Innovative use of Cloud Computing and Hardware Platforms to Improve the Accuracy, Efficiency and Auditability of LLRW – 11622

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ABSTRACT

In the absence of a specialized ERP or enterprise LLRW tracking system, companies in the LLRW industry capture data primarily on paper and in spreadsheets. This leads to errors, and a lack of data for analysis to support business decision making. For example, there are projects that occur infrequently – such as small demolition and decommissioning projects. In this case, it is difficult to develop experiential efficiencies as a team is less practiced and team members might change between projects. By maintaining data electronically, it allows for more intelligent review of previous projects and identifying better ways of processing, lower cost disposal options, and control contingencies as a part of future project planning. If data are available only on paper and in separate files, constructively using the data in subsequent projects is not readily possible.

Use of disjointed commercial applications like Microsoft Excel, industry specific software packages, custom databases and other makeshift software introduces further inaccuracies and inefficiencies. These inaccuracies and inefficiencies result primarily due to the fact that the same information is entered multiple times across the workflow and because business rules cannot be enforced. For example, a company might utilize multiple disposal paths. Shipping has created a unique identifier such as *Path1*, *Path2*, *Path3* and *Path4* for each disposal path in the shipping software. In this example, assume disposal *Path3* is utilized for a waste shipment. Accounting also has created unique identifiers for each disposal path such as *Path One*, *Path Two*, *Path Three* and *Path Four*. For the same disposal shipment, accounting receives an invoice from *Path Three*. These two disparate information trains are depicted in Figure 1.

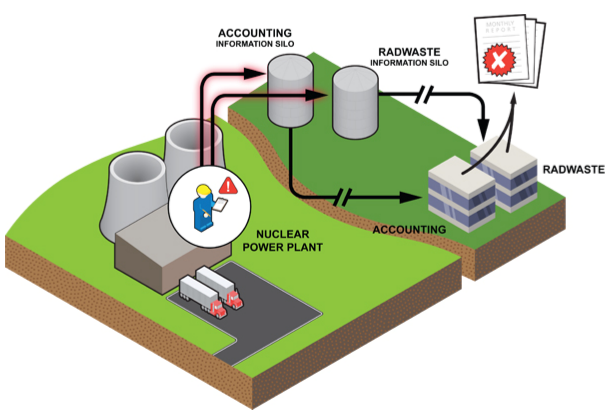

Fig. 1. Information silos are maintained separately by radwaste and accounting.

How is accuracy of the invoice checked against the shipment in the shipping software? Is this done automatically or manually? Is the comparison native to either the accounting or shipping software? For comparison, is the information from each of the shipping and accounting systems exported to Excel and a comparison made? As the reader can see, although many of the dedicated applications perform a single function well, the information each produces remains in a silo.

To solve these problems, Studsvik has developed an innovative information system that integrates all departments within the enterprise – regardless of geographical location. Studsvik believes that those companies with LLRW tracking needs would also want to eliminate manual effort, increase overall reliability of data, streamline work-flow and satisfy auditing requirements by the use of just one enterprise-wide application.

Studsvik has introduced additional improvements not only in information technology, but also by deploying the technology on common devices such as Apple's iPad and iPod Touch. These platforms further increase the efficiency and accuracy of waste tracking and improve waste accountability. This is due to the fact that, at all times, a computing device is with the user and information can be updated in the system. This simple convenience minimizes "forgetting" to do something as might more commonly happen when you "make yourself a note." The systems can also provide real time validation against business rules highlighting issues immediately with data entry, as well as providing immediate access to known information about the waste being processed.

INTRODUCTION

Waste Management heavily involves risk management considerations through multiple facets of operations. This is especially true when dealing with Low-Level Radioactive Waste. There are multiple areas of risk management as it relates to LLRW:

- Environmental
- Radiological Health and Safety
- Financial & Economic.

Risk management is a concern for the collective industry. The public does not differentiate one country, company, reactor type or technology from another. Public perception is based solely on the nuclear industry and a problem at one site impacts the operations of another site. An error can cost not only a company, but also an industry.

Improvements in the accuracy of waste management data, the efficiency of collecting data, and improved auditability of data improves risk management. Improved risk management results not only in helping a company, but also an industry.

Historically, LLRW management has been organized into silos. There has been no connection among the different departments (intra-entity) or the different companies (inter-entity).

Review of information flow from generator, to processor to disposal reveals many problems. It does not matter whether LLRW is at the NPP, processor or disposal site. Departments and groups do not exchange information well.

