Leaning the Tank Closure Process at the Savannah River Site – 15515

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ABSTRACT

The Savannah River Site liquid waste system consists of multiple facilities that safely receive and store legacy radioactive waste prior to treatment and disposition. The liquid radioactive waste is stored in large underground tanks. The waste inventory currently stored in these tanks is a complex mixture of insoluble metal hydroxide solids and soluble salt supernate. The high-level (radioactive) portion of the waste is vitrified into a glass waste form, while the low-level waste is immobilized into a cementitious grout waste form called saltstone. Once the waste is retrieved and processed, the tanks are closed. The closure process includes; waste removal, characterizing residuals, isolating the tank systems, and stabilizing the tank with tailored grout formulations.

The core of Lean is to eliminate waste or non-value added steps from processes to maximize customer value. From the perspective of the customer, "value" is defined as any action or process for which a customer would willingly pay. In this case our product is to safely and efficiently remove waste from the underground storage tanks and demonstrate operational closure to the State of South Carolina. Savannah River Remediation (SRR) initiated the use of the Lean process in late 2013 and identified the Tank Closure process as one of the targeted areas to improve. The first step in the Lean process is to “map” out the value stream and identify areas where non-value added steps are present and then prioritize Rapid Improvement Events (RIE). Based on this mapping process, there were a number of areas that SRR determined warranted further evaluation for improvements, including; standard equipment design, characterization, standard work packages, regulatory documentation, tank characterization, structural evaluations, engineering documentation and equipment re-use.

This paper focuses on the application of the Lean process at SRR and more specifically, effective application to the Tank Closure Process. This paper discusses the value stream mapping process for Tank Closures, as well as, summarizes the RIEs and demonstrate the realized benefits. Benefits can come in a variety of forms, from schedule compression to decreased costs. Through the Lean process we have been able to identify close to $10M in savings over the life cycle of the tank closure process and a 4 year schedule compression. Cost and schedule savings are used to accomplish further risk reduction efforts. In addition to hard benefits, there are also soft benefits. These soft benefits are a result of the process itself and help drive improved efficiencies through better communication with key stakeholders, such as regulators and customers.

INTRODUCTION

Lean Manufacturing is not a new concept. The history of Lean can be dated back to Eli Whitney and his use of interchangeable parts. More recent derivations are tied to the Toyota Motor Company. Toyota was intrigued by the Ford mass production line, but realized there was waste in the Ford process. So, Toyota developed their own version; this came to be known as the Toyota Production System, also called Just in Time. Toyota Motor Company determined that the key to efficient production was the workers. Their knowledge of the assembly process, more than their ability to assemble, was the key to unlocking production efficiencies. It wasn't about finding ways to make the workers faster, but about finding ways to make the processes the worker uses more efficient.

Lean Management relies on three basic principles.

1. Eliminate waste: Get rid of waste (non-value added steps) in the process to increase productivity.
2. Design continuous process flow: Ensure that the process incorporates a pulling (not a pushing) of the value added steps in the process flow.
3. Respect the worker knowledge base and talent: People want to do things as efficient as possible. Their process knowledge is integral to the development and implementation of production improvements.

So what does a manufacturing process improvement concept have to do with a Nuclear Waste Site? Lean principles are an integral part of a strong Nuclear Safety Culture. Both the Integrated Safety Management System (ISMS), that defines the five core functions for performing work safely to include a feedback and improvement step, and the Voluntary Protection Program (VPP) which recognizes promoting safety excellence through direct involvement of the workforce are consistent with the Lean core tenets. Lean uses our greatest asset, the worker, to develop safe and efficient ways to accomplish our work scope.

LEAN JOURNEY AT THE SAVANNAH RIVER REMEDIATION PROJECT

The SRR Project began its Lean journey in late 2013 to provide better value to our customer and equip our SRR work force with the tools to be empowered problem solvers. Lean principles rely on the person who is doing the work to best identify and implement the solutions to problems or inefficiencies. The process starts with the establishment of an SRR Executive Steering Committee to create overall company-level objectives as documented in a Transformational Plan of Care (TPOC). The TPOC defines our reason for action, our high return value streams, our True North Metrics (fundamental objectives of the company), and what our target accomplishments or target state, will be the first year using the Lean process.

SRR began with three value streams and conducted value stream analyses (VSA) to map out the areas for directed improvements. At the heart of Lean Management are week-long RIEs where team members come together to resolve problems and improve their processes. SRR has completed 25 of these events to date. Action items from the events are tracked to closure and then results of the process improvements are tallied over time to confirm actual results with the estimates made at the time of the event.

