Improvements in Hanford TRU Program Utilizing Systems Modeling and Analyses

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ABSTRACT

Hanford's Transuranic (TRU) Program is responsible for certifying contact-handled (CH) TRU waste and shipping the certified waste to the Waste Isolation Pilot Plant (WIPP). Hanford's CH TRU waste includes material that is in retrievable storage as well as above ground storage, and newly generated waste. Certifying a typical container entails retrieving and then characterizing it (Non-Destructive Examination [NDE], Non-Destructive Assay [NDA], and Head Space Gas Sampling [HSG]), validating records (data review and reconciliation), and designating the container for a payload. The certified payload is then shipped to WIPP. Systems modeling and analysis techniques were applied to Hanford's TRU Program to help streamline the certification process and increase shipping rates.

The modeling and analysis yields several benefits:

- Maintains visibility on system performance and predicts downstream consequences of production issues.
- Predicts future system performance with higher confidence, based on tracking past performance.
- Applies speculation analyses to determine the impact of proposed changes (e.g., apparent shortage of feed should not be used as basis to reassign personnel if more feed is coming in the queue).
- Positively identifies the appropriate queue for all containers (e.g., discovered several containers that were not actively being worked because they were in the wrong "physical" location – method used previously for queuing up containers).
- Identifies anomalies with the various data systems used to track inventory (e.g., dimensional differences for Standard Waste Boxes).

A model of the TRU Program certification process was created using custom queries of the multiple databases for managing waste containers. The model was developed using a simplified process chart based on the expected path for a typical container. The process chart was augmented with the remediation path for containers that do not meet acceptance criteria for WIPP.

Containers are sorted into queues based on their current status in the process. A container can be in only one queue at any given time. Existing data systems are queried to establish the quantity

of containers in each queue on any given day. This sets the amount of feed available that is then modeled to be processed according to the daily production plans.

The daily production plans were created by identifying the equipment necessary and the staff that performs each process step, and determining the expected production rate for each step. Production performance is monitored on a weekly basis with Project senior staff to establish a total operating efficiency (TOE) for each step (comparing actual performance to production capacity). The unit operations were modeled to be constrained by each day's feed queue plus the performance of the preceding step. The TOE for each unit operation was applied to an integrated model to determine bottlenecks and identify areas for improvement.

All of the steps were linked to predict future system performance based on available feed and integrated system-level TOE. It has been determined that at times sub-optimization of a particular unit operation is necessary to ensure the system remains balanced (e.g., having excess capacity in assay does no good if there is no feed available because the real-time radiography [RTR] is working at half capacity). Several recommendations have been provided to the Project management team resulting in improvements in the performance of TRU certification activities by Hanford's TRU Program.

INTRODUCTION

Systems modeling and analysis techniques were applied to Hanford's Transuranic (TRU) Program in an effort to help streamline the certification process and increase shipment rates. Several goals were established:

- Help the Waste Stabilization and Disposition Project (WSD) meet contractual milestones by establishing production goals, measuring performance, and recommending adjustments.
- Provide the ability to predict future performance based on historical performance by developing a tool that utilizes appropriate measures of effectiveness.
- Assure that the unit operations do not run out of feed ("feed the beast") by identifying and locating all available process feed, then assigning it to queues based on the process status of each container.
- Identify and determine actual status for each container by obtaining status information from three separate data systems and integrating it using standard Microsoft® Office products.

METHOD DEVELOPMENT

A model of the TRU Program certification process (see Figure 1) was developed using a simplified process chart based on the expected path for a typical container. The process chart was augmented with the remediation path for containers that do not meet acceptance criteria for WIPP. Information about each container is housed in three separate data systems: The Hanford Site Solid Waste Inventory Tracking System (SWITS) used by the Waste Retrieval Project, the Data Management System (DMS) used by the WRAP facility, and the TRU- Electronic Data Management System (TRU-EDMT) used by Hanford's TRU Program. To determine actual status for each container, custom queries of the multiple waste container databases were created and the resulting data was integrated using standard Microsoft® Office products. The model is primarily housed in a Microsoft® Excel file.

