers	IP-1 Containers	IP-2 Containers
3x3x6.5 metal box	6x4x4 metal box	10x4x8 metal box
8x4x4 metal box	20x8x8.5 freight container	20x8x8.5 freight container
9x5x5 metal box	Wide Side	20x8x8.5 freight container w raised floor
10x5x5 metal box	Top Hat	20x10x9 1800-TL
12x4x4 metal box		
4x4x4 metal box		
Grey Cruiser		
SLB2		
SWB		
20x10x9 1800-TL		
TDOP		
Super 7A		
212N		

Packaging Design Authority - S. McGaughey & A. Bridges

Index / 3x3x6.5 7A, AF / 8x4x4 Type A, 7A / 10x5x5 Type A, 7A / 9x5x5, Type A, 7A / 12x4x4 Top Open, Typ

Figure 4. The Database Index is Organized by Container Type and has Hyperlinks and Tabs for Navigation to Specific Container Work Sheets.

Once in place, the CHPRC Transportation Safety organization, the database owners, provided training to user organizations including those responsible for work planning, waste management, and waste shipping to familiarize users with the information and solicit feedback for improvements. Using the database waste managers can select the appropriate container for the waste they are generating and access container drawings and specifications through the hyperlinks provided; work planners can access container-specific closure procedures, spare parts lists, and approved tie down plans for inclusion in work packages; shippers can verify the container pedigree, certificate of conformance, maximum container payload weight, and other relevant data prior to releasing a shipment – all in a few key strokes from one central location.

To ensure the accuracy of the database, it is assessed quarterly and updated real time as new data is provided. Containers that are permanently disposed are dropped from the active database and the information is archived so that it is still accessible should the need arise. As users identify special requirements information is added to the database. Such was the case for the inventory of containers with

greater than 4-inch tapered grout ports. It was pointed out that the closure instructions for these grout ports were inadequate to accomplish closure. Using the database, the PDA identified the containers that had the >4-in. grout ports by adding a column in the database and indicating the affected containers, worked with the container manufacturers to develop supplemental closure instructions for the grout ports, issued the supplemental closure instructions, ensured that the instructions were affixed to the side of the affected containers, and modified the container specifications to require the manufacturer to provide the revised closure instructions for any future procurements.

Another example of the improvements that have come about as a result of the database can be found in the CoC Authorizations. As mentioned earlier, because there was no correlation between container serial numbers and barcodes, and in the absence of a verified configuration baseline for the inventory of containers, it was very difficult to provide container-specific certification data, particularly Certificates of

Figure 5. DOE/RL has Reviewed Data Packages for Containers Built to the Same Specification/Drawing and Issued Authorizations for Use without Further Review.

Conformance for any given container. Now that the information was organized, verified, and easily accessible, the CHPRC Transportation Safety organization compiled data packages for the most commonly used containers. These data packages were organized in groups of containers that were built by the same manufacturer and to the same specification/revision and drawing/revision. These data packages were then submitted to DOE/RL for review and approval. If approved, DOE/RL issued a CoC Authorization (See Figure 5) that authorized the use of the containers covered by the Authorization. Any conditions of approval are noted on the Authorization.

The database has spawned additional improvements, including complementary documents and databases, such as:

- Tie Down Database – Includes two databases, one for approved internal securements and one for approved external tie downs for different packaging configurations
- Specification Listings – Includes links to the latest revisions of specifications for the most commonly used Type A containers
- List of Packaging Commodities – List of container-specific packaging commodities by catalogue ID and/or specification that includes notes as to whether or not the commodity has been approved for use
- Reusable Container Inventory – Lists "reusable" containers along with their status (listed in the database)
- DMCS Container Listing – Searchable list of all packaging ECRs and VIs resident in DMCS

While each of these tools stand-alone, they are also linked through the database to provide comprehensive information to users.

CONCLUSION

As the database matures and visibility into the inventory improves, the usefulness of the database expands significantly – with long-range plans that include customized reports and upgrades to incorporate Radio-Frequency Identification (RFID) technologies for container tracking. It has quickly become the primary tool for managing the container inventory from procurement, through receipt and data management, to life-cycle management of containers at the Hanford Site. The results thus far have shown that the time and effort spent in development have been quickly recovered. The database has reduced the errors experienced in selection of containers that are approved and certified for use, both to Department of Transportation (DOT) and DOE requirements. Its use has also reduced the amount of time and work required to obtain container-specific data and information and eliminated the practice by projects of overstocking containers, as they now have a reliable inventory in place. Work planning can be more effectively completed since operations and maintenance personnel can now access complete and accurate information from one central location, and easily incorporate the information into work planning documents. On a site such as Hanford, with thousands of waste containers needed annually, having immediate access to container information and avoiding container duplication results in significant cost savings.