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Revision 0

Utilizing OSIsoft Visualizing PI Data System for Tank Level Data

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800

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Washington River Protection Solutions

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STUDENT SUMMER INTERNSHIP TECHNICAL REPORT

Utilizing OSIsoft Visualizing PI Data System for Tank Level Data

DOE-FIU SCIENCE & TECHNOLOGY
WORKFORCE DEVELOPMENT PROGRAM

Date submitted:

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FLORIDA INTERNATIONAL UNIVERSITY

ABSTRACT

Displays showing tank level measurements from single-shell tanks (SSTs) and miscellaneous underground storage tanks (MUSTs) for the Hanford Site were developed, organized, and categorized to better observe and analyze large volumes of data all at once. Historically, the data was only available in a fragmentary fashion through the Personal Computer Surveillance Analysis Computer System (PCSACS), the software previously utilized within Washington River Protection Solutions (WRPS).

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1. INTRODUCTION

This report provides an overview of the ten-week internship served with the Washington River Protection Solutions (WRPS) in Richland, Washington, during the summer of 2018. Under the management of Ruben Mendoza and the mentorship of Marissa Ammer, Benjamin Piepenbring, Gretchen Reeploeg in the Tank Monitoring group, DOE Fellow Clarice Davila was tasked with creating, organizing, and categorizing displays with tank level measurements from single-shell tanks (SSTs) and miscellaneous underground storage tanks (MUSTs). The purpose of this task was to improve the ability to observe and analyze large volumes of data all at once, rather than in a fragmentary fashion as had been historically performed through the Personal Computer Surveillance Analysis Computer System (PCSACS), the software previously utilized within WRPS. During her time at WRPS, the intern received guidance on the software's functionality, developed a greater understanding of how the tanks were maintained, and participated in team communications to define the project goals and report ongoing progress. Furthermore, the intern was given the liberty of creating the design and structure of the data displays after considering the team's suggestions. This level of freedom provided a beneficial experience full of learning and teamwork.

2. EXECUTIVE SUMMARY

This research work has been supported by the DOE-FIU Science & Technology Workforce Initiative, an innovative program developed by the US Department of Energy's Environmental Management (DOE-EM) and Florida International University's Applied Research Center (FIU-ARC). During the summer of 2018, a DOE Fellow intern, Clarice Davila, spent ten weeks doing a summer internship at WRPS in Richland, WA under the supervision and guidance of Ruben Mendoza. The intern's project was initiated on June 4, 2018, and continued through August 9, 2018, with the objective of creating user-friendly displays of tank level data within PI Coresight that was provided by OSIsoft Visualizing PI Data System (PI).

3. RESEARCH DESCRIPTION AND RESULTS

The objective of this internship was to create, organize, and categorize displays of tank level data through PI Coresight, which was provided by OSIsoft. The tank level data came from the 149 single-shell tanks and 33 miscellaneous tanks that Washington River Protection Solutions (WRPS) manages for DOE EM. The displays consisted of trending graphs showing data points of the waste level that was collected and stored in the tanks. The data was quite varied and included weekly, monthly, or quarterly frequencies, as well as waste level measurements from an assortment of different systems: Honeywell ENRAF 854 level gauges, manual reel tapes, sludge weights, and liquid observation wells (LOWs). This data was historically reviewed and analyzed through an older software system known as PCSACS. Unlike PCSACS, PI allows the user to view a large volume of information all at once and provides the flexibility to filter the data into practically any time frame desired. This in turn permits the user to quickly and easily ascertain the status of the tanks for risk of possible leakage or overfilling.

Level Indicators for the SSTs and the MUSTs

Two primary sensors are used for the SSTs: Enrafs and LOWs. Enrafs measure surface levels and are based on the detection of variations in the buoyancy of a displacer. The displacer is suspended from a strong, flexible measuring wire which is stored on a precisely grooved measuring drum. The shaft of the drum is connected to the stepper motor via a magnetic coupling. A diagram of the Enraf sensor is shown in Figure 1.