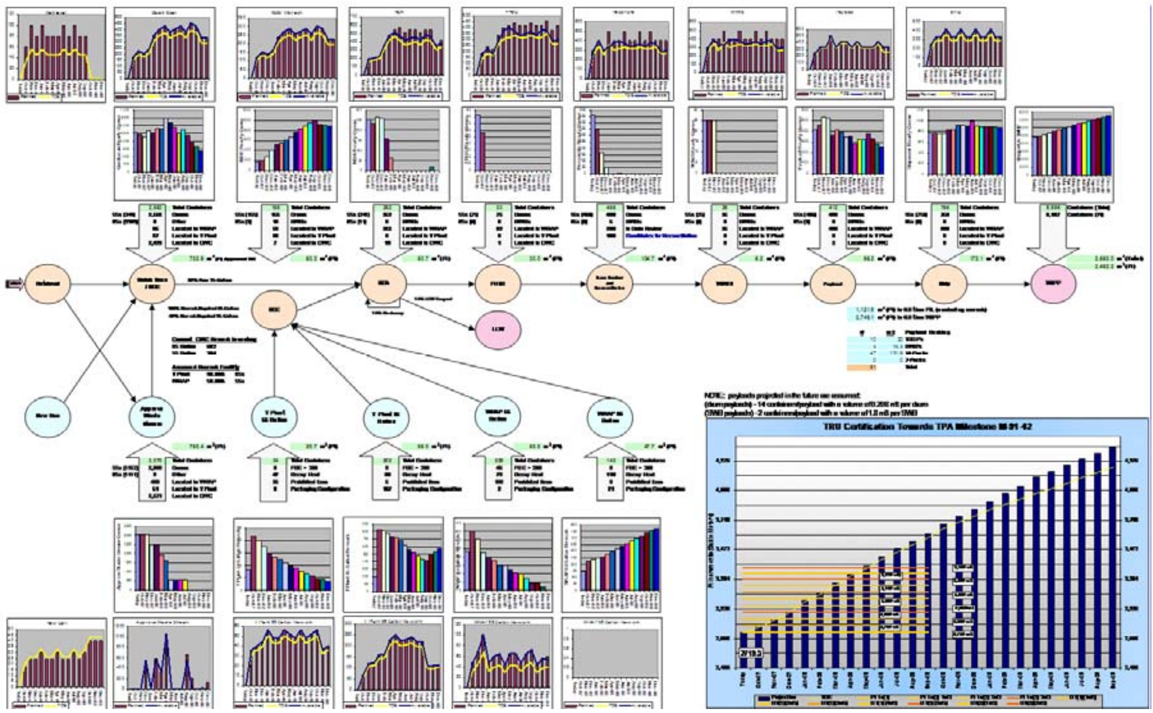

Fig. 1. Example of the SWOC (Solid Waste Operations Complex) Systems Modeling and Analysis chart.

Containers were sorted into queues based on their current status in the process. The queues for a typical container were identified as: Retrieval, Quick Scan/Non-Destructive Examination, Non-Destructive Assay, Flammable Gas Sampling, Data Review and Reconciliation, WWIS (WIPP Waste Information System) Certification, Payload, Ship, and WIPP. There were additional queues identified for containers that do not meet the acceptance criteria for WIPP. Those queues include the following: Approve Waste Stream, 55-Gallon Drum Remediation, and 85-Gallon Drum Remediation. In addition, assumptions were made regarding the quantity of containers that would not meet acceptance criteria during Quick Scan/NDE and NDA.

Existing data systems are queried daily to establish the quantity of containers in each queue. Each TRU container must be in one and only one queue at any time. This criterion sets the quantity of containers available which is then modeled to be processed according to the daily production plans.

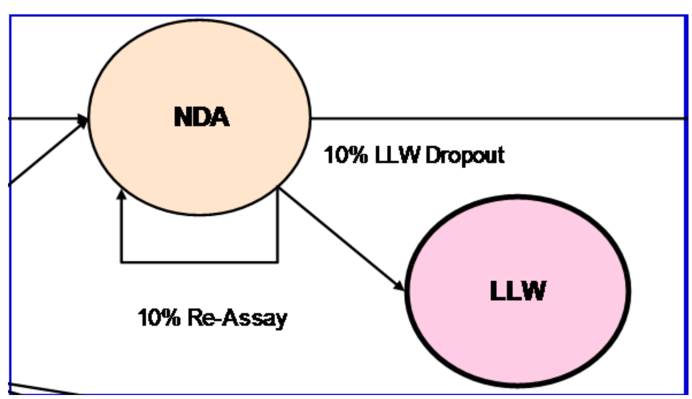

Fig. 2. Enlargement of the SWOC Systems Modeling and Analysis depicting the process steps (i.e., queues).