Figure 1 demonstrates the flow down of the TPOC through VSAs and subsequently into RIEs. The RIEs and VSAs tie directly back to the TPOC and our True North Metrics.

One of the initial high-impact value streams SRR pursued was Waste Retrieval and Tank Closure. This paper presents the results of our year-long effort to compress the schedule and reduce the complexity and cost for waste retrieval and tank closures.

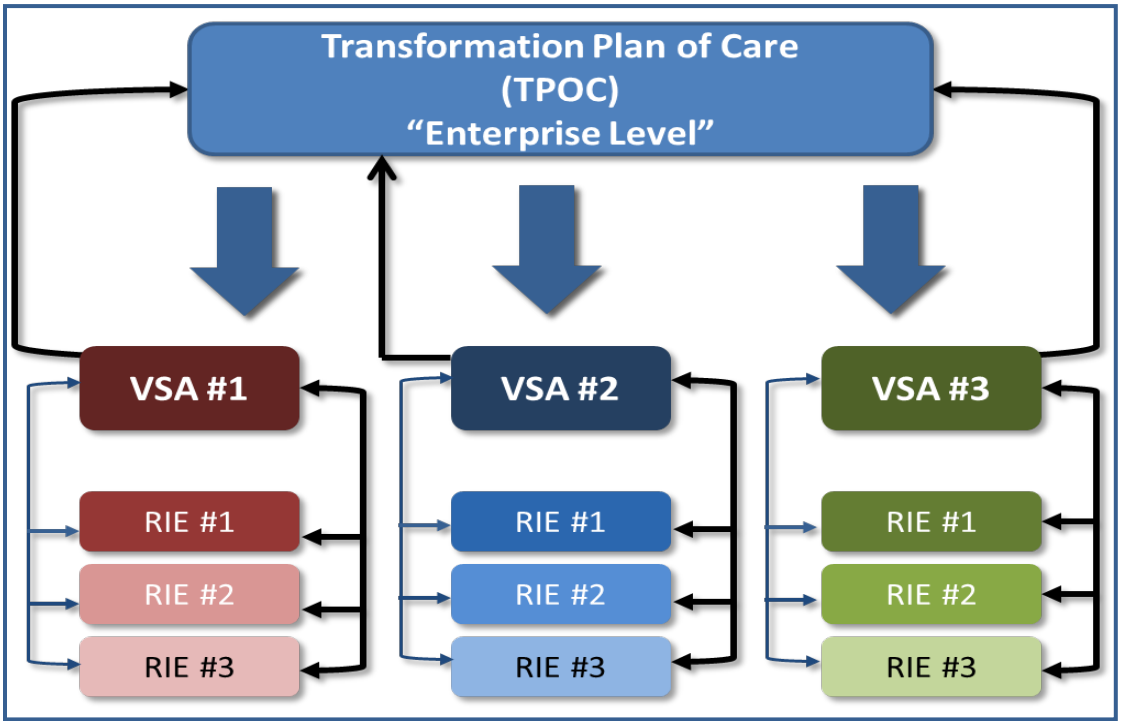

Fig. 1. Flow of work from the Transformational Plan of Care through Rapid Improvement Events

THE A3 WAY OF THINKING – WHERE'S THE VALUE IN A WASTE TANK?

There are 51 underground storage tanks that are subject to the Federal Facility Agreement between the Department of Energy and the South Carolina Department of Health and Environmental Control and the United States Environmental Protection Agency. This agreement establishes, amongst other things, closure requirements for 24 old style tanks, which includes dates for completing bulk waste removal efforts and tank closure. Per the agreement, six tanks have been closed to date and there are another two tanks required to be closed in the near term. Our reason for action was simply that we needed to find a more efficient and timely way to close the tanks to meet our regulatory commitments.

For a number of reasons including budget constraints, contract execution, baseline development, and project implementation, the tank closure activities have been segmented, resulting in a complex multi-step process that is expensive and time consuming. The Lean process begins with the mapping of the current state of waste retrieval and tank closure process. The average current cost to complete waste removal and close a tank is $50M over a time span of eight years, with a first pass yield of <1%, meaning we seldom got through the entire cycle without enduring a form of rework.

Figure 2 shows a simplified current state map for Waste Retrieval and Tank Closure before we began incorporating Lean principles into our value stream.