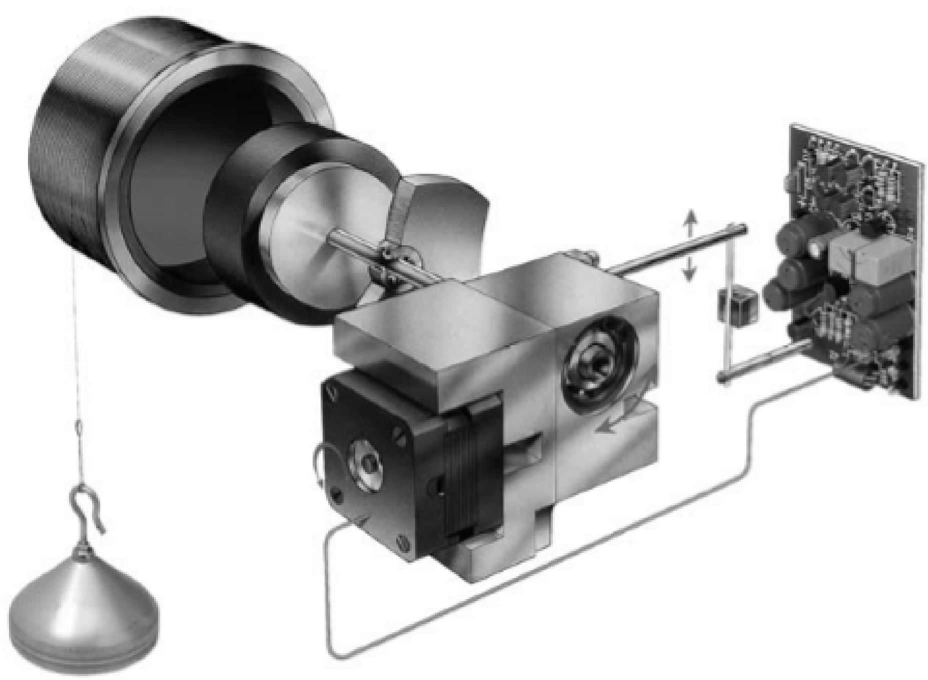

Figure 1. Diagram of the Enraf sensor used to measure tank waste levels.

The LOWs are used to measure the interstitial liquid levels (ILLs) in the tanks. The LOW system consists of a van housing specialized hardware and software, as well as a cable used to lower a probe into the LOWs, which are closed-ended tubes approximately 3.5 inches in diameter. The probes provide a profile of the waste that can be interpreted to find the ILL, or saturation level in the waste. Neutron probes are more commonly used. They emit fast neutrons and detect returning neutrons that have been slowed by hydrogen in water. Gamma probes are rarely used and detect gamma radiation in the waste, primarily from cesium-137. An image of the probe attached to the van is shown in Figure 2. In Figure 3,is an example of what the scan graph from the neuron LOW looks like, while in Figure 4 is a sketch of the procedure of using the LOW van to gather scans.

Figure 2. LOW van with ILL attached to gather tank level measurements.

