A Proposed Systems Logic Approach for Meeting a Demanding Shipment Schedule for Contact Handled Transuranic Waste - 11650

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ABSTRACT

The US Department of Energy's (DOE) Carlsbad Field Office (CBFO) was tasked under the American Recovery and Reinvestment Act of 2009 with Accelerating Transuranic (TRU) Waste to the Waste Isolation Pilot Plant (WIPP). This acceleration addresses a portion of the environmental legacy of TRU nuclear waste generated by weapons research and development throughout all DOE sites. The CBFO has the responsibility for oversight of the National TRU Program (NTP) to facilitate and ensure all TRU waste at the Generator Sites and interim storage sites is processed safely, efficiently, and within all regulatory requirements. It is imperative that the CBFO and host sites continue to improve their established processes to realize operational efficiencies and reduce costs in their mission goals and program targets.

To meet the accelerated goals, the DOE tasked the AMWTP with shipping 18 shipments per week to the WIPP. Due to the increased shipping schedule and time pressures for meeting the demanding schedule and lack of a back log of certified containers, a couple of shipments were delayed. The AMWTP requested their shipping profile be modified or adjusted to minimize the risk of a safety issue, NRC or Department of Transportation violation. The CBFO requested that the certification to shipping process be analyzed with an objective to understand the "process" and identify barriers that impact shipping.

A systems logic approach using Lean Six Sigma was used to analyze the certification to shipment process which included timelines, paper flow, communications and drum movement. The analysis also looked at the average weight of certified containers from the AMWTP and the Accelerated Retrieval Project (ARP) that were being planned for payloads and their physically location at the AMWTP.

The analysis revealed an extremely complex process the AMWTP, Centralized Characterization Program (CCP) and the CBFO undertake day-to-day to meet the extremely demanding shipping goals under the ARRA. Required steps in the process prevented any one step from being removed; however, the analysis showed that the majority of certified containers on site were very heavy. Heavy containers make building compliant payloads very difficult based on the shipping profile provided by the CBFO. Subsequently the CBFO adjusted the shipping profile which allowed the AMWTP to ship more of its heavier containers. Another measure was to put "stop-gaps" in place where if the paperwork was not completed by a certain time or the shipment is not ready at a certain time it will be either cancelled or delayed. This provided better scheduling for the truck drivers and the Idaho State Police. These measures have helped the AMWTP in meeting the aggressive shipping schedule.

Introduction

The USDOE- CBFO was tasked with accelerating the disposition and shipment of Transuranic (TRU) Waste from its host sites to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico to address a portion of the environmental legacy of nuclear weapons development-sponsored nuclear energy research, and specifically defense-generated TRU waste. The Assistant Secretary for the Office of Environmental Management (EM-1) set an aggressive shipping goal for all sites to achieve. DOE's vision and overall goal is to disposition 90% of legacy TRU wastes by 2015 which will ultimately lead to completing clean up of both large and small quantity sites.

The certification process at each site is different and unique due to the type and complexity of the waste. This includes the site infrastructure for TRU Program operations, Fissile Gram Equivalents (FGE), number of containers on site, waste handling and storage and type of containers to be shipped, to list a few. In addition, timely communications between multiple organizations and contractors becomes critical in the process to safely and compliantly ship waste containers to WIPP.

Background

From 1952 to 1970, wastes consisting of transuranic contaminated solid wastes and low-level wastes were buried in a series of pits and trenches located within the Radioactive Waste Management Complex (RWMC) at the Idaho National Lab (INL). In 1970, burial of the transuranic contaminated waste was discontinued and temporary above-ground storage initiated. The buried waste is located in the area now known as the Subsurface Disposal Area (SDA) and the storage location for the above-ground waste is the Transuranic Storage Area (TSA) within the RWMC. The majority of the transuranic-contaminated waste is also believed to contain EPA-regulated hazardous contaminants, and is therefore under current regulatory definitions identified as mixed waste.

The wastes stored at the TSA are DOE laboratory and processing wastes primarily from Rocky Flats operations, but also include wastes from the INL and various other DOE facilities. The wastes are typically heterogeneous mixtures of various solid materials including paper, cloth, plastic, rubber, glass, graphite, bricks, concrete, metals, nitrate salts, process sludge's, miscellaneous components, and some absorbed liquids. Various Resource Conservation and Recovery Act (RCRA) hazardous organics and metals, and alpha-emitting transuranic radionuclides are distributed throughout. Some Toxic Substance Control Act Polychlorinated Biphenyl (TSCA PCB)-contaminated materials are present. These wastes are stored in drums, boxes, and bins. Most are capable of being contact-handled (radiation levels < 200 mrem/hr), but some containers or contents may require remote handling due to higher radiation levels.