The complexity related to risk management of LLRW is due to the fact that physical, regulatory and financial responsibilities are separable. However, a unified system does not exist that tracks these items as a single unit. Disparate IT systems exist within entities to track physical, regulatory and financial liabilities. The systems are not connected.

Why not?

The cost of a comprehensive system has been high. A business case has not existed that supports the creation, use and maintenance of such a system. With the emergence of *Cloud Computing* and the change in computing economics it offers, a business case is now feasible and sustainable.

Cloud Computing is a term many IT professionals, engineers and business managers hear. A definition is less common; primarily due to the fact that *cloud computing* is a broad concept. In a focus group conducted by F5 Networks, participants developed the following definition[1].

> "*Cloud computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service. Users need not have knowledge of, expertise in, or control over the technology infrastructure in the "cloud" that supports them.*"

Although outside the scope of this document, *cloud computing* provides economic benefit through agility. There is both agility in business processes (primarily flexibility and responsiveness) and agility in scaling and resources (platforms, etc.). Cloud computing also offers the benefit of higher availability of the system over a broad range of devices and locations.

THE WASTE LIFE-CYCLE

Table I below enumerates the primary elements in the Waste Life-Cycle. Physically moving LLRW through the Waste Life-Cycle while maintaining data integrity is difficult.

Table I. The primary stops along the Waste Life-Cycle.

• Identification	• Reporting
• Generation	• Storage
• Characterization	• Processing [Least Cost Formulation]
• Liability accrual	• Billing
• Scheduling	• Payment
• Packaging	• Packaging
• Shipping	• Transportation
• Transportation	• Disposal
• Receipt	• Reporting

Each event in the waste life cycle has attributes. The tracking of attributes as LLRW progresses through the waste life-cycle has a price and cross departmental and entity responsibility. This increases the complexity of the process. Increased complexity leads to substantial additional expense.

Example - NPP Operational Waste Management

Two departments are responsible for managing and accounting for operational waste at an NPP. Radwaste and accounting work together to identify, track, expense, ship and pay for operational LLRW. As operational LLRW is identified, it is input into at least two IT Systems: (1) a waste shipping system and (2) an accounting system.

Once LLRW exists in two systems that are not linked, a complex and disciplined activity of synchronization of data must occur. Each department is driven by different factors. Monthly, accounting must review its waste accrual adding additions to the physical waste balance, and

[1] "Cloud Computing Survey: June – July 2009" F5 Networks, http://www.f5.com/news-press-events/press/2009/20090824a.html

subtracting dispositions. Radwaste makes changes to the inventory of LLRW as something physically occurs. Radwaste is able to make changes to information it collected in previous months. This must be communicated to accounting. However, accounting is not able to make changes to its financials from the previous months as accounting "closes" each period's activity due to financial controls. This becomes a regular reconciling item.

Example - NPP Outage Container Tracking

All NPP's focus on outage efficiencies. Shortening an outage can mean a significant savings and lengthening an outage can change the profitability for a facility. Many temporary skilled contractors converge at a facility and operate at a frenetic pace throughout the outage. The logistics of tracking containers are complex. Real-time information is not available, and locating containers following an outage is left to NPP employees. The contractor who might have moved a container is no longer available.

Example - LLRW Transporter

Specialty transporters move LLRW from an NPP to a processor, storage or disposal site. As shown in Figure 2, the movement of the waste involves three parties: (1) an NPP, (2) a transporter, and (3) the receiving party. From beginning to end, changes in possession of the LLRW neither correspond to changes in the regulatory jurisdiction of nor the financial responsibility for the LLRW.