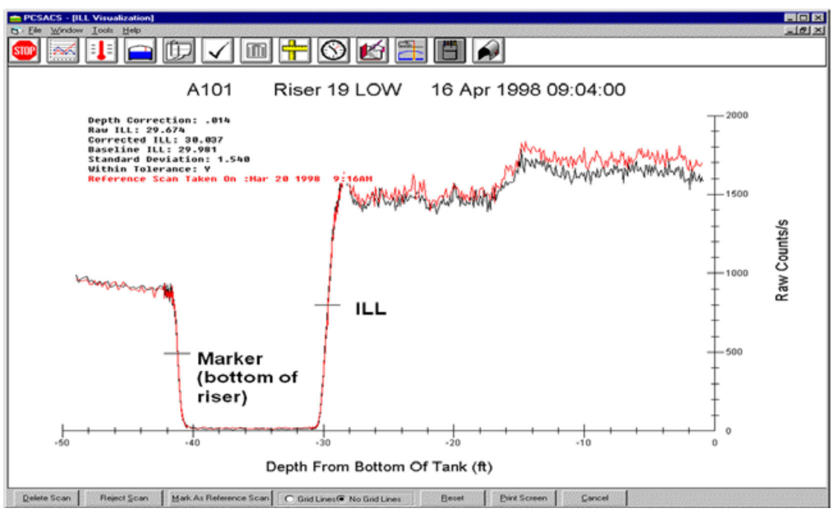

Figure 3. LOW scan graph from the A101 SST.