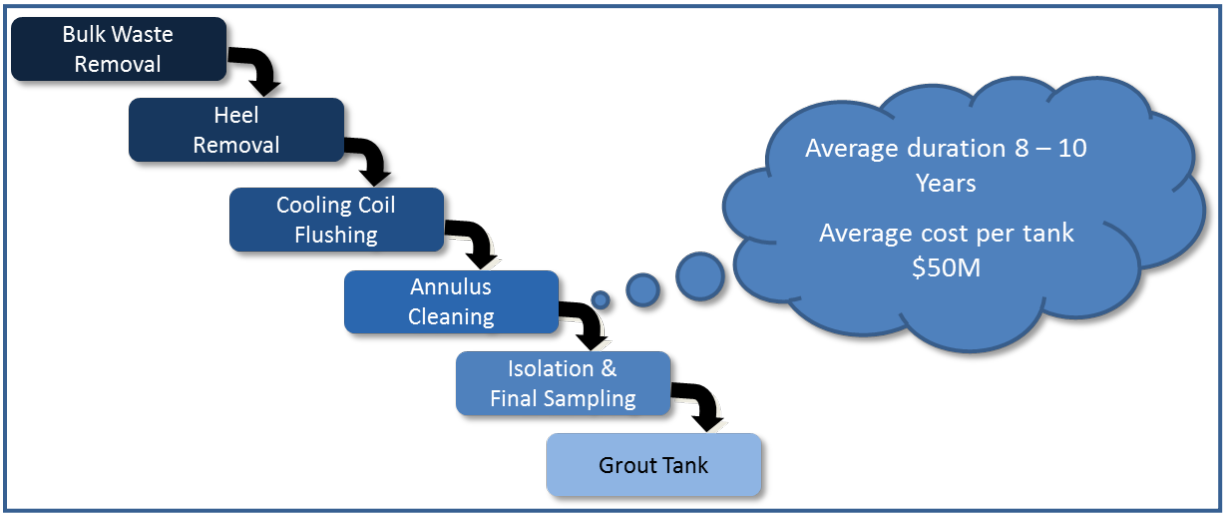

Fig. 2. Current State Map for Waste Retrieval and Tank Closure

The team is then challenged with identifying what would be the ideal state for tank closures. Figure 3 shows the ideal state established by the Team. If options were limitless and obstacles were non-existent – how would we complete tank closure? By posing this question the team starts to think about the disparity between the current state and the ideal state, which sets the team up for the next step in the Lean process, determining the new target state.

The target state established for Tank Closure includes the following attributes:

1. Stay the course – eliminate starts and stops across the process
2. Closure process revolves around standard work
3. Simplified regulatory deliverables
4. Increased parallel work rather than sequential
5. Design with the end in mind – meaning design not just for waste retrieval but also consider what is necessary for characterization and grouting the tanks
6. Earlier characterization strategy to eliminate need to wait for grouting
7. Universal maximum extent technically and economically practical determination earlier in process

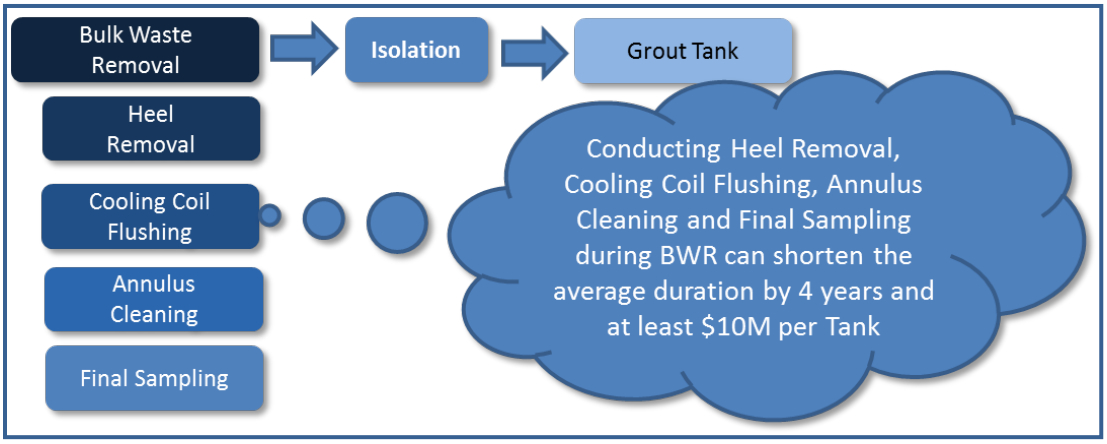

Fig. 3. Ideal State of Tank Closure Process

The team believed that if we could achieve those attributes then we could reduce the time to close a tank by four years and reduce the associated cost by $10M per tank. These were aggressive goals, but achievable.