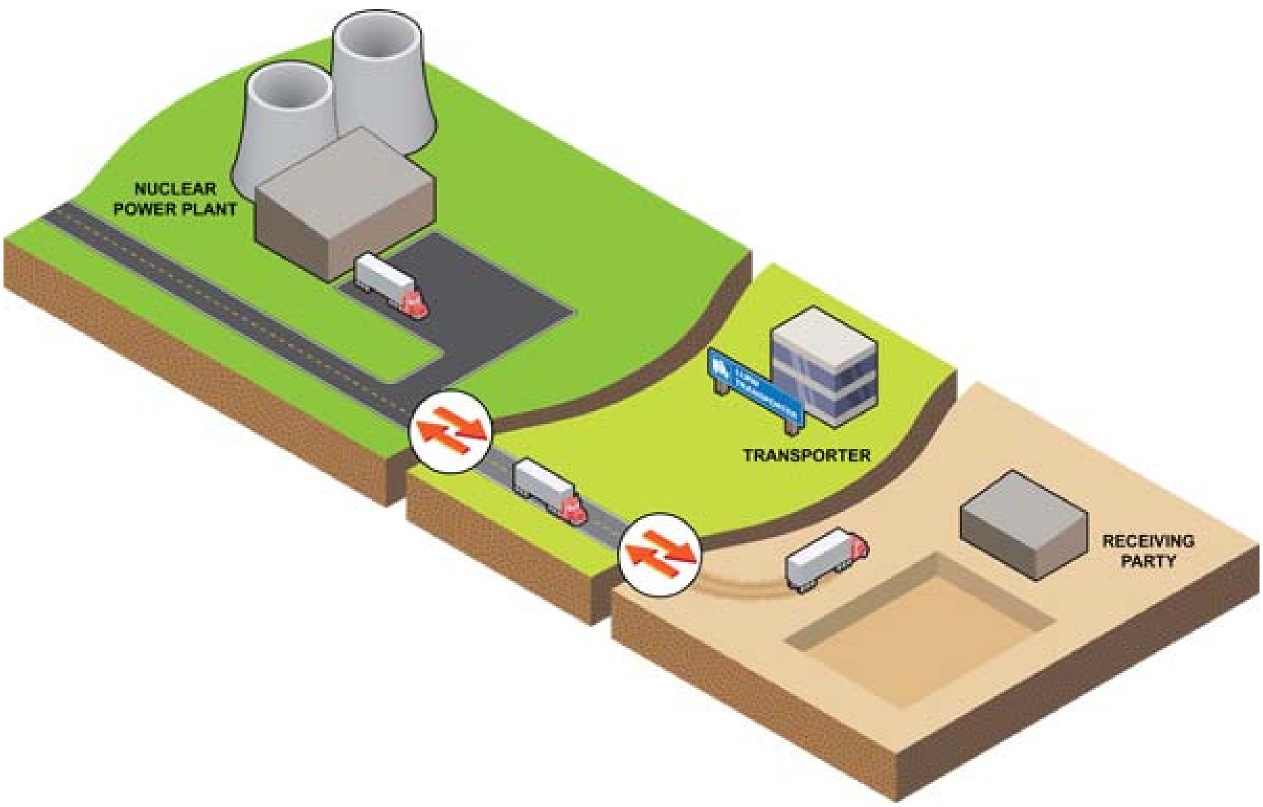

Fig. 2. The physical movement of LLRW changes possession among multiple parties, crosses regulatory and legislative boundaries.

Example - LLRW Processor

Processors are entrusted to help manage and lower the financial liability of LLRW on behalf of the generator. As Figure 3 illustrates, at any point in time, the processor is stewarding LLRW for multiple NPP's with varying contractual obligations, through a single facility; co-mingling and co-processing the waste; and packaging and disposing of the LLRW at the appropriate facility. There are regulatory and contractual reporting requirements, and the processor must document, account for and bill all waste and transactions.