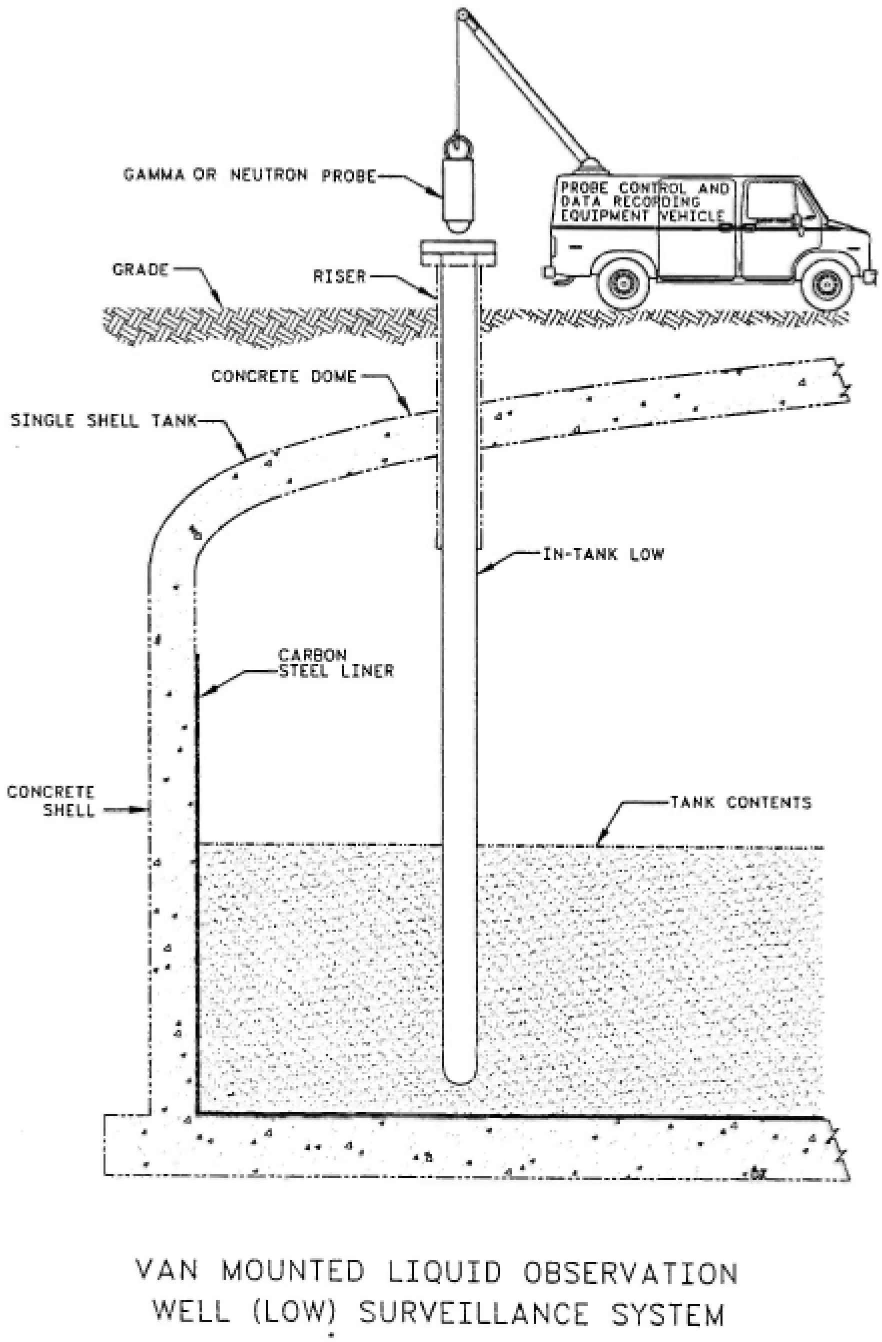

Figure 4. Sketch of the procedure of the LOW van placing in the probe. It is from WHC-EP-0685, "Engineering Evaluation of Alternatives: Technologies for Monitoring Interstitial Liquids in Single-Shell Tanks." Image is not to scale.

Many of the MUSTs use an Enraf sensor but the remaining MUSTs use either weight factors or a manual reel tape to determine waste levels. A weight factor is an indirect method of determining the tank liquid level by measuring the air pressure necessary to overcome the hydrostatic head in an open-ended vertical steel pipe terminated about 2-in. above the tank floor.

Although the manual reel tape is not the primary sensor for all of the SSTs and MUSTs, it is still a very useful tool. The device consists of a steel tape attached to a reel that is permanently mounted on a tank riser. A direct current meter is used to detect levels by measuring the conductivity between the plummet, waste, and tank. The probe is lowered until the electrical circuit is completed and the liquid level at the point of contact is read manually from the tape housing. Some images of the device and tape housing are shown in Figure 5.

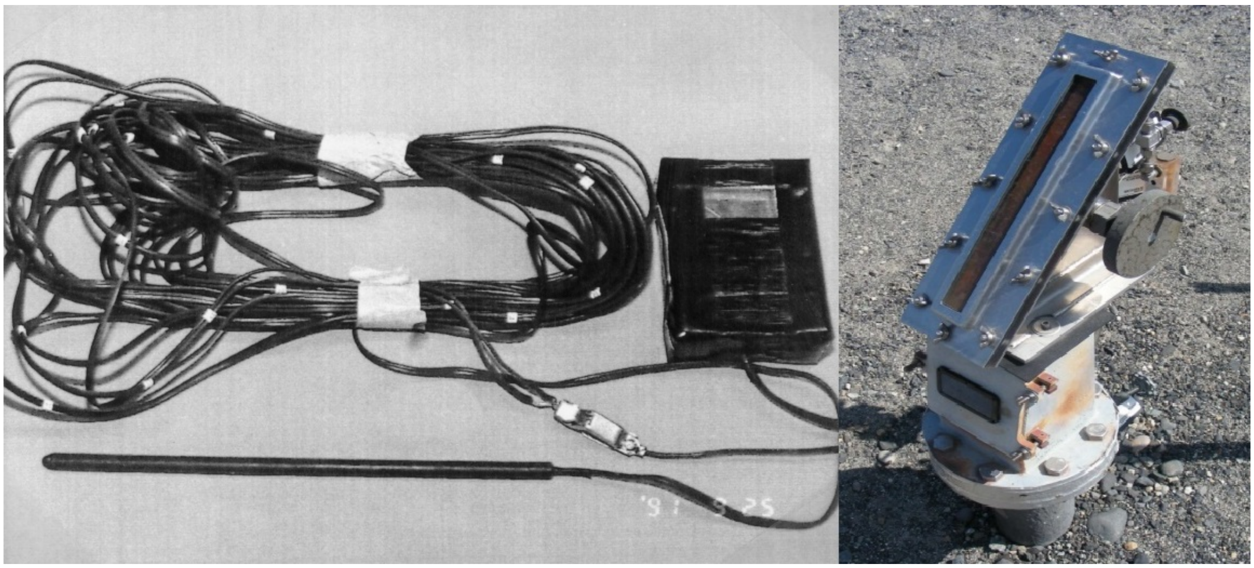

Figure 5. Direct current meter used in completing the electrical circuit for the manual reel tape level indicator (left) and the manual reel tape housing (right).