TAKING THE WASTE OUT – TARGETING IMPROVEMENT AREAS

Once the current state of the process is mapped, the team determines where waste exists in the process. These are the non-value added steps that result in extended durations and additional costs. This part of the process is called "star bursting" and is represented in a density process map. The density map shown in Figure 4 indicates where the team members believed the largest portion of issues are in the tank closure process. The next step was grouping the starbursts into problem statements that could be solved through subsequent RIEs, Projects or "Just Do Its". The team prioritized the subsequent actions based on the potential impact that implementation of each idea would result in, either through employee satisfaction, schedule compression, or cost savings. The team initially identified 12 RIEs, 6 Projects, and 9 "Just Do-Its" using this process. This was the basis for the implementation plan over the next 12 -18 months.

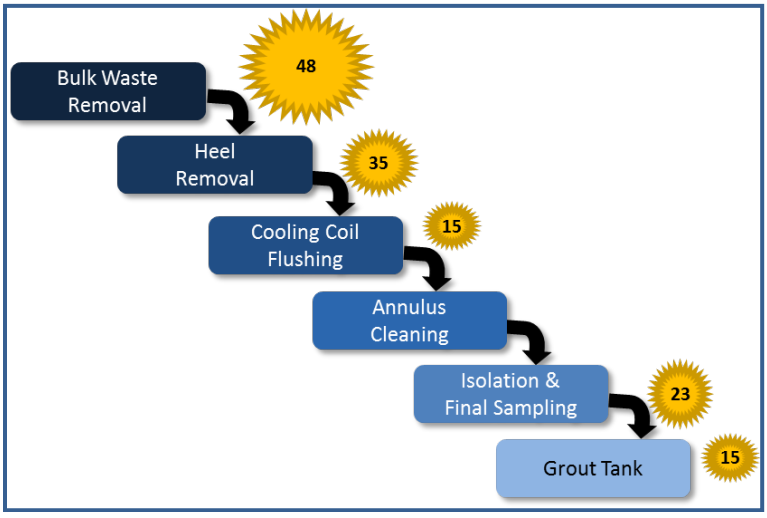

Fig. 4. Density Map of Starbursts for the Current State

DISCOVERING IT'S ALL IN OUR OWN HANDS – INSIGHTS TO LEAN EVENTS

One of the unique lessons that the Lean process has taught those who have been involved to date, is that it is typically our own paradigms that drive our behaviors, not the customer, contract or even regulatory requirements. As part of the process, the Team is challenged to identify all of the applicable requirements for the process that is being "Leaned". In the case of Tank Closure processes, the team was challenged to document the "true" requirements versus what has been the status quo with our key stakeholders (customer, regulator, etc.). There is a common misconception that since this is the way "we have always done it", our stakeholders will not consider accepting anything different for future tanks. The strength of the Lean process is that key stakeholders are invited to participate (or observe) the events. This assembly of all of the affected parties is extremely powerful in not only the team building aspect, but also in educating each other about what drives each organization's decision making. For example, the Tank Closure organization elaborates on the technical challenges associated with the process, the customer provides the budget and contractual issues, and the regulator brings the regulations and public welfare aspects to the table. Having the key organizations in one room working collaboratively toward a common goal is invaluable in defining where opportunities are that will meet everyone's needs while improving the efficiency of tank closures.

What our team found was that there is always more than one way to tackle a problem and our stakeholders were open to alternate solutions that had sound technical basis. In one instance, we were able to resolve a technical challenge during the course of an event that saved six months from our closure schedule, resulting in a win-win for all parties.

CAN WE REALLY SAVE THAT MUCH? TRACKING OUR BENEFITS

With a target of $10M and four year schedule compression, the team was challenged during each event to break-out of our paradigms and track to our targets. As of October 31, 2014, the team has identified approximately $6M that can be eliminated from the cost of each future tank closure. In addition, the team also identified another $2.4M in savings that can be realized annually that not only impacts tank closure but also help with other projects across the site. We have an opportunity with Tank 15 in the near term to plan the execution of work straight through to closure, saving at least four years off the extended schedule. The opportunity will require a change in our contract and project management philosophy to be implemented in the spring of 2015. A summary of realized and future benefits are provided in Table 1.