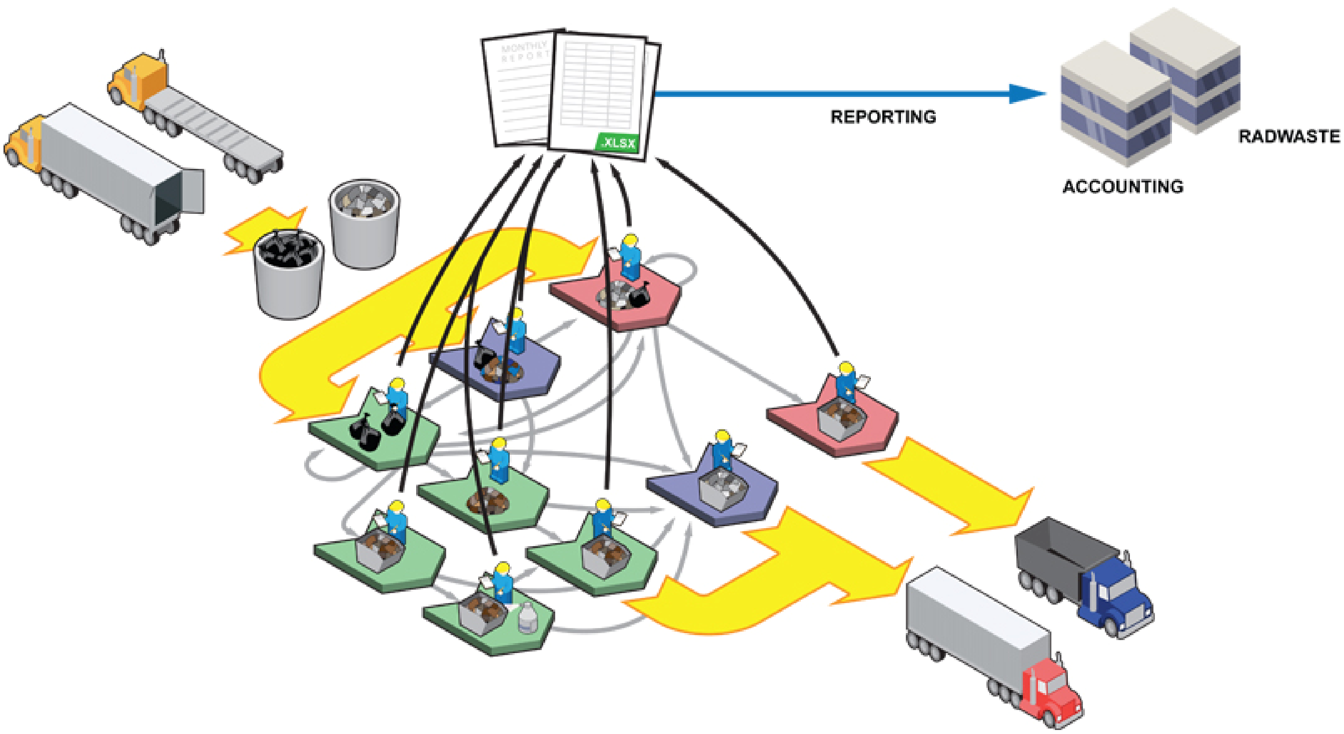

Fig. 3. The complexity of LLRW movements at a processor and the volume of waste along with the number of parties involved multiples the complexity of information tracking.

Example - Disposal Site

The disposal site is the permanent storage location for the physical waste. There is a transfer and termination of financial responsibility. The disposal site is required to know and understand what it is receiving and burying. The disposal site represents the point at which the physical, regulatory and financial liabilities come back together and reside in a single entity.

In each of the examples listed here, tracking of LLRW is required to be accurate, auditable and compliant. How is this accomplished? The complexity of the problem lends itself well to an information system that connects manufacturing, regulatory and financial packages.

This paper assumes the view point of the Processor as (1) Processors have historically both helped and hurt the industry in the management of LLRW financial liabilities, (2) Processors have a higher-volume of LLRW, (3) Processors are subject to different regulatory oversight, and (4) the authors understand Processors more intimately.

The Studsvik Processing Operations in the US can process over 50 million pounds of waste annually. This represents a very high volume of LLRW. The facilities in the US are expected to provide a valuable service to its clients so that the final liability for LLRW is reduced for its clients, and Studsvik makes a profit.

Studsvik has developed an ERP platform, referred to as Cesium, that connects the various silos required to manage LLRW. The primary connection is made between a Customer Relationship Management (CRM) package, an accounting package (GL), a reporting package, a shipping and receiving package, and the ERP platform.

THE ARCHITECTURE

From the beginning of the conceptual design, the architecture has planned on the availability of other enterprise systems that are mature and have open architectures. If a mature and open enterprise system is available, Studsvik uses hooks into the system rather than duplicating and replacing the functionality in its ERP system. Table I provides a quick review of the Waste Life-Cycle with the associated enterprise applications noting the maturity of a system and if the system is open or closed.

Table I. The Waste Life-Cycle noting the enterprise application, its maturity and system design.

Waste Life-Cycle	**Enterprise Application**	**Status - Mature and Open**
Identification	LLRW Package	Mature, Not Open
Generation	LLRW Package	Mature, Not Open
Characterization	LLRW Package	Mature, Not Open
Liability accrual	General Ledger Package	Mature, Open
Scheduling	LLRW Shipping Package Customer Relationship Management Packages	Mature, Not Open Mature, Open
Packaging	LLRW Package	Mature, Not Open
Shipping	LLRW Package	Mature, Not Open
Transportation	OTR Software	Mature, Not Open
Receipt	LLRW Package	Mature, Not Open
Reporting	Reporting Package	Mature, Open
Storage	LLRW Package (limited to a single location per site)	Mature, Not Open
Processing [Least Cost Formulation]	Proprietary Packages	Mature, Not Open
Billing	General Ledger Packages	Mature, Open
Payment	General Ledger Packages	Mature, Open
Packaging	LLRW Packages	Mature, Not Open
Transportation	OTR Software	Mature, Not Open
Disposal	Proprietary Packages	Mature, Not Open
Reporting	Reporting Packages	Mature, Open

As a reader can discern, the General Ledger (GL), Customer Relationship Management (CRM), and reporting packages are enterprise in scale, mature and open. LLRW specific attributes are of enterprise scale (primarily single-site), and while mature, each is not open.