Before this approach was adopted, the physical location was used to associate the containers with the process step (e.g., Building X is where the Quick Scan/NDE feed was stored). A problem with using the physical location was that containers were often stored in the wrong location, which then resulted in processing delays for these 'missing' containers. The storage problems were evaluated separately and a method for sorting containers was developed using the queues established by this modeling analysis.

In the model, the current inventory for each queue is shown in the arrows. The inventory is represented as the number of containers by type and location. In front of the arrows and to the right, the inventory is shown in cubic meters (highlighted in green).

The arrows are hyperlinked to a worksheet with the list of containers, including relevant physical and status information about each container.

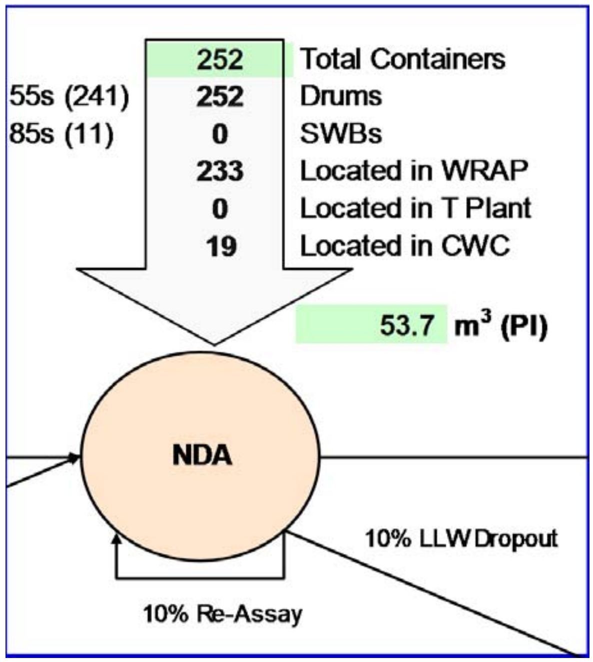

Fig. 3. Current inventory for NDA as shown in the SWOC Systems Modeling and Analysis chart.

The daily production goals for each unit operation are established by identifying the design capacity of the equipment and the available staffing level. This information is validated via periodic reviews and adjustments are made as appropriate.

In the model, the daily production capacity is summed into monthly production capacity and is shown as red columns representing the next 15 months of production.

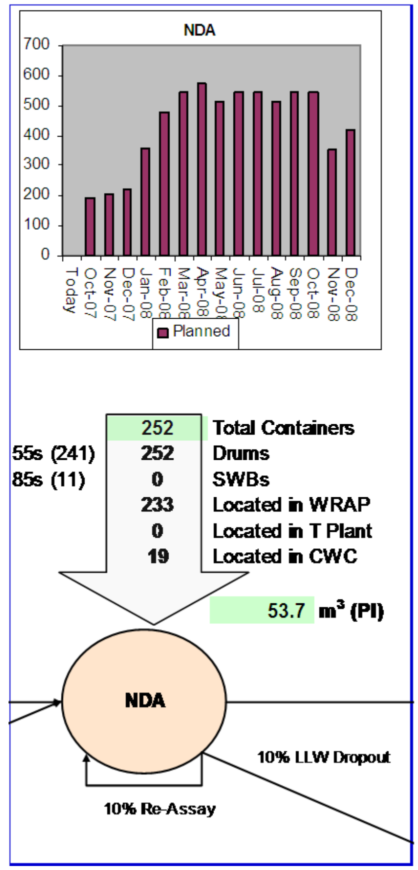

Fig. 4. Production capacity for NDA is displayed in the bar chart above.

If the unit operations were completely independent and isolated from each other, this would be a good predictor of future performance. However, there is significant inter-dependency that must be accounted for in the analysis. The "Systems" concept recognizes that each unit operation is constrained by that day's feed queue plus the future production of the preceding step. The model was adjusted to reflect that constraint.

In the model, the blue line reflects feed available from the preceding step. The unit operation is performing at its design capacity when the blue line matches the red column. When the blue line is below the red bar, the unit operation is constrained by the lack of feed coming from a prior operation.