In 2003 the DOE officially divided the RWMC into two separate operations; the Advanced Mixed Waste Treatment Project (AMWTP) was born out of the RWMC. The AMWTP mission was to retrieve, treat and ship all the TRU waste stored at the TSA to the WIPP. The RWMC was now responsible for retrieving, treating all the transuranic waste stored in the SDA with final disposition through CCP characterization to the WIPP.

Operational Activities

Nearly all TRU waste remaining throughout the DOE complex requires repackaging or remediation, and each generator site's facilities are different. This is the most significant barrier to accelerating shipments to WIPP. In addition, the time it takes for a container(s) to get from the remediation/repackaging process to certification and shipment can sometimes take as long as 6 months or more. While the same processes are required at each generator site to compliantly ship the waste, the composition of the waste dictates the variability in processing rates both for characterization and certification for shipment.

Examples include:

- Widely varying isotopic compositions or problematic isotopes (such as cesium) can slow assay determinations
- Waste type/waste form
- Prohibitive items
- The need for specialized equipment
- High activity or high-dose waste

- Variability in packaging needed for certification and shipment (i.e. pipe overpacks, neutron shielded canisters, TRUPACT III's, etc.)

In 2001 CBFO implemented the Centralized Characterization Program (CCP). This program is intended to streamline the characterization, remediation, certification, and shipment of all TRU waste destined for WIPP. With its implementation, CBFO can realize economies of scale across the DOE Complex with standardized processes. Washington TRU Solutions (WTS) operates the CCP and herein is referred to as CCP. The shipment of TRU waste throughout the complex is accomplished by utilizing mobile loading units operated by Los Alamos National Laboratory, Carlsbad Office (LANL-CO) with the exception of Hanford and AMWTP. Those sites have built- in permanent fixture loading docks. The loading/unloading and shipment of the TRUPACTS is done jointly with the host site workforce, LANL-C and CCP.

Approach

The AMWTP was experiencing time pressures for meeting a demanding schedule of 18 shipments per week. The lack of a back log of certifiable containers resulted in having "just-in-time" certified payloads for shipments. Consequently, paper flow issues and overweight payloads for shipments caused delays and/or last minute re-planning. The potential risk of a safety issue and/or the potential for a Nuclear Regulatory Commission (NRC) or Department of Transportation (DOT) violation for a shipment goes hand-in-hand with "just-in-time" operations.

Understanding a need to reduce risk in this area motivated CBFO to request its Carlsbad Technical Assistance Contractor (CTAC) to perform analyses of the certification to shipping process with an objective to understand the "process" and identify barriers that impacted the shipment schedule. The AMWTP assigned a Lean Six Sigma Black Belt to assist in mapping out the process. Using DOE's Carlsbad Technical Assistance Contractor (CTAC) provides for an independent analyses and recommendations to CBFO. As a consequence, CTAC, CCP, AMWTP and CBFO worked collaboratively throughout this exercise to resolve/remove barriers identified.

A systems logic approach using Lean Six Sigma was taken to analyze the certification to shipment process. A systems logic or systems engineering approach is generally used in complex projects when dealing with logistics, coordination of different teams, and when work processes overlap with both technical and human-centered disciplines. Although this is not a complex project, it was determined that the best means for gathering the data, analyzing it for problem solving was to "map" all the activities beginning at certification and ending with shipments to WIPP. The certification to shipment process included timelines, paper flow and the drum movements required to stage drums for payload assembly, certification, loading into the compliant shipping container and ultimate dispatching of the shipment.

There are 11 organizations involved in the certification to shipment process which can take approximately 7 to 10 days to complete for a shipment to go out the door. All of this depends upon the number of containers in the shipment, how many TRUPACTs in a shipping profile and, more importantly, where the containers are stored that will make up a shipment. The process outlined begins once a container has been ***fully characterized*** and is available ***to certify***. Once certified in the WIPP Data System (WDS), it is ***available for shipment***. The ***key and critical component*** that became evident in the process is timely communications. The outline of the stepwise process is described in detail below.

Process

Communications between AMWTP production planning and CCP personnel commences, with AMWTP and CCP identifying which containers are certified and available for shipment. Determining the packaging configuration for shipment is the first step and gets the ball rolling. Configurations of payloads consist(s) of 7/14 pack payload containers, 6 pack payload containers, Standard Waste Box (SWB) payloads or Ten Drum Over Packs (TDOPs) (Figure 1). CCP first notifies its TCOs (shippers) and