Also from the beginning of the conceptual design, information was to be bitemporal and auditable. Bitemporal tracks when an event occurred and when an event was noticed. When an event occurred is the actual time that the event occurred. When an event was noticed is the time that the event was noticed and recorded, which may be completely different from the time that the event actually occurred. Auditable means tracking who made a change by domain account and user credentials.

Bitemporal and auditable information supports a change log. A change log is an integral part of the enterprise system and records who made a change, when the change was made, and what was changed. A complete history of changes is logged, allowing for a complete rollback of data to any point in time. Table II is an overview of the Waste Life-Cycle with the associated enterprise applications noting the availability of a persistent and integrated change log.

Table II. The Waste Life-Cycle noting the enterprise application and its change log.

Waste Life-Cycle	**Enterprise Application**	**Change Log**
Identification	LLRW Package	No Change Log
Generation	LLRW Package	No Change Log
Characterization	LLRW Package	No Change Log
Liability accrual	General Ledger Package	No Change Log
Scheduling	LLRW Shipping Package Customer Relationship Management Packages	No Change Log Change Log
Packaging	LLRW Package	No Change Log
Shipping	LLRW Package	No Change Log
Transportation	OTR Software	No Change Log
Receipt	LLRW Package	No Change Log
Reporting	Reporting Package	No Change Log
Storage	LLRW Package (limited to a single location per site)	No Change Log
Processing [Least Cost Formulation]	Proprietary Packages	No Change Log
Billing	General Ledger Packages	Change Log
Payment	General Ledger Packages	Change Log
Packaging	LLRW Packages	No Change Log
Transportation	OTR Software	No Change Log
Disposal	Proprietary Packages	No Change Log

Reporting	Reporting Packages	No Change Log

Cesium was designed with open hooks to a CRM, GL and reporting package. The design objective of Cesium is to be a LLRW Package that provides standard enterprise features and scale to the overall system.

Example - Forecasting and Scheduling

Due to the volume and the multiple processing options, Operations and the Studsvik facility need to be able to plan its work based on a number of criteria. Scheduling shipments proves to be a complex task involving multiple groups within Studsvik, in two different geographical locations as well as a customer and a transportation vendor each in other geographical locations.

Studsvik Customer Service schedules all shipments for each Studsvik facility. Based on the shipment, the information required for scheduling differs. There are multiple requirements for a scheduling system and shipping information must always be available for each facility, and multiple company departments including sales & marketing, accounting, executive management, site management, shipping & receiving, and operations.

The CRM package used by Studsvik is web-based and open. Studsvik Customer Service is able to forecast and schedule shipments with complete visibility to all necessary departments within Studsvik. Summary reports are available to match the needs of each department. Cesium incorporates the CRM package through an open API to integrate the required information.

As there is a single data source for all shipment information, any changes are visible to each department as the change occurs. There are business rules associated with each facility as to the number of shipments that can be scheduled and received. The rules are incorporated into the CRM application so that Studsvik Customer Service does not routinely violate the rules established by each facility.

The CRM is a cloud application. The Studsvik IT department has no activities associated with the care and maintenance of the application. User accounts and licenses scale up and down as necessary. The CRM vendor maintains all of the hardware, software, and connectivity to the application. Through cloud computing, Studsvik benefits from a better CRM package provided and maintained at a lower price point.

Example - Planning and Production

Planning and production requires visibility. Through the Cesium application, there is visibility into the CRM system for shipments that are forecast, but not yet scheduled. This provides earlier and better visibility into the LLRW that will be present at a point in the future for processing. Cesium also provides real-time visibility into LLRW already received and not 100% processed. Executive management, site management and operations are able to regularly and thoroughly review received and planned inventory in order to provide a production plan.

Information is coordinated through Cesium from three different enterprise applications located on at least as many different servers in at least three geographical locations. All of this is invisible to the user and changes without disruption to the user. This flexibility lowers the cost of ownership to Studsvik as the company can take advantage of better and ever changing economics.

As production information is captured, planning for future special projects is based on receipt performance for similar projects. This helps with worker dose, safety and pricing to the customer.

Example - Receiving

Shipments are received at the facility through Cesium. Receipt information is entered into Cesium through a web-based application. The physical location where information resides, how it is managed, etc. is invisible to the user. Receipt of an LLRW shipment creates the tracking mechanism for the LLRW through processing and to disposal. Information is matched among the different departments as necessary. All information resides in the enterprise application that is best suited for the creation and maintenance of the information.