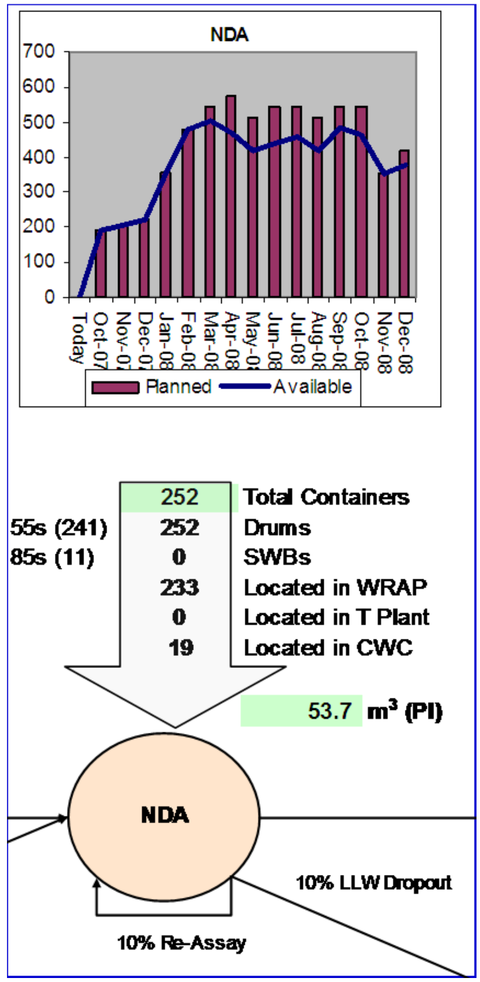

Fig. 5. Available feed for NDA (blue line).

If each unit operation performed at 100% efficiency, this would be a good predictor of future performance. However, if we were to compare actual performance to production capacity we would be able to can calculate a total operating efficiency (TOE) for each step. This allows the future size of the "feed queue" (or backlog) to be predicted.

In the model, the TOE is applied to the blue line, and the result is shown as a yellow line. The backlog is shown in the charts just between the Production Charts and the Process Steps. If the backlog is shrinking or holding steady the System appears to be balanced. If the backlog is growing, that unit operation appears to be the bottleneck.

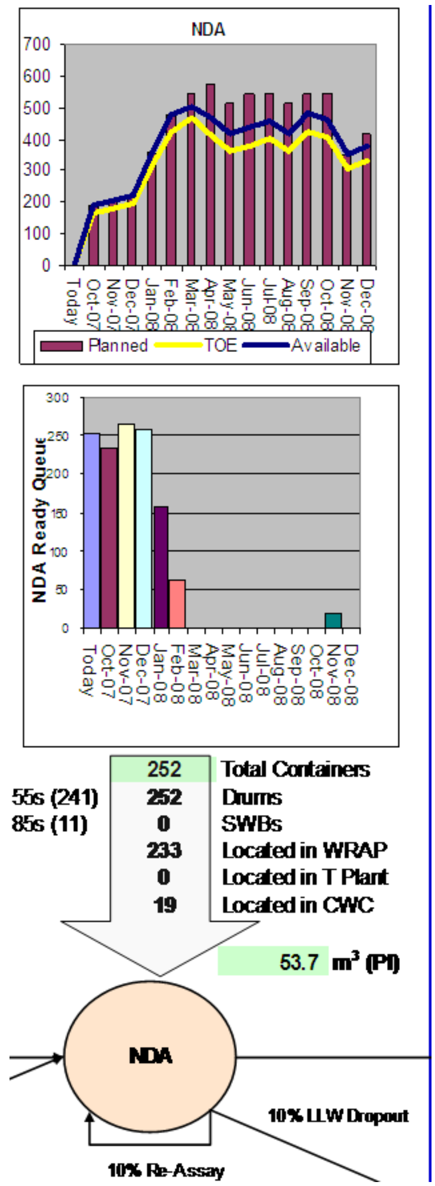

Fig. 6. NDA TOE (yellow line) and Backlog (multi-colored bar chart).

Production performance is gathered daily and evaluated on a weekly basis with Project senior staff comparing actual performance to production capacity. This has established a TOE for each step, which has been used to predict future performance, determine bottlenecks, and identify areas for improvement focusing efforts on key process steps.