The Transition of PCSACS to PI System

Despite the fact that PCSACS would no longer be the main software being used for incoming data, it was still an excellent resource for confirming that the transition of data entering the PI System was going smoothly. Reviewing the format structure within PCSACS also assisted with developing the PI data trending graphs in a manner that would seem familiar to the Tank Monitoring group as well as other departments. Keeping the user interface in PI similar to the one in PCSACS enables the user to easily access and identify specific information of interest without struggling to learn a new format structure. An example data trend graph produced by PCSACS for one of the tanks is provided in Figure 6.

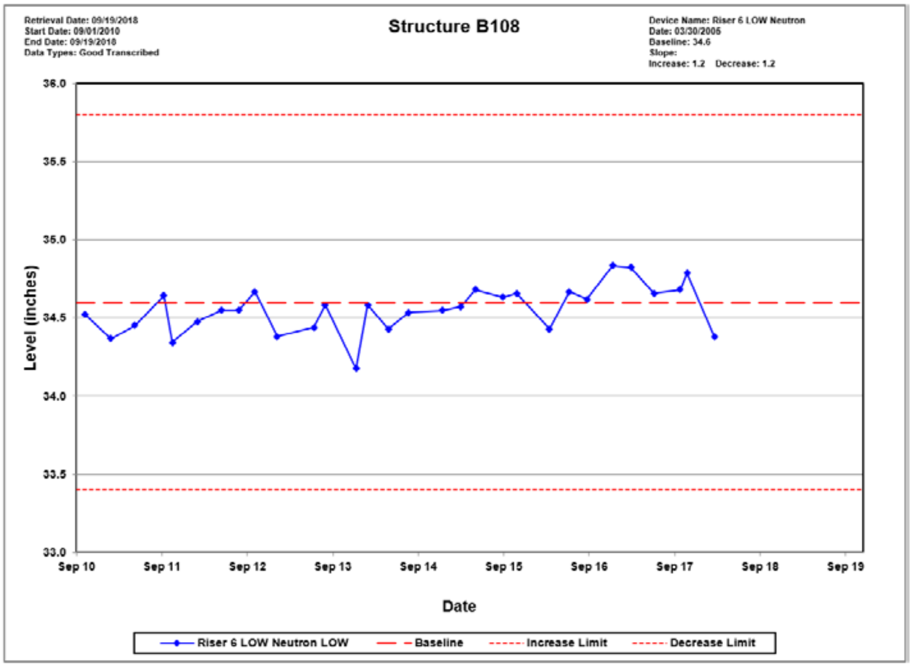

Figure 6. Display of SSTB-108 in PCSACS showing tank level data gathered from the ILL.

Working with PI System

Working with the PI System included confirming the following:

- The primary sensors for each tank were functioning properly and sending the required data at the expected times,
- The baseline and specification limits were accurately shown along with the value of the current level measurement,
- The tags, which were the titles the equipment was categorized by within the software, were properly labeled,
- The description for each sensor was properly listed in addition to the color coding, and
- The timestamps were displayed to notify the user of the last data point input.

An example of one of the farm displays is shown in Figure 7.