As receipts arrive, manifest information is input at the same time that actual receipt survey information is recorded. All differences between manifest information and the observed receipt information are automatically noted.

As seen in Figure 4, a dashboard is displayed summarizing all relevant information for each shipment and each container.

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As Manifested:		**Nuclide:**	**Activity:**		
Container Description:	7	H-3	7.82E-05 mCi		
Volume:	230 ft³	Mn-54	5.74E-05 mCi		
Waste and Container Weight:	30,400 lb	Fe-55	4.79E-03 mCi		
Surface Radiation Level:	0.05 mR/hr	Co-58	5.61E-06 mCi		
α Surface Contamination:	<20 dpm/100 cm²	Co-60	2.86E-03 mCi		
β/γ Surface Contamination:	<1,000 dpm/100 cm²	Ni-63	2.98E-03 mCi		
Waste Descriptor:	33	Sr-90	2.58E-06 mCi		
Approximate Waste Volume:	200 ft³	Cs-134	2.64E-05 mCi		
Solidification:	100	Cs-137	1.84E-04 mCi		
Chemical Form:	metal oxides				
Chelating Agent:	NP				
Weight % Chelating Agent:	NP				
Total Millicuries:	1.10E-02 mCi				
Waste Classification:	A				
As Received:					
Gross Weight:	26,280 lb -4,120 lb (-13.55%)				
Tare Weight:	0 lb				
Net Weight:	26,280 lb				
Surface Radiation Level:	<0.2 mR/hr +0.15 mR/hr (300%)				
1-Meter Radiation Level:	<0.1 mR/hr				
α Surface Contamination:	<20 dpm/100 cm²				
β/γ Surface Contamination:	<1,000 dpm/100 cm²				
Taxes:	$394.20				
As Processed:		**Date:**	**Weight:**	**Volume:**	**Waste Container:**
Processed Weight:	0 lb (0%)				
Remaining Weight:	26,280 lb (100%)				
Date:					
Process Type:					
Material Type:					
Work Performed:					
Waste Container:					

Fig. 4. Shipment processing dashboard with discrepancies between the manifest and received observation noted.

Example - Regulatory Reporting

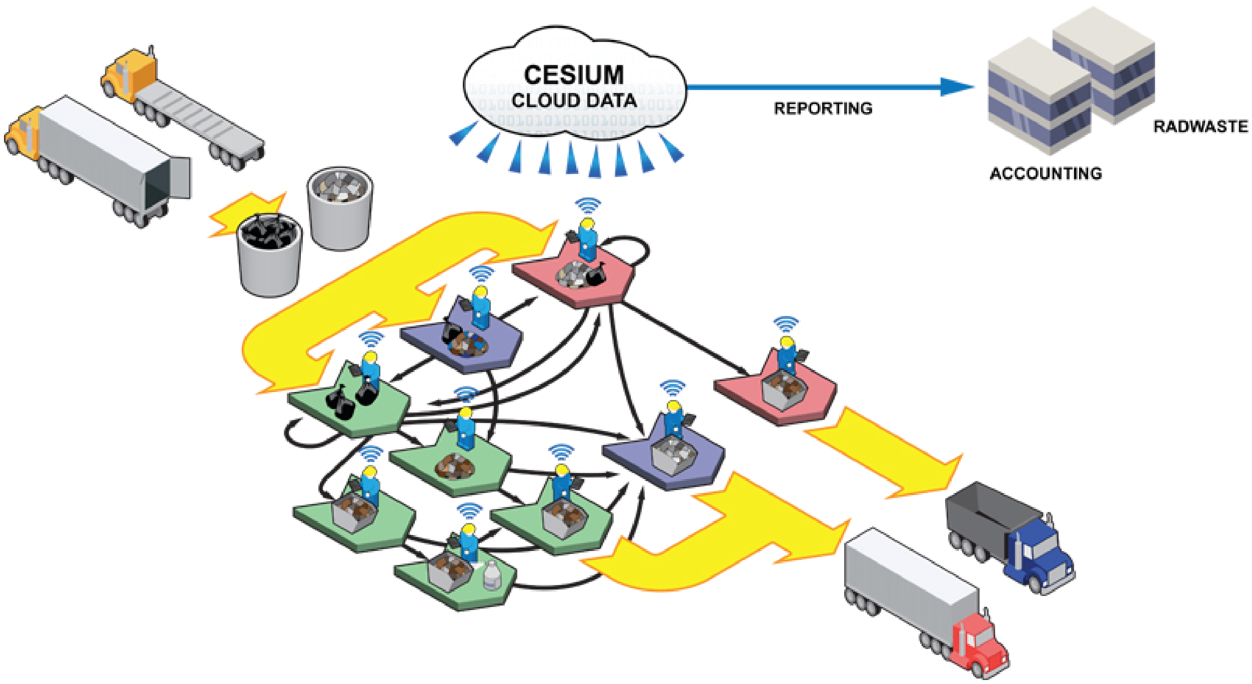
Through Cesium, the collection and reporting of regulatory information is simplified so that site management, operations, and radiological management can readily review regulatory information. Several stakeholders serve as explicit or quasi regulatory entities, including the State of Tennessee (explicit), Studsvik Corporate, Studsvik customers, and the specific facility. This is due to the poor history the industry has sometimes exhibited as it relates to the proper tracking of LLRW. Through Cesium and cloud computing, the information is made available to all stakeholders.