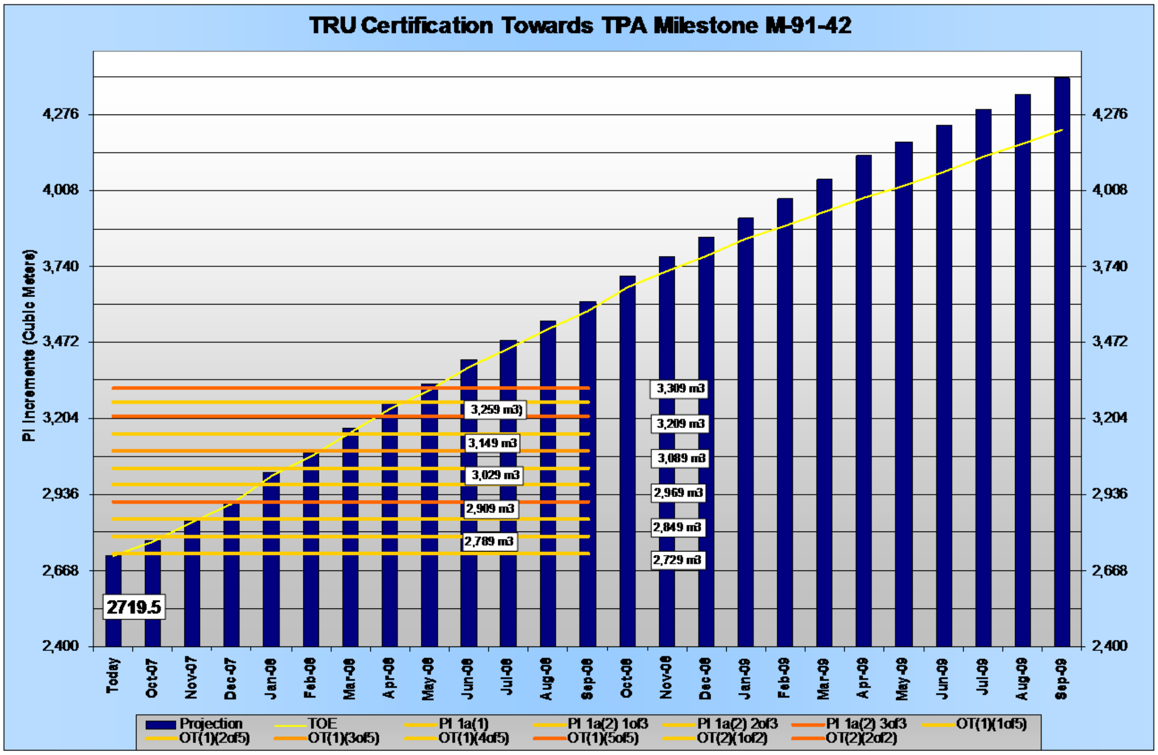

Fig. 7. System TOE used in the SWOC Systems Modeling and Analysis.

The "System" TOE is calculated based on the TOE for each unit operation applied to the integrated model resulting in the above chart. In this chart, the blue columns represent the system capacity, as constrained by available feed. The yellow line reflects the system TOE and indicates when the next increment or commitment is expected to be complete. This chart has been used to predict future performance with very good reliability and accuracy.

USING THE CHARTS

The model is used in several different forums. On a day-to-day basis, the TRU Program staff evaluates the queues and makes tactical decisions about which containers to process and certify. On a weekly basis, the WSD Senior staff review the actual performance against the production goals and make appropriate adjustments based on Project priorities. On a bi-weekly basis, the TRU Program director evaluates all of the system queues to determine if any bottlenecks are developing. In addition, since this is an executable model, several speculation analyses have been performed in support of longer term strategic planning and baseline development.

BENEFITS OF THE METHOD

The modeling and analysis yields several benefits:

- Maintains visibility on system performance and predicts downstream consequences of production issues.
- Predicts future system performance with higher confidence, based on tracking past performance.

- Applies speculation analyses to determine the impact of proposed changes (e.g., apparent shortage of feed should not be used as basis to reassign personnel if more feed is coming in the queue).
- Positively identifies the appropriate queue for all containers (e.g., discovered several containers that were not actively being worked because they were in the wrong “physical” location – method used previously for queuing up containers).
- Identifies anomalies with the various data systems used to track inventory (e.g., dimensional differences for Standard Waste Boxes).

Several speculation analyses have been performed to evaluate various proposals and unanticipated events. Many recommendations have been provided to the Project management team resulting in improvements in the performance of TRU certification activities by Hanford’s TRU Program.

CONCLUSION

The systems model and analysis approach is much more effective at predicting and improving system performance than a static analysis. Having clearly defined goals and a way to measure performance against those goals is a very powerful motivational tool. Measuring performance will likely create improvements and caution should be taken to ensure this is the desired outcome. At times, sub-optimization of a particular unit operation is necessary to ensure the system remains balanced (e.g., having excess capacity in assay does no good if there is no feed available because the NDE is working at half capacity). In any event, this systems modeling and analysis approach provides project management with better information to enhance decisions regarding optimal project performance.