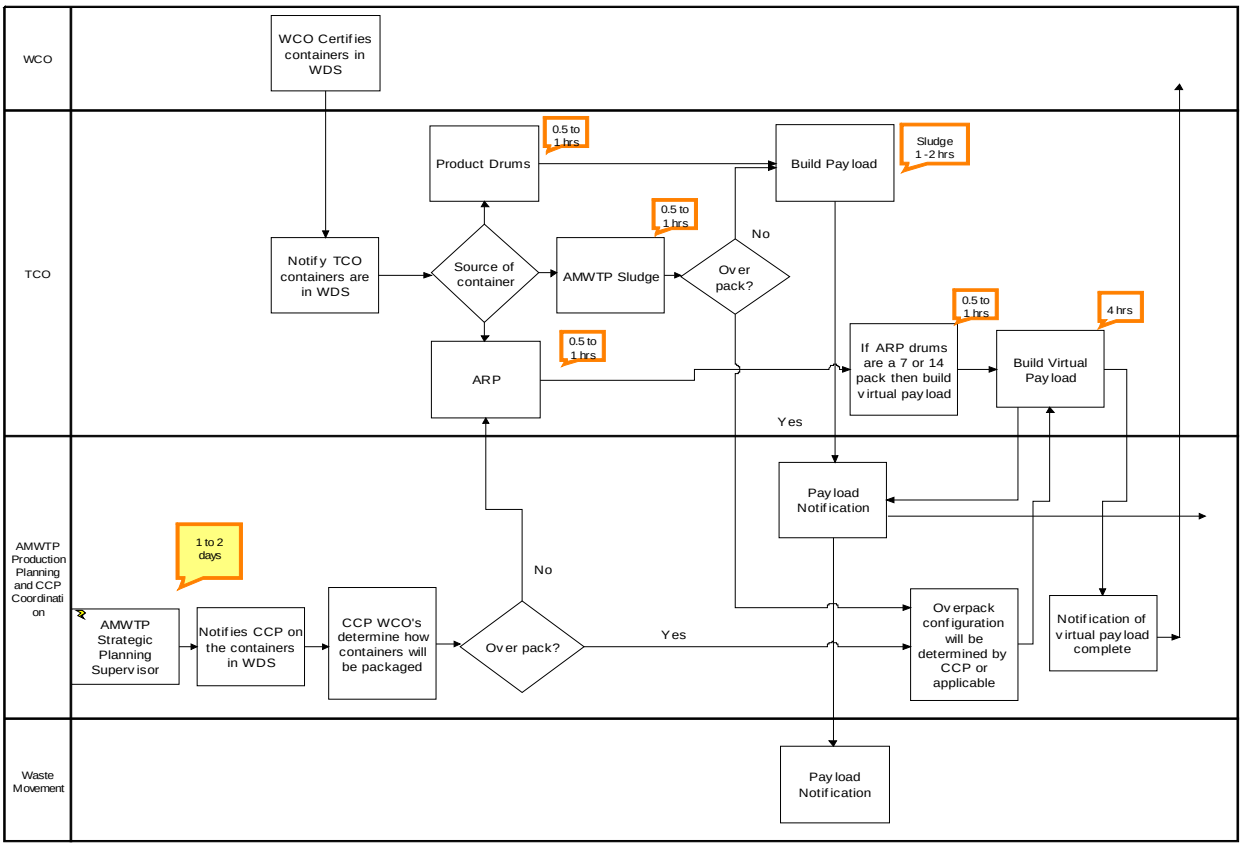

Figure 1. Payload configuration process

the AMWTP waste handling crews to begin container movement and staging for payload assembly and subsequent loading into TRUPACTs. This can take up to 1 day to complete all the paperwork/communications for a container(s) to be moved and staged (Figure 2). Once staged depending on the type of payload, it can be built at a rate of 1 payload per hour. Depending on the type of shipment, payloads can be built in 3 to 6 hours after the containers are moved and staged (Figure 3). After the payloads are built, the TRUPACTs can be loaded and leak tested in 5 to 6 hours and ready for shipment. In parallel with this effort, shippers review all the paperwork required for the shipment to be achieved. The review of each shipment's paperwork takes an average of 4 hours to complete (Figure 4). Any delays in obtaining and providing the shipping paperwork by CCP personnel to the AMWTP personnel has the potential for putting the shipment at risk for delay and delays can cause the shippers to "rush" through the paperwork to meet the planned departure time(s) of a shipment. Any "rush" can put the shipment at risk for a safety and/or regulatory issue with incorrect paperwork (e.g. proper manifesting, overweight, wrong payload in a TRUPACT, etc.).