TABLE 1 – Summary of Benefits Identified

Event	Summary of Benefits
Engineering Documents Rapid Improvement Event	• 58 day (50%) reduction in average cycle time from design input to design output • Reduction in the average number of drawings requiring change from 20 to 10
Contaminated Pump Removal Rapid Improvement Event	• Develop storage control for necessary equipment, reducing approximately 900 person hours reduced from critical path • Grouting pumps in place, saving approximately $1M per tank
Tank Characterization Rapid Improvement Event	• Implementing PM practices with the end in mind removes three years from tank closure critical path, saving approximately $1.2M • Sampling prior to tank being dry, saves six months schedule, saving $600K
Grouting of In-Tank Equipment (including cooling coils) Rapid Improvement Event	• Eliminating coil flushing saves over $65K per tank and generation of 5,000 gallons of liquid waste that historically goes back to an active waste tank for treatment • Eliminating grey water totes (20 per tank) saves approximately $100K per tank • Standardized header removal saves over 2,000 person hours per tank
Just Stop Its/Just Do Its	• Just stop ventilation removal • Just stop pump removal when it does not make economic sense • Engineering develops and approves configuration management template • For each tank define and obtain early DOE buy in to complete scope waste removal to tank grout • Develop standard work package • Develop standard design approach for closure tanks

Figure 5 summarizes cost savings that we have rolled up to date through our Tank Closure Lean events. Because this process was multi-year in nature, we could "annualize" those savings to track up to the overall SRR project savings and kept these separate in a "Per Tank" savings thermometer. These per tank projected savings are dependent on the life cycle that each tank is in at this point in time. For purposes of demonstrating our success against the overall Tank Closure target of $10M and 4 years, however, we have combined the two savings types together. To date we have achieved approximately 85% of our goal.

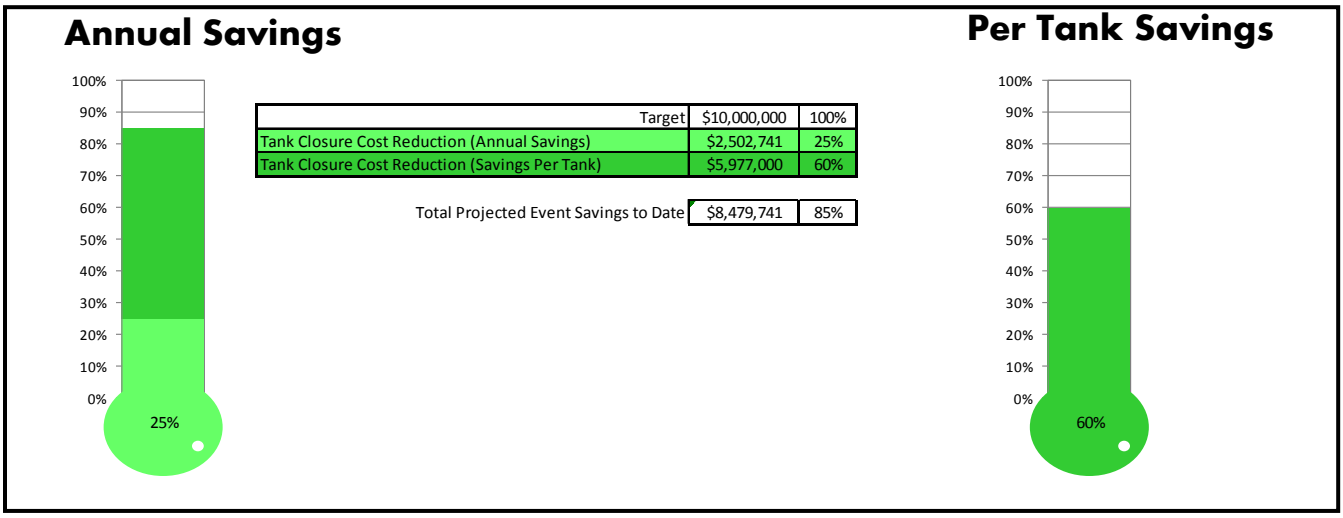

Fig. 5 Summary of Realized/Expected Savings Through Tank Closure Lean Events

CONCLUSIONS

The Lean process has been effective at producing the desired results in hard dollar savings and schedule compression. Although the organization was pessimistic at first, through the Lean process we have been able to identify close to $10M in savings over the life cycle of the tank closure process and a 4 year schedule compression. In order to realize some of these projections, we will need support from the customer in how we package work for execution. We expect over the course of the next 1 – 5 years to demonstrate implementation of these process improvements as we close the next group of tanks. The employees, regulators and customer have all embraced the program and have been extremely positive about the experience and the results. As we continue to work through our Tank Closure events other ideas have been identified creating an environment for ongoing process improvements and culture change.