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REFUELING THE LIFESPAN

Effective Secondary Containment System for the State-of-the-Art Fuel Storage Facility at Point Loma

By Hassan Sahudin, PE, LEED AP BD+C; Bill Shehane, Seaman Corp., and Alan Strecker, Seaman Corp.

In 2008, an eight-year military construction project (MILCON P-401) was approved to replace the aging Point Loma Navy fuel storage facility originally constructed between 1917 and 1954. Located at Defense Fuel Support Point (DFSP) Point Loma, San Diego, this was the largest construction project ever within the Defense Logistics Agency Energy (DLA Energy) at $174 million. Eight 125,000-barrel aboveground fuel storage tanks were constructed to replace the existing 1 million barrel capacity of jet and diesel fuel storage. A fuel-resistant reinforced polyurethane geomembrane liner was used under each tank and a fuel-resistant reinforced ethylene interpolymer alloy (EIA) geomembrane was used in the dike areas for secondary containment. The project was contracted through NAVFAC Southwest, and Burns & McDonnell provided engineering services. Design began in March 2005 with construction closeout in January 2014.

Image 1: Burns & McDonnell helped upgrade the Point Loma Navy fuel storage facility with eight 125,000-barrel aboveground fuel storage tanks.

Image 2: Using white tanks and liner help reduce the heat island effect at Point Loma.

PROJECT GOALS

In addition to the U.S. Navy fleet, DFSP Point Loma services a number of other agencies including the U.S. Marine Corps Air Station Miramar, the 11th District of the US Coast Guard/ Homeland Security, the National Oceanographic and Atmospheric Administration (NOAA), and Military Sealift Command (MSC). The project upgrades were necessary to modernize existing fuel storage infrastructure with 21st century operation requirements in mind and to maximize sustainable practices. In addition, the project sought accreditation from the U.S. Green Building Council (USGBC) for Leadership in Energy and Environmental Design® (LEED) status.

EXISTING CONDITIONS

The Point Loma facility was originally constructed in 1901 as a storage point for Navy coal. Since operations first began, the facility has modified and expanded its infrastructure to accommodate petroleum-based fuels and increase use by air and sea forces. Tanks were added over the years for storage.

Before this project was constructed, the site included 54 storage tanks, the last of which were added in 1954. Both aboveground storage tanks (ASTs) and underground storage tanks (USTs) provided storage for approximately 1 million barrels, or 42 million gallons. The location increased its service to provide more than 460 million gallons of fuel and oil to the many commands it served by 2003.

Most of the original tanks, constructed with riveted seams, were leaking at various rates. As a result, the DFSP command actively extracted fuel and contaminated water from site soils. Replacing the tanks was necessary to prevent further contamination and fuel loss.

CONSTRUCTION

Initial construction included the demolition, or closure in place, of all existing ASTs and USTs and removal of containment berms. Old material and equipment were used to the extent possible. Located on a hillside, the site underwent major grading modifications

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to better accommodate the new facility and redirect stormwater, including the construction of new stormwater basins. The site soils were remediated to remove fuel and oil contaminants. Where possible, existing vegetation was left in place and porous surfacing material, such as crushed aggregate, already on site was used as ground cover.

Eight new ASTs were installed during construction, each with a storage capacity of 125,000 barrels (Image 2), which primarily store jet fuel (JP-5) and marine diesel fuels (F-76). Other major new structures included a pumphouse, a truck load/unload facility, a lube oil storage and transfer facility, a fuel oil recovery (FOR) facility, which included a 25,000-bbl AST receipt tank and a 10,000-bbl issue tank, and a two-story control tower near the existing fueling pier.

SECONDARY CONTAINMENT

With demolition of the existing earthen embankments, new containment structures were needed. Exposed concrete vertical dike walls were used for perimeter enclosure. and flexible membrane liners (FMLs) were selected in lieu of concrete floor for use as secondary containment. FMLs offer a number of advantages over concrete in this application.

Lower cost. Typical concrete containments cost $6-$7 per square foot installed (Bausch 2013). FML installed costs are typically $1-$2 per square foot.

Rapid installation. FML containment on nearly 12 acres was installed in less than 25% of the time required for concrete floors.

Reduced maintenance. FMLs do not require a sealant along the joints/seams to be applied or maintained as concrete does. Repair of FMLs is a simple, inexpensive process that can be done with patches applied by hot air welding or adhesives.