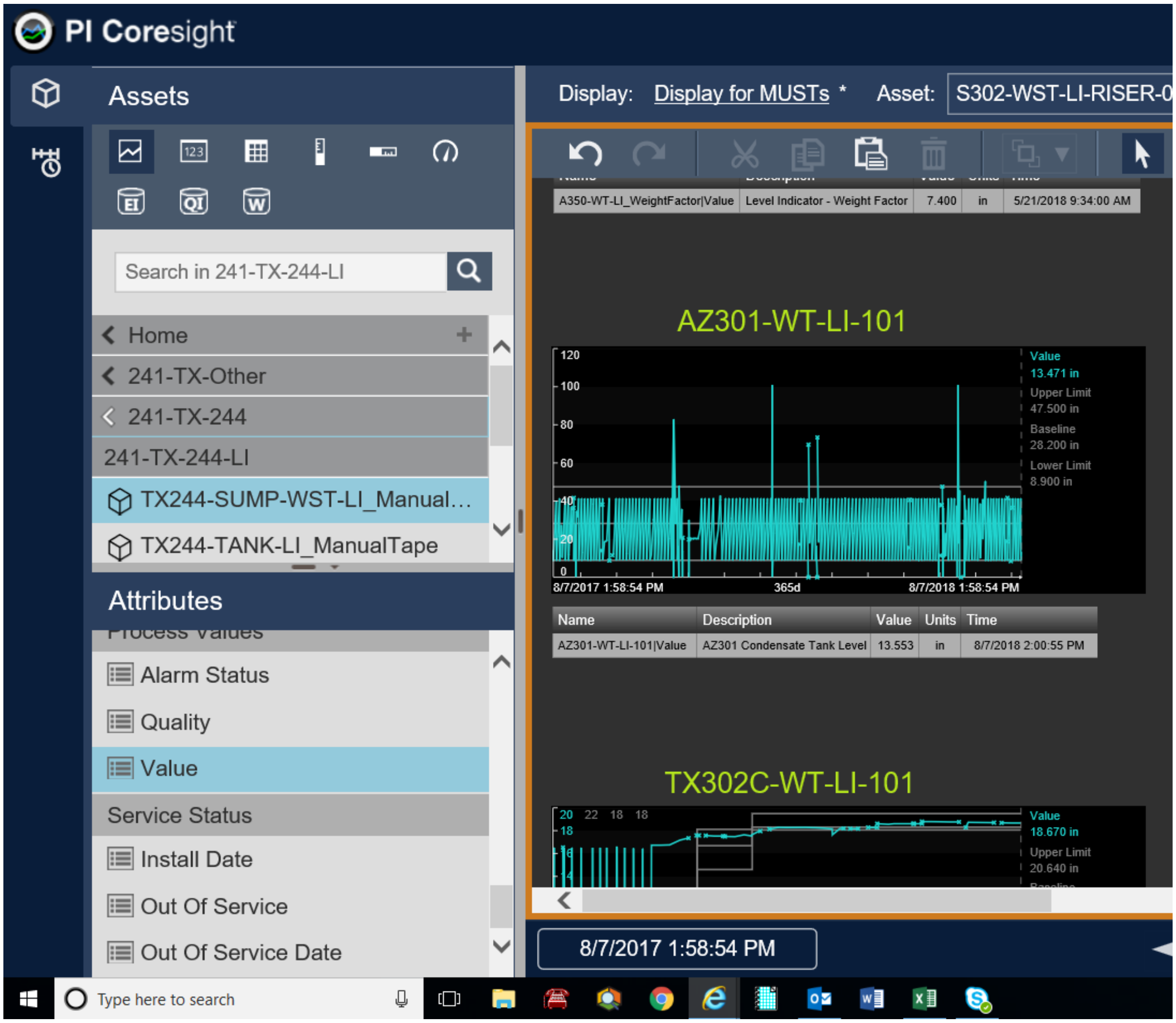

Figure 7. A sample display for MUSTs showing that all of the tanks are properly organized and categorized by tag and color, along with a description and timestamp of the primary sensor and latest waste level data.