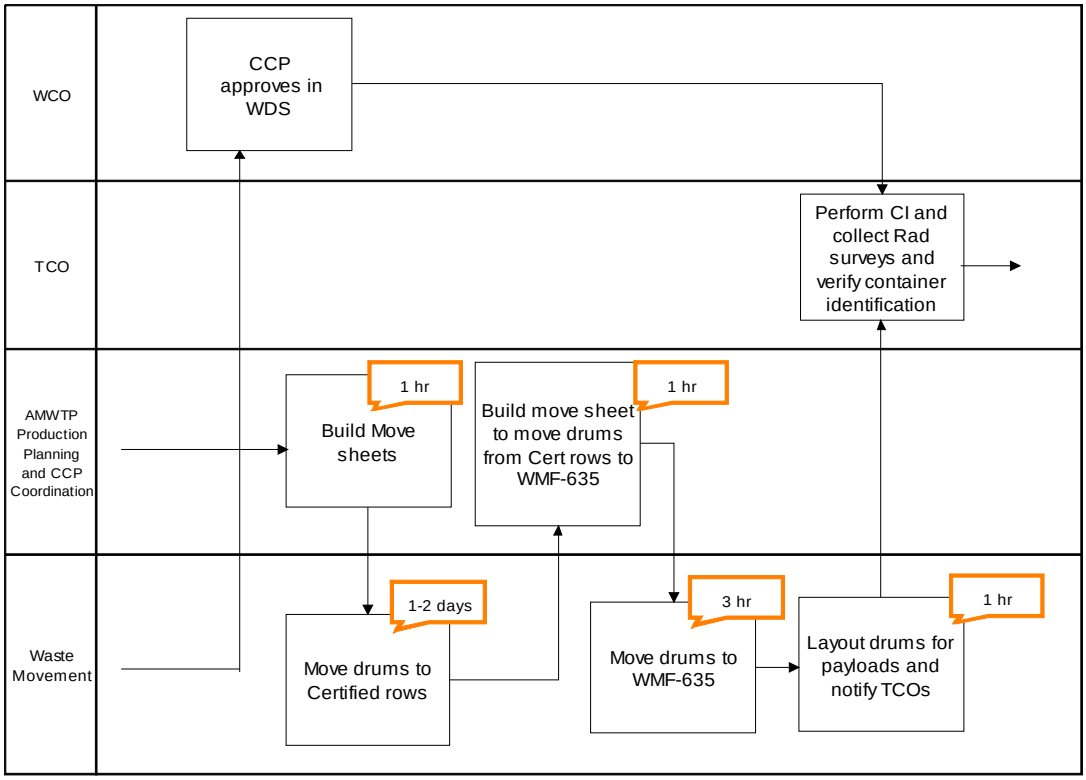

Figure 2. Waste handling and production planning steps involved in the process

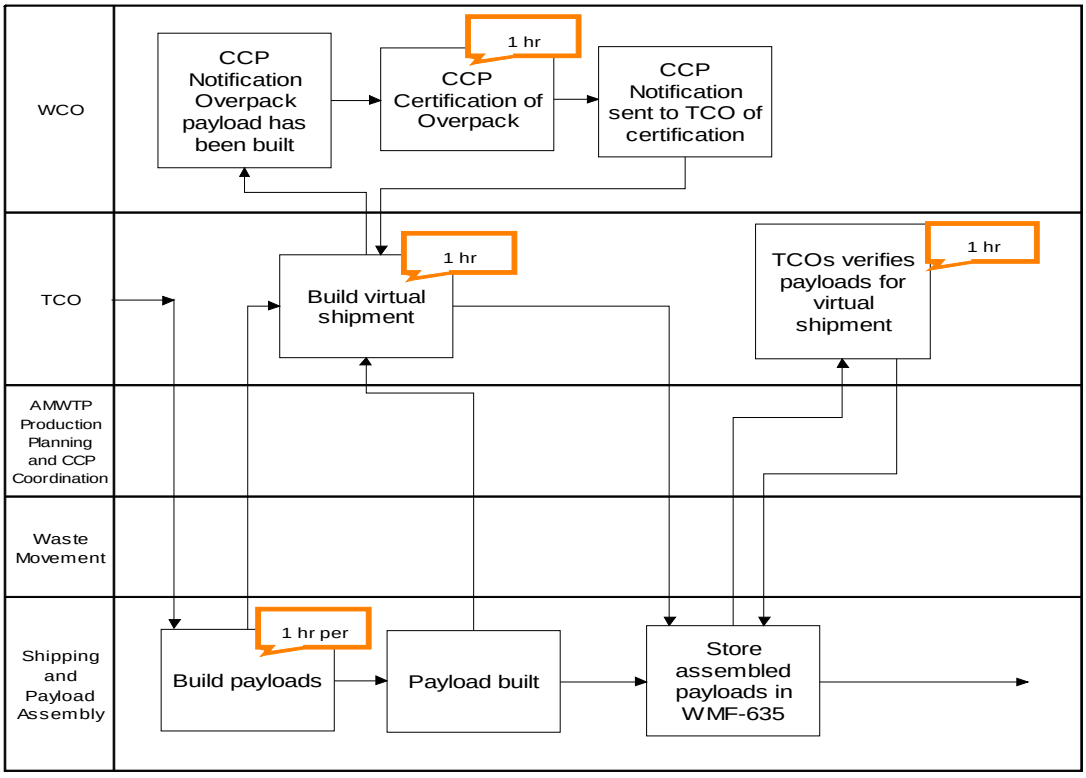

Figure 3. Payload assembly and confirmation steps in the process

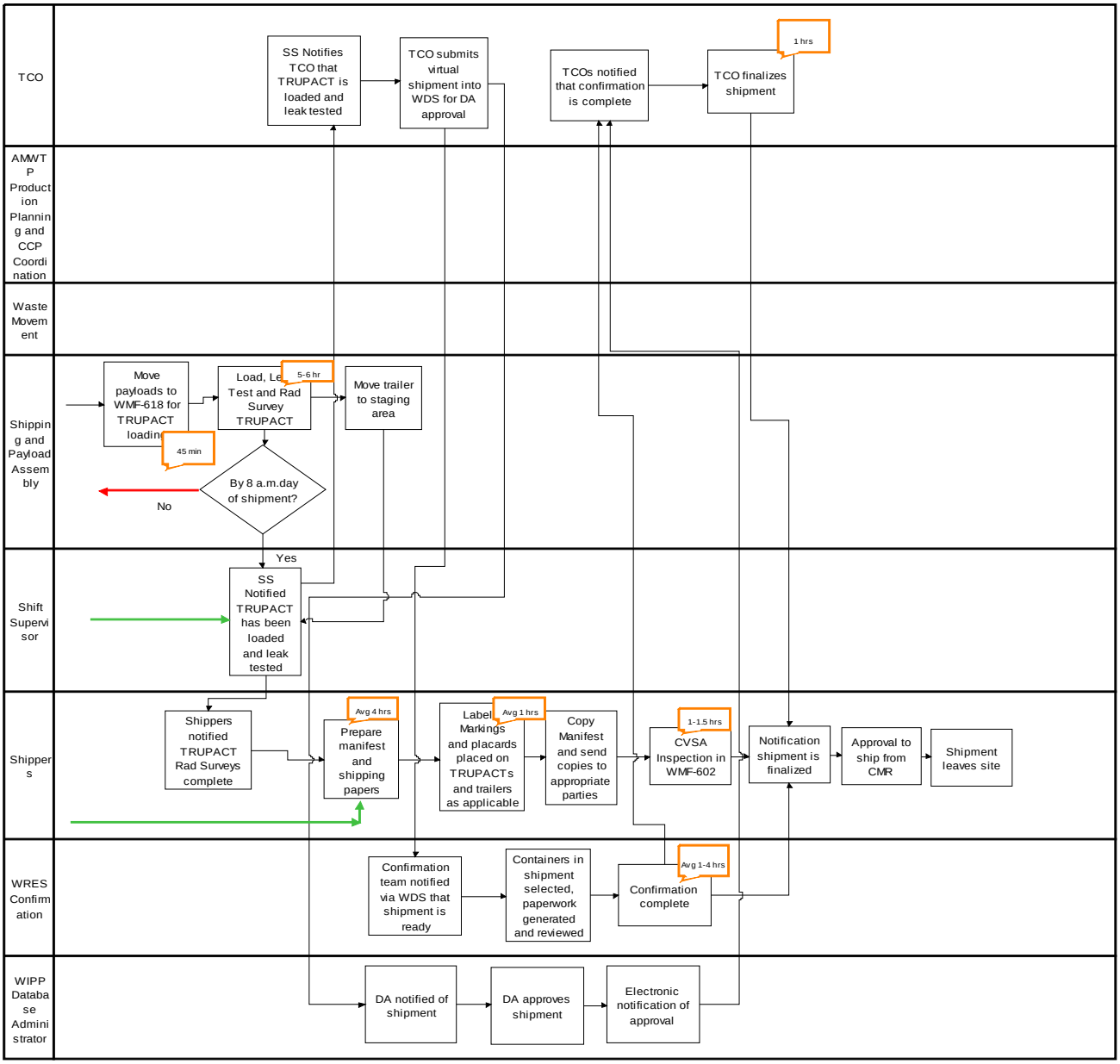

Figure 4. Review and confirmation process

The building of virtual payloads is a means of avoiding "just-in-time" shipments. However, to do this efficiently there must be a sufficient backlog of certified containers. At one time, the AMWTP kept a certified backlog of 75 built payloads at any given time. However, that backlog was rapidly depleted with the increased demand for shipments at 18 shipments per week sustainable as compared to 12 shipments per week. As a consequence, communications between the AMWTP and the CCP became critical in meeting the schedule demand. Increased weight of sludge and soil containers has also impacted the ability to efficiently build both virtual payloads and payloads. At times, shipments have to be re-planned to maintain the NRC and DOT weight limits. To maintain efficiency per payload, the use of dunnage is minimized to the extent possible. When virtual payloads or payloads have to be re-planned or re-built, there is a real risk for paperwork error because paper work already being processed has to be recalled and the new paperwork routed.