Under Tank Secondary Containment

Guidance for the design of secondary containment under fuel storage tanks is provided in UFC 3-460-01. Product selection direction is given in the Naval Facilities Engineering Command's (NAVFAC) Unified Facilities Guidance Specification (UFGS) Section 33 56 13 15. The UFGS guidelines call for reinforced thermoplastic urethane (rTPU) underneath because of its superior long-term resistance to chemicals, construction damage, a broad range of fuels and oils, and gasoline and volatile organic compounds. The superior abrasion and puncture resistance of rTPUs increases the likelihood that the liner won't be compromised during construction. More than 142,000 square feet of rTPU, manufactured by Seaman Corp., was used on this project.

Dike Secondary Containment

A scrim reinforced FML — in this case, a coated knitted polyester — was chosen for the containment liner in the dike enclosed area. The coating chosen was ethylene interpolymer alloy (EIA), which is an alloy of PVC, and a ketone ethylene ester (KEE), Elvaloy. A DuPont product, Elvaloy differs from traditional plasticizers in two significant ways. First, KEE is solid rather than liquid. Second, it is an

Image 3: Using a white membrane liner system provides effective secondary containment in the dike areas.

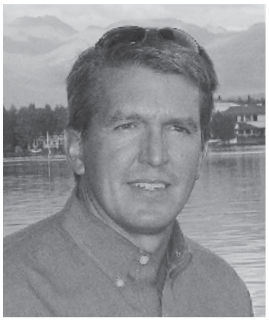

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Image 4: Geotextile fabrics placed under concrete sidewalks protect the liner.

extremely large molecule. While traditional liquid plasticizers have molecular weights in the 1,000 g/mol to 5,000 g/mol range, KEEs have molecular weights ranging from 250,000 g/mol to 400,000 g/mol. This is large even in comparison to PVC molecules which range in size from 50,000 g/mol to 150,000 g/mol. The solid, dense KEE molecules are stable in the coating which has excellent resistance to chemical and UV action. This results in long-lasting performance of the finished EIA FML. EIA liners have been used in exposed applications for more than 30 years of continuous service.

EIAs have been used for secondary containment on more than 50 U.S. military installations. Traditionally, black liner was used. In recent years the trend has moved toward lighter colors to reduce surface temperature on the liner and tan has become a more common color. In same-site comparison tests, the temperature on the surface of black FMLs has been measured at 160 degrees F whereas the white liner adjacent to it has been measured at 130 degrees F. As a side benefit, light-colored liner is easier to clean, inspect and repair as well.

Because achieving LEED certification was a goal at the Point Loma facility, the decision was made to use a white liner (Image 5), which resulted in lowering the Solar Reflectance Index (SRI) of the liner to below 29 degrees F. This is the maximum allowed by the LEED “Heat Island Effect, Non-Roof” credit requirement.

In addition to being UV resistant, an EIA provided the advantage of having a low coefficient of thermal expansion. This reduces the probability of liner failure due to environmental stress cracking caused by repeated expansion and contraction. It also meant that maintenance personnel would be able to access the facilities without the trip hazard posed by extreme wrinkling that can occur in geomembranes subject to thermal expansion.

The ability to leave the liner exposed resulted in additional savings in surfacing material and placement costs. In the event of a spill, the containment area would also be easier to clean up without having to remove and remediate the contaminated surfacing materials.

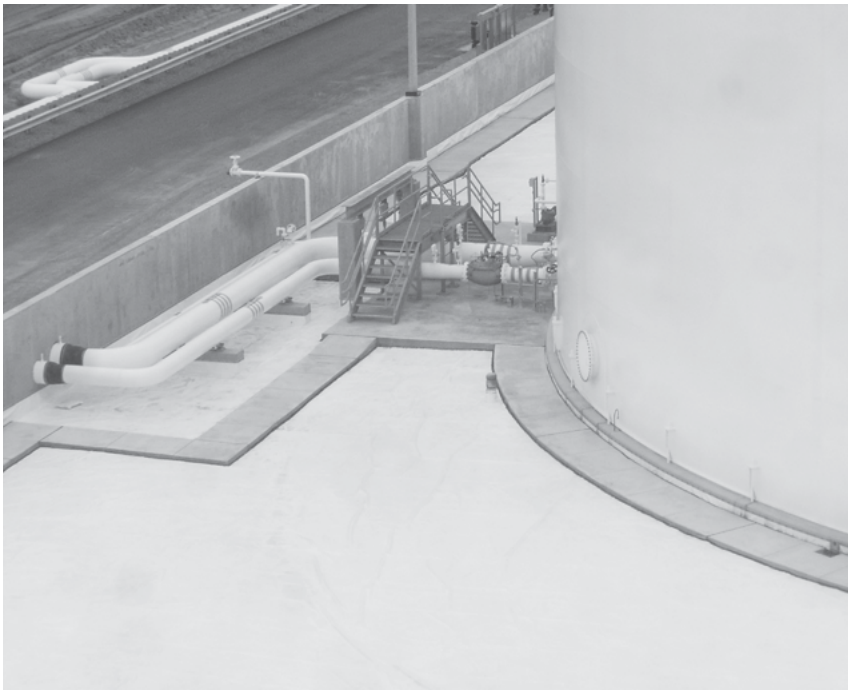

Image 5: The secondary containment area around storage tanks includes vertical concrete dike walls and membrane liner.