Reports are developed for each stakeholder and information is maintained across multiple servers and locations. A stakeholder can access the information from any location provided he has internet access and the requisite security credentials.

Example - Operational Reporting

The needs of operations differs from the other departments at Studsvik. With Cesium, operations has access and visibility into the CRM system that maintains the forecast and schedule. Operations has access to all radiological information on a container-level basis. As containers are processed, the remaining weight and activity is updated for each container. As containers are moved to new locations or as the regulatory status of a container changes, the update is captured immediately on-the-spot through either an iPod Touch or iPad used by the Studsvik employee. The device is connected to Cesium over a secure wireless network.

Figure 5 depicts Cesium cloud data and several reports that provide visibility into the operational workflow.



Operations – Shipments

- Customer Shipments Received
- Customer Shipments Processed
- Customer Shipments Disposed
- Customer Shipments Disposed (Summary)

Operations – Containers

- Incoming Containers Received
- Incoming Containers Processing (by Receipt Date)
- Incoming Containers Processing (by Customer)
- Incoming Containers Disposed But Not Shipped
- Incoming Containers Disposed and Shipped

- Disposal Container Status
- Disposal Container Summary
- Containers To Return (This report may take a few minutes to run)
- Container Shipment Processing Status
- SPFM Processing Backlog

Operations – Shipment Details

- Customer Shipments Received but not Started
- Customer Shipments Started Processing But Not Completed
- Customer Shipments Completed Processing
- Last Shipment Received Dates (by Customer)
- Customer Shipments Received But Not Billed (This report may take a few minutes to run)
- Customer Shipments Completed Processing But Not Billed (This report may take a few minutes to run)

Fig. 5. The operational workflow organized by Cesium cloud data and several reports available to manage daily operations.

Operations is also able to track the sort rates and cost information it achieves while processing happens due to the immediacy that information is brought together from multiple sources across multiple systems through the cloud. The shipment processing dashboard in Figure 6 maintains a summary of processing results.

2A FWH

As Manifested:		Nuclide:	Activity:		
Container Description:	19	Mn-54	1.28E+00 mCi		
Volume:	1,328 ft³	Fe-55	4.59E+01 mCi		
Waste and Container Weight:	73,600 lb	Co-60	8.14E+00 mCi		
Surface Radiation Level:	0.3 mR/hr	Zn-65	6.63E+00 mCi		
α Surface Contamination:	<20 dpm/100 cm²	I-131	6.14E-03 mCi		
β/γ Surface Contamination:	<1,000 dpm/100 cm²	Cs-137	2.18E-01 mCi		
Waste Descriptor:	33	La-140	4.66E-10 mCi		
Approximate Waste Volume:	1,326 ft³	Ce-141	5.866E-01 mCi		
Solidification:	100	Ce-144	7.02E-01 mCi		
Chemical Form:	METAL OXIDES				
Chelating Agent:	NP				
Weight % Chelating Agent:	NP				
Total Millicuries:	6.35E+01 mCi				
Waste Classification:	A				
As Received:					
Gross Weight:	73,600 lb				
Tare Weight:	0 lb				
Net Weight:	73,600 lb				
Surface Radiation Level:	0.3 mR/hr				
1-Meter Radiation Level:	<0.1 mR/hr				
α Surface Contamination:	<20 dpm/100 cm²				
β/γ Surface Contamination:	<1,000 dpm/100 cm²				
Taxes:	$1,104.00				
As Processed:		Date:	Weight:	Volume:	Waste Container:
Processed Weight:	44,288 lb (60.17%)	12/20/2010	320 lb	Unknown	BSFR
Remaining Weight:	29,312 lb (39.83%)	12/30/2010	116 lb	Unknown	ECU04-101216-01
		12/30/2010	20,420 lb	Unknown	BSFR
Date:		1/5/2011	752 lb	Unknown	ECU05-101207-01
1/7/2010:	3,200 lb (7.23%)	1/5/2011	15,280 lb	Unknown	BSFR
12/20/2010:	320 lb (0.72%)	1/6/2011	4,200 lb	Unknown	FR
12/30/2010:	20,536 lb (46.37%)	1/7/2010	3,200 lb	Unknown	FR
1/5/2011:	16,032 lb (36.2%)				
1/6/2011:	4,200 lb (9.48%)				
Process Type:					
BSFR - AMP:	35,700 lb (80.61%)				
BSFR - Repack:	320 lb (0.72%)				
Disposal:	868 lb (1.96%)				
FR - AMP:	4,200 lb (9.48%)				
FR - Direct:	3,200 lb (7.23%)				
Material Type:					
DAW:	436 lb (0.98%)				
Metal (Ferrous):	43,852 lb (99.02%)				
Work Performed:					
BSFR - AMP - Metal (Ferrous):	35,700 lb (80.61%)				
BSFR - Repack - DAW:	320 lb (0.72%)				
Disposal - DAW:	116 lb (0.26%)				
Disposal - Metal (Ferrous):	752 lb (1.7%)				
FR - AMP - Metal (Ferrous):	4,200 lb (9.48%)				
FR - Direct - Metal (Ferrous):	3,200 lb (7.23%)				
Waste Container:					
ECU04-101216-01:	116 lb (0.26%)				
ECU05-101207-01:	752 lb (1.7%)				
BSFR:	36,020 lb (81.33%)				
FR:	7,400 lb (16.71%)				