Adding to the complexity of building virtual payloads is the variability of tractor, trailer, and TRUPACT weights. TRUPACTs have a restricted DOT shipment weight of ~80,000 lbs. Certified truck scale weights have ± 1%

variability, so to ensure trucks don't exceed the weight at any given weigh station along the shipping route(s) shipments are typically held at or below 79,000 lbs. This adds additional complications to building payloads for shipment and thus virtual/payload selection. Furthermore, the tractors, trailers, and TRUPACTs all have varying weights with the newer trailers weighing more. When planning a virtual payload, or payloads, the equipment variability must be factored into the process. Equipment assignment(s) is generally done each week so the TCOs (shippers) can efficiently plan their virtual payloads or payloads and ensure regulatory limits are not exceeded. However, when equipment has to be changed out the day before, a few days before or day of the shipment because of issues, payloads may have to be re-planned. Currently CCP, AMWTP and the host sites are making 30 CH shipments a week (including inter-site shipments to INL). To change out equipment is a barrier to keeping shipments moving forward efficiently. Weather and maintenance also play a role in which tractors, trailers, and TRUPACTs go where and when. Accounting for all the variability is not an easy task for the shippers and schedulers and adds additional complexity to the process. Having virtual payloads and payloads built meeting all the regulatory requirements becomes extremely burdensome and time consuming. Continual communications that are timely and accurate among AMWTP site personnel, CCP, and CBFO is crucial to ensure compliant shipments will be sent to WIPP.

The configuration of the shipment also plays a large role during the process to build a payload. A trailer can transport either 3 TRUPACTs, 2 TRUPACTs and a half PACT or on rare occasion, 2 TRUPACTS. Trailer configurations are set one to two weeks in advance by the CCP. With the current supply of containers at the AMWTP and at the ARP ranging from 300 to 900 lbs and the majority weighing above 500 lbs, packaging 3 TRUPACTs will push the shipment weight over the 79,000 lb requirement. Managing containers, their weight and how they will be built into a payload based on the configuration of the shipment plays a large role in the payload building process and typically takes the greatest amount of time.

Adding yet another layer of complexity to the shipment process is the "confirmation" loop. All shipments destined to WIPP must go through the "confirmation process" before it can be approved for shipment. The confirmation process is part of the Permit requirements under the WIPP Waste Analysis Plan (WAP). This process averages approximately 1 to 4 hours, depending on the type of shipment. It is done in parallel with the shipper's review of the paperwork and the TCOs submittal of the paperwork to WDS for Data Administrator (DA) approval. The key in the confirmation process is the timely submittal of all necessary paperwork by the AMWTP to the confirmation team in a timely manner for them to complete their task. Again, communications is key and critical. Once approved by the confirmation team, the shipment is approved by the DA and ready for the Commercial Vehicle Safety Alliance (CVSA) inspection which is performed by the Idaho State Highway Patrol. After the CVSA inspection is satisfactorily completed, the shipment is ready to depart for the WIPP (weather dependent).

If at any point in the certification to shipment process there is a delay (miss-communication, failure with drum integrity, paper flow issue, personnel not available, etc), a shipment is at risk for delay or last minute cancellation. Because of the time pressure to keep the scheduled 18 shipments a week and ensure compliance, the AMWTP has proactively inserted two stop-gap measures to avoid delay or last minute cancellation to any given shipment. However, these stop-gap measures are at the "last minute". In one sense, it is better to delay or cancel a shipment than have it leave in a rush with a potential DOT or NRC violation. On the other hand, last minute delays and/or last minute cancellations are not only time consuming but also costly. One of the stop-gap measures implemented by AMWTP is if a shipment leaving the next day is not loaded and leak tested by 8:00 a.m. the morning of a scheduled shipment, AMWTP will cancel that shipment and reschedule (Figure 5). A second stop-gap measure is if the paperwork for a shipment is not in the Shippers hand(s) by 3:00 p.m. the day before the shipment is scheduled, it is cancelled. The consequences of these actions are good in the sense that unnecessary mistakes and/or safety issues or DOT/NRC violations can be avoided. On the other hand, this can cause the shipment drivers to wait another day at the Site and the Idaho State Patrol will have to travel from Boise, Idaho the following day to complete their required CVSA inspections.