Image 6: Because of potential damage to the liner, traditional steel reinforcing bars and steel from stakes could not be used during construction of concrete sidewalk in the diked containment area.

Guidance for the design of secondary containment in dike liner areas is also provided in UFC 3-460-01. Product selection direction is given in the UFGS Section 33 56 63.

Access for Personnel

Concrete sidewalks were used to provide access for operations personnel (Images 5 and 6).

Burns & McDonnell used the Corps of Engineers' standard detail to construct the sidewalks. Because of potential damage to the geomembrane, a geotextile is placed on top of the liner (i.e., below the concrete). Rebar is eliminated from the construction by using fiber reinforcement instead (Image 6). The use of sidewalks provides safer access for operations personnel and also helps to minimize potential damage to the liner during operations.

CONCLUSION

The project received a final LEED Silver certification in June 2014. The thermal profile created by the white geomembrane proved to be an important contributing factor. In addition to contributing to LEED achievement, the white geomembrane liner also provided the following benefits:

- Cost-effective secondary containment system
- Ease of maintenance, inspection and repair
- Improved working environment in summer months due to reduced heat gain.
- Proven long-term performance
- Rapid installation
- Reduced thermal contraction and expansion

REFERENCES

- SS Credit 7.1: Heat Island Effect, Non-Roof, LEED 2009 for New Construction and Major Renovations, USGBC, Washington, D.C.
- Section 33 56 13.15, Undertank Interstitial Space, United Facilities Guide Specifications, NAVFAC
- Section 33 56 63, Fuel Impermeable Liner System, United Facilities Guide Specifications, USACE

IT'S ALL ABOUT THE PROCESS

Finding the Right Work Flow Can Save Time and Costs

By Judith Morley

When we think about assets and asset management our minds go directly to those tangible items we can purchase, see, touch, use, fix and replace. We don't readily consider the intangible things, such as intellectual property or knowledge about processes, as assets. We talk about, execute, analyze, recreate, violate and sometimes completely ignore processes every day. Processes are assets and are as important to an organization as any other tangible asset or intellectual property.

Extracting the Right Process

All organizations face challenges when it comes to working efficiently. Departmental and team silos can create roadblocks to moving work through an organization. Employee turnover can cause disruption to the normal flow of work. Other restrictions such as cost reduction, time constraints, volume of data and the amount of work to be done are all factors contributing to process failure. Perhaps the biggest challenge to effective process execution and adherence is how best to extract knowledge from people's brains about the work to be completed and use that knowledge to work more effectively.

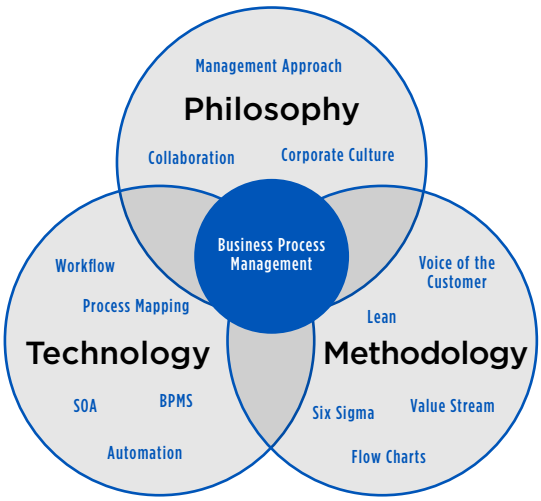

Figure 1: BPM facilitates the merging of technology and ideas.

From the need to overcome process challenges came several improvement methodologies. Lean is a production practice or methodology mostly designed to eliminate waste by doing things better. Eliminating waste and unnecessary processes will eventually reduce production time and costs and increase quality. Many companies see this as a way to change culture, to have these methods become part of their organization's way of life, minimizing silos and leading to greater collaboration. Everyone from senior leadership to the lowest level employee must buy in to the culture change for it to be successful.

Six Sigma focuses on the process of quality improvement. The philosophy advocates training in areas such as strategy, quality and customer focus and then defines key performance indicators designed to measure and improve the effectiveness of business processes. Lean and Six Sigma are often used together, leveraging the best of both methodologies to improve organizational processes and quality.