Fig. 6. Shipment processing dashboard with no discrepancies between the manifest and received observation noted. Processing results are listed by date, process type, material type, contract work performed and waste container. *Can you find the processing error?*

The association of business rules with operational performance is a major advantage for data protection that Cesium provides. Because information is tied together across all systems, a problem can be identified and corrected as it occurs. In this example found in Figure 7, the processing date was entered as January 7, 2010, instead of the actual date of January 7, 2011. Cesium automatically identified and highlighted the error. A routine review by management identified the mistake and was able to contact operations and address the data entry error before it was propagated further.

Fig. 7. Business rule violations are identified as problems by the system.

Example - Billing

Accurate billing is based on a number of factors and requires a consistent connection among information from Sales & Marketing, operations and the accounting system. Based on business rules, the accounting department receives the authorization to bill a customer from operations based on pre-established criteria for each customer contract. The contract information is based on the shipment contract and PO entered and verified by customer service. The manifest and actual weights and volumes received are compared with the amount actually processed. A report is generated daily that includes the actual production outcome and services provided. Accounting can establish its own analytics and tie together information for each of the disparate systems to create appropriate checks and balances. Senior management and site management also have access to the reports in order to more proactively manage the business.

SUMMARY

The LLRW industry has primarily captured its data recording efforts on disparate systems and physical paper. This has made it difficult to both optimize waste processing and mitigate the risks associated with the poor tracking of the waste.

A cloud based enterprise system offers the ability to capture LLRW tracking from receipt, through processing, to disposal, all the way communicating with accounting (GL) and customer service (CRM) systems through system hooks. Data integrity is significantly improved due to the elimination of redundant spreadsheets and other paper based systems. Business intelligence is promoted through electronic reporting, data mining, and trend analysis. This allows for optimizations at all levels of the business – from the facility, scheduling, processing, disposing, and billing.

Future projects can be analyzed based on previous experiences, improving safety and optimizing planning. Errors in data recording are mitigated by real-time business rule validation, and reporting. Communication issues between departments are mitigated through the reporting systems, so that everyone looks at the same numbers and data.

The use of modern innovative technologies such as the Apple iPad and iPod Touch devices allows for users to have access to the system wirelessly while walking around the facility. Data can be captured real time, instead of taking notes on paper for later which may be forgotten or misinterpreted by others. Hosting Cesium in the cloud as a web based service allows it to be available "anytime, anywhere, on any device" with high availability.

The bitemporal tracking of the data provides the ability to monitor changes in the data, allowing reporting on changes over closed accounting periods, and answers to the question – what changed? Full auditability monitors who changed what and when, and what from.

Because of the system design, no user is aware of the physical location of the information, or the host application servers. The user only knows that the Cloud makes the application available when and where the user requires.

REFERENCES

1. F5 Networks Customer Focus Group "Cloud Computing Survey: June - July 2009" http://www.f5.com/news-press-events/press/2009/20090824a.html