Before attempting to create a data display of the tank waste level measurements, the first task was to become familiar with the PI Coresight software. Ms. Davila was given the freedom to experiment with a variety of formats which helped her to later recommend a specific format for implementation. Once she received training on the PI System, she was better able to execute her assigned task to create, organize, and categorize the data displays for the tank level measurements.

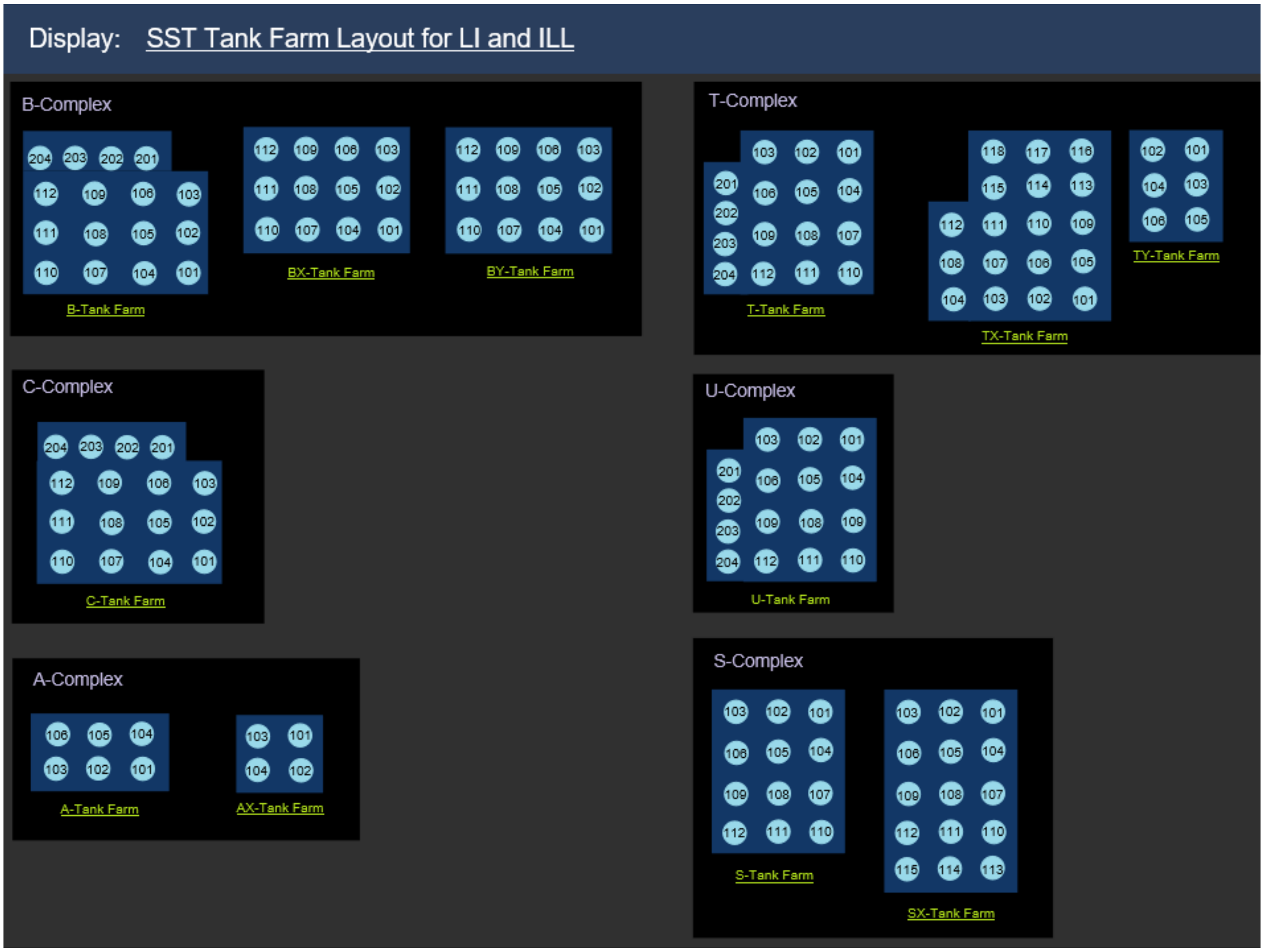

Figure 8. Tank farm layout in PI Coresight showing data for the SSTs. This served as a reference point for access to all of the displays for all of the SST farms and for the MUSTs (not shown in the figure but located directly below the SST display within