Business Process Management

Business process management (BPM) is known for optimizing transaction processing — activities that are processed the same way repeatedly and with very little deviation. In its most recent Magic Quadrant for Intelligent Business Process Management Suites, Gartner defines BPM as "a management discipline that treats processes as assets that directly contribute to enterprise performance by driving operational excellence and agility."

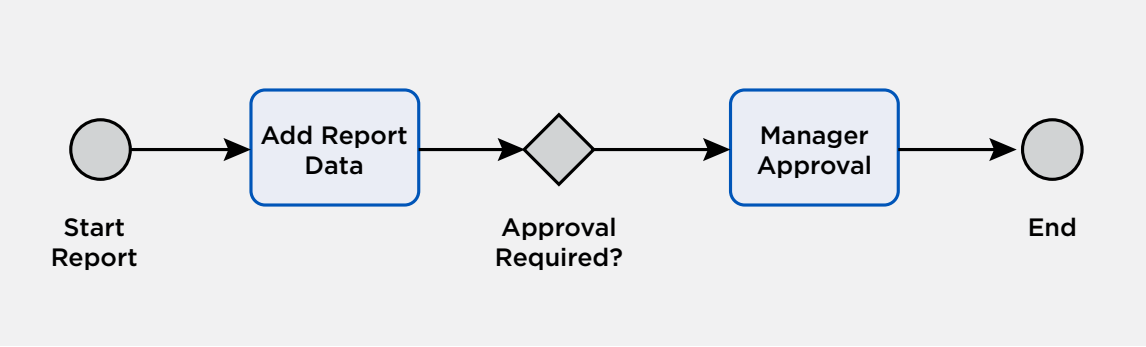

Figure 2: Sample business process model.

BPM is most often used in financial services, insurance and healthcare, but there are uses for BPM in all organizations. Looking outside the traditional BPM markets and applying process analysis criteria to manufacturing, energy and construction, we will see that as organizations seek ways to increase cost savings, efficiency, and accuracy, while meeting industry requirements and production standards, the use of BPM to manage workflow will become increasingly critical. Many organizations are establishing centers of excellence focused on process improvement. Process champions are leading teams of cross-functional employees in collaboration sessions aimed at examining current processes, figuring out what is working and how to fix what isn't working.

Business Process Model Notation

Business process model notation (BPMN) is a method of illustrating processes, similar to a flowchart you might see in applications such as Microsoft Visio. The core components for BPMN include events, activities, gateways and flows.

An event is a trigger — something that starts or ends a process. For example, you might receive an email or other notification that it is time to create a report for an audit or inspection. The notification you receive is the event that starts the process to create the report.

Activities are tasks done throughout the life of the process. These can be user tasks or system tasks. User tasks might include the presentation of a form to a user that allows the user to input data relevant to the process. System tasks are automated and require no user intervention. For the audit report you are creating, data must be retrieved from a database and displayed in a chart. A system task can automate that activity, reducing the time and resources required to compile the data.

Gateways are objects in the process model that make decisions. These can be very simple yes or no questions, but when integrated with sophisticated rules, processing engines have the power to make more detailed decisions about the process. The audit report must go through an approver prior to being distributed. It's possible, with the use of gateways, to automate that decision and control the outcome of the process.

The flow of the process is created when these components are linked together to create the process model.

Opportunities for Using BPM

Facilities and asset management. Processes control the routing of work orders and assignment of staff. Historical data could be used in making decisions about how to address

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issues. Setting inventory thresholds could trigger automatic reordering of inventory with minimal user intervention.

System warnings or failures. Notification of a system failure triggers a process. By automating that process using the notification as the start event, we could systematically extract critical data and, using business rules built into the process, route the notification to the appropriate team so remedial action could begin.

Project closeout. When projects or programs end, there is a process followed that may include multiple departments playing a role in the activity. Using BPM to model the project closeout process and route the work to those playing a role in the closeout facilitates collaboration amongst teams.

Reporting. Generating reports can require people to access data from systems and spreadsheets and compile that data to create reports. Using the task automation capabilities in BPMN, these tasks can be automated, saving money and resources. Date-driven reports can be automatically created by the process model, but routed to an approver for final review.

Compliance. Processes followed to prove compliance with governing agencies can be modeled using BPM so each step is executed and organizations remain in compliance. BPM could be used in security monitoring, reliability testing or other mandated compliance processes.

BPM and those who understand it for an organization are truly assets that can be the difference in how well a company executes projects and maintains productivity.