A flying start

Derek Blagg, Varec Inc., USA, discusses best practices for automation at airport fuel farms.

Fuel farms at airports contain bulk fuel storage tanks, truck racks and other equipment, similar to a commercial tank farm or marketing terminal. However, there are complexities to managing an airport fuel farm that make control and automation critical to ensure an efficient and safe operation. All fuel farms have a control room, and with proper automation, operators can monitor all aspects of the fuelling system.

There is a wide range of concerns for those managing these fuel farms. Ensuring overall safety is always paramount, but there are unique challenges at each location that impact day-to-day operations. One of the biggest challenges faced by operators is trying to manage and integrate the disparate systems utilised across the fuel farm. Most of these systems are procured and installed over time by different vendors and manufacturers, which compounds the issues even further. In addition, some operators do not have access to accurate real time inventory information that would enable them to make more informed operational decisions about fuel movement and storage. They also express concerns around managing required pressure and flow volumes for on-demand hydrant systems due to inconsistent pump run time and uneven wear and tear on those pumps. Another issue is the lack of integration between fuel management systems and the emergency fuel shut-off (EFSO). This can result in extended downtime for the hydrant system while the issue is located.

Figure 1. Airport fuel storage tanks and hydrant pumps.

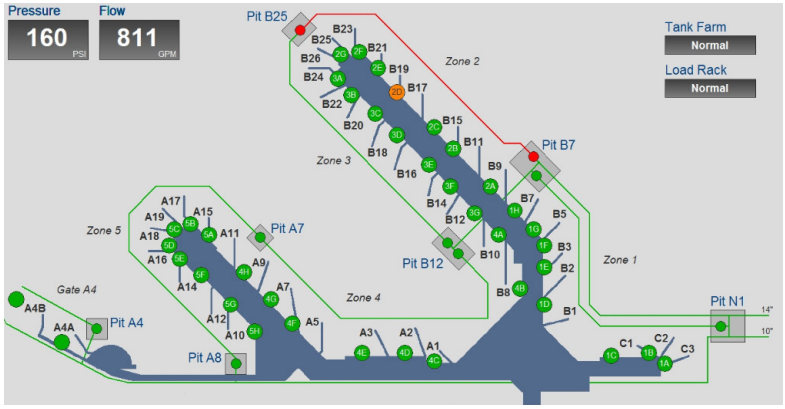

Figure 2. EFSO terminal map showing active alarm in, and resulting isolation of, Zone 2.

The importance of movement tracking systems

Product movement tracking is an essential component of any fuel farm automation system. A movement tracking system can automatically track fuel movements based on valve position, pump status or user command. Beginning level, end level, transfer set points, volume, time stamps, and other critical information is stored in the movement transaction for use in reconciliation and reports. With a movement tracking system, every time a valve is opened or closed on a tank, the product movement is tracked. Therefore, it is easy to view which tank received or issued fuel and how much was moved. If there are discrepancies, they are identified immediately and the process to determine why can begin.

Another benefit of having a movement tracking system is the ability to incorporate a fuel accounting system to track ownership and perform reconciliation. When fuel is delivered to the fuel farm, the operator receives a bill of lading (BOL) denoting how much fuel was delivered. The amount reflected on the BOL is used as the quantity received in the inventory accounting system. Fuel typically leaves the fuel farm by hydrant system or load racks and is recorded on fuel tickets as it is loaded onto aircraft or into tanker trucks. Sometimes, the reconciliation and closeout process indicates a variance because the calculated book inventory, based on incoming and outgoing product, does not match the measured physical inventory. This variance can be a result of any one or a combination of issues. For example, what was recorded as received from the BOL may not match what was physically received. Product movements at the hydrant system or load rack could be recorded incorrectly or entire transactions could be missing due to lost tickets. The automatic creation of transactions by the movement system captures real time data and is critical in the investigation of variances.

Pressure and flow vs pressure then flow

At most airports, the current system pressure is typically only factored into the equation when it is time to initiate the start of the first hydrant fuel pump. Each additional pump then starts or stops based on flow rate. This is often problematic because the system is starting or stopping a pump without taking the current system pressure into consideration. Starting a pump based only on flow, without regard to the current pressure, could cause pressure to rise above the recommended operating threshold. Alternatively, stopping a pump without regard to pressure could produce a sudden drop in pressure and bring the system down to alarm limits, forcing a quick start on the next pump. Augmenting the programmable logic controller (PLC) to take into account both pressure and flow reduces quick starts and stops that cause unnecessary wear and tear on pumps.

Achieving optimal pump performance

With hydrant systems, fuel pump performance and maintenance are major concerns for most airport fuel farms. It is common for fuel control systems to utilise a lead-lag methodology for managing when fuel pumps start and stop. In these systems, a lead pump is designated and then additional pumps are started as needed to provide demand at the desired flow rate. As demand and the flow rate decreases, the most recent pump started will be the first pump stopped. This continues throughout the day, based on demand, until only the lead pump remains on. Typically, the pump designated as the lead only changes after a preset amount of time passes, or when all pumps have stopped,

then the next pump in sequence becomes the lead pump. This method results in some pumps having long run times and others having short cycle run and stop times.

Using lead-lag, the pumps in the middle of the sequence tend to be started and stopped the most. As such, the pumps are unable to properly rest between cycles. For optimal performance, pumps should have a long run-time, followed by a cool down period. Alternatively, the first-in, first-out (FiFo) system does not have a dedicated lead pump. Instead, pumps are rotated through as demand increases and decreases, resulting in more even run times across all pumps. This methodology requires more complex PLC coding, but the benefits to the overall pump system are high. FiFo spreads the run times across all pumps in a more distributed manner, thus reducing the wear and tear experienced in a lead-lag system. This helps improve overall performance while also reducing maintenance costs and pump downtime.

EFSO system integration

The EFSO system at an airport is one of the most important aspects to running a safe hydrant fuelling operation. There are EFSO buttons near the hydrant system throughout the airport and fuel farm. When an EFSO button is pushed, the pump system providing service to that section shuts off immediately. At many airports, when an EFSO button is pushed, operators are not able to quickly identify where the shutoff took place. Teams across the airport race to check each panel to determine which EFSO button was hit and why. In the meantime, the hydrant system supplying fuel to specific areas, or sometimes the entire airport, remain shut off. This can cause significant issues, especially at large airports.

When the EFSO system is integrated into the hydrant control system, tank farms can better isolate and manage EFSOs. In an effective integration, there are a series of controllers in the field bringing all the EFSO inputs into a main system in the control room. The human machine interface (HMI) for the EFSO system displays the entire layout of the airport, including each EFSO button location and the status. When a button is pushed, an alarm sounds in the control room and the operator can easily locate which EFSO button was initiated by looking at the monitor. If the hydrant system layout allows, this integration can also isolate the shut off to only those terminals or gates affected by the button pushed, meaning the rest of the airport and hydrant system can continue to operate as normal.

Conclusion

This article outlines some of the recommended best practices for aviation fuel farm automation, and should not be considered a comprehensive list of all possible automation configurations. When considering an automation upgrade, the design team needs to understand the current infrastructure, goals and budget. Finding a strong partner to help execute the automation is critical. Where possible, it is advisable to select a single partner that can integrate all automation, or can support the entire system once a project plan has been developed. T&T