As shown in Figure 8, the green titles have hyperlinks that can take the user to a display of the farm itself while the numbers within the light blue circles have hyperlinks that can take the user to a display of the individual tank within the specified farm.

Difficulties with the PI System

In developing a display format that more or less matched PCSACS, while also providing more capabilities and flexibility, Ms. Davila encountered some obstacles. For the SSTs and MUSTs, it was noticed that there were multiple reported values that were either significantly higher or lower than the average values collected for the tank level measurements. Through discussion and analysis with her mentors and with the workers that managed the servers for the PI System, this was determined to be caused by one or a mixture of two scenarios.

The first possible scenario involved the transfer of all the historic data points from PCSACS into the PI System. While the exact cause is unknown, it appears that data points that were previously identified as suspect, false, or otherwise unreliable within PCSACS, and thus separated from the main data set, were merged with the main data set upon transfer and integration into PI. This led to a significant number of data points displaying values outside (higher or lower) than the actual measurement values expected.

The second possible scenario involved communication from the sensors themselves. Instead of sending the data point for the current tank level and remaining on standby until time to collect the next data point, the sensor continuously sent a signal as it was trying to collect another data point. Unable to collect the next data point during the standby time, the system registered the signal as a value of zero, which then was displayed on the trending graphs for the tanks.

To correct for these two scenarios in the short-term, discerning the errors from the valid data points was needed. Separating out the invalid data points was possible due to the false data points from PCSACS being either significantly above or below the typical value of the tank level or a zero value. These data artifacts were further communicated to others in the department for any future corrections needed.

Another obstacle that Ms Davila encountered was a marked variation in the labeling of tags between the SSTs and MUSTs. She was able to resolve this issue by investigating whether the older tag data from PCSACS correctly transferred over to PI, despite any differences in tag name for the tank or the primary sensor. The process to have the tag names corrected would take some time so, as a work-around, Ms. Davila created titles for each of the individual tanks. These titles can be easily changed in the future once the tag names are corrected. The designated titles were then added to the description for each type of sensor displayed in the PI table below the trending graphs.

The third obstacle Ms. Davila encountered was figuring out how to best display the MUSTs along with their reference display. She determined that it would be best for the MUSTs to have a section of their own in which they were organized numerically. She further ensured that access to their information was as simple as when accessing the SSTs.

While an ultimate goal is to create an automatic alert feature using the PI System, the current status of the technology does not have this capability. Regardless, Ms. Davila made the most of the current capabilities by creating displays that permit users to observe and analyze data from a long time range to easily discern whether the storage tank levels were stable or if there was any near-term potential for leakage or overfilling.

4. CONCLUSION

As time goes on, the task of ensuring that the storage tanks continue to be well monitored and are provided proper maintenance persists to be challenging. Transitioning from PCSACS to the advanced technology of the PI System, along with the implementation of additional automatic level indicators, will continue to increase the efficiency of the waste level monitoring effort, decreasing the difficulty of ensuring that the waste remains safely stored. Eventually, it is anticipated that technology will become sufficiently advanced and an automatic alert system will be effective enough to replace much of the current manual activities.

The internship provided an invaluable experience to Ms. Davila in gaining a better understanding for the level of effort that goes into monitoring storage tanks of nuclear waste. The efficient communication and collaboration between the different members of the Tank Monitoring department left a great impression on Ms. Davila and has taught her much about the power of strong teamwork and being willing to ask questions to further her understanding.

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