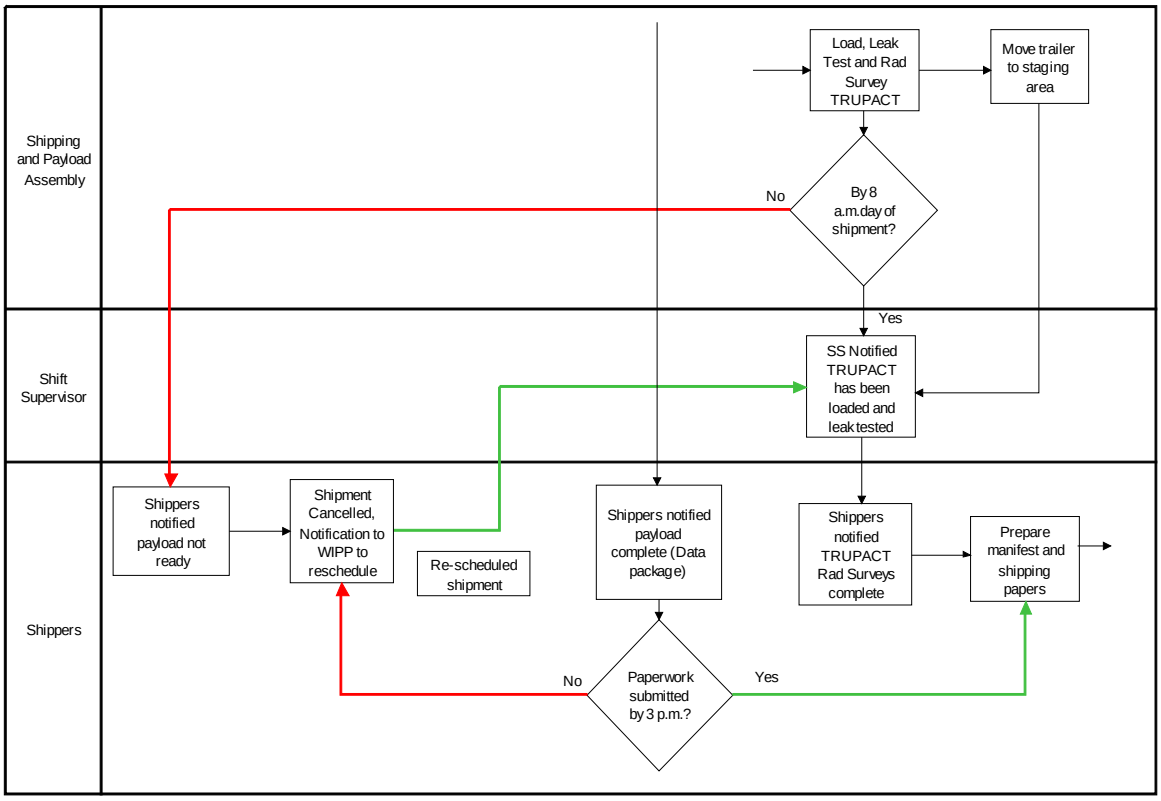

Figure 5. Stop gap measures implemented by AMWTP

Process Mapping

The certification to shipment process was viewed from the stand point that everything was part of a procedure and each step evolved over a long period of time (~3 years). Since the process was stable, each organization was interviewed and the steps performed in the process were recorded on a process flow map. In addition, each organization provided the time each step took in the process to determine if there was one process that was taking longer or might have the greatest impact for missing a shipment. The process map (Figure 6) demonstrates the intricate and complex details required to process one container and a payload for shipping. The process is further complicated due to the use of multiple contractors, multiple crews working varying shifts and schedules. Adding additional burden and time to this process, is having incompatible workflow mechanisms. For example, the AMWTP has an automated system for container certification, container movements, staging, identifying location of certifiable containers etc., whereas CCPs system is manual, paper intensive, and is more time consuming. This further illustrates the critical need for timely and accurate communications between the 11 organizations involved.

Summary

Employing a systems logic approach using Lean Six Sigma to this and/or any other process using flow charts shows how steps in a process fit together. This makes them useful tools for communicating how processes work and for clearly documenting how a particular job is done. Furthermore, the act of mapping a process, using the flow chart format, helps clarify the understanding of a process and assists when thinking about where the process can be improved. This type of approach allows for early detection of possible failure points and subsequent mitigation actions that could be implemented upfront to avoid issues later in the process.

Due to required steps in the certification to shipment process, elimination of any one step was prohibited, however, the process flow, as currently mapped, gave an indication time wise when notifications need to be sent out or when a shipment is going to be delayed, rescheduled or cancelled. Benefits realized as a result of this approach at the AMWTP were that additional efficiencies early in the process between the AMWTP and the CBFO could lead to

better shipping profiles. This enabled the AMWTP and the CBFO to come up with a suitable shipping profile that was efficient and cost effective. The change in the shipping profile allowed the AMWTP to compliantly ship some of its heaviest containers to the WIPP, thus allowing the AMWTP to continue meeting its target of 18 shipments per week.

The systems logic approach using Lean Six Sigma used in this instance proves that shipping waste can be done in a safe manner while maintaining a high level of sustainable productivity and regulatory compliance. The key to the success of this project was the collaboration displayed between the CBFO, AMWTP, CTAC, and CCP. The CBFO, AMWTP, CTAC, and CCP are committed to continued collaboration in problem solving and gaining efficiencies where possible to further the success of the accelerated disposal of TRU waste throughout the DOE complex.

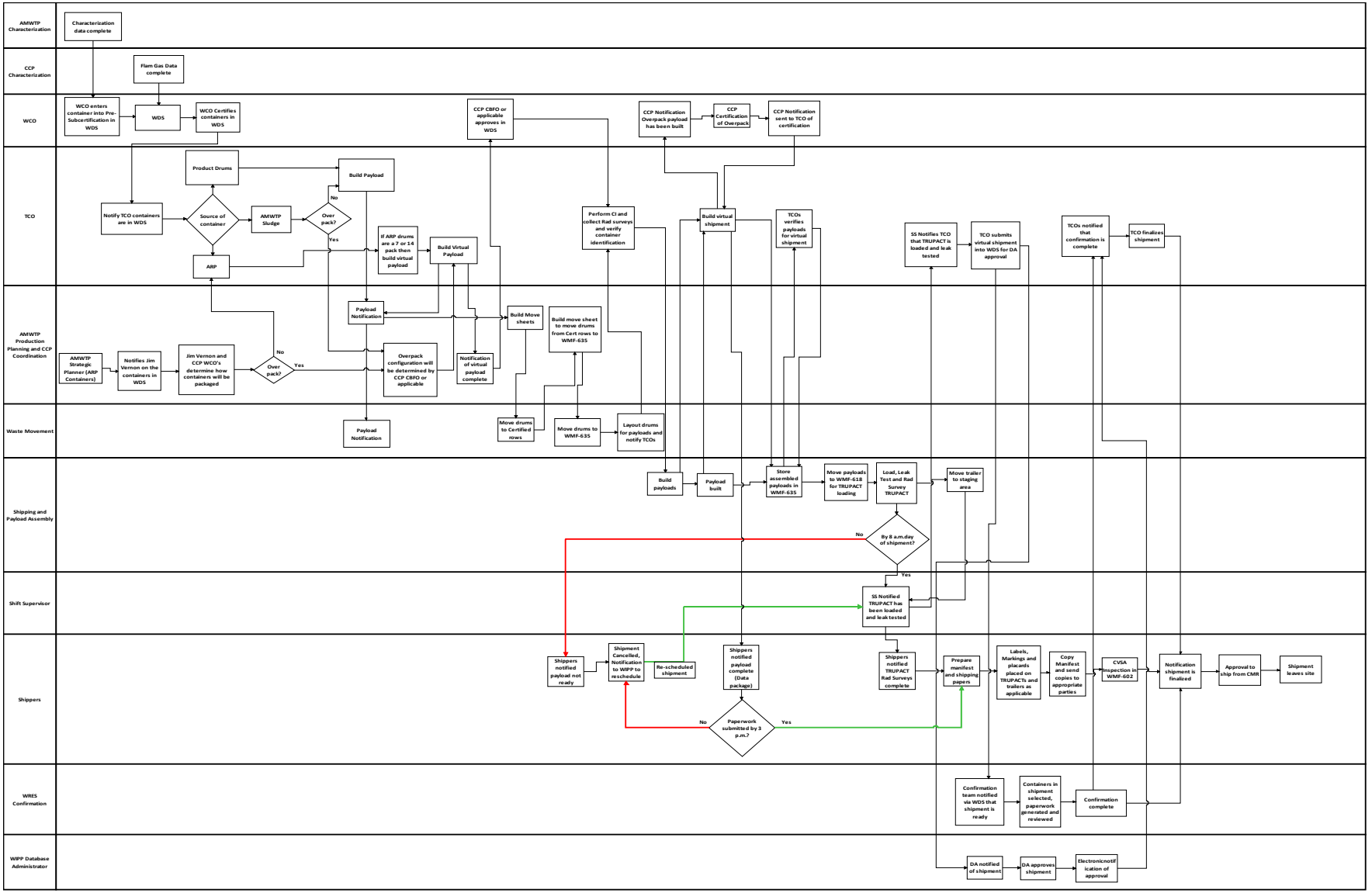

Figure 6. Overall process flow