DEPLOYING AUTOMATION LOGIC TO FUEL MANAGEMENT SYSTEMS

Automation of tank terminal processes at Chicago O'Hare International Airport improves operational efficiency across fuel management systems

Aircraft Service International Group (ASIG), now owned by Menzies Aviation, has been the fuel system operator for the tank farm at the Chicago O'Hare Airport since 1960.

There are two tank farms at O'Hare, one for United Airlines (UAL) and one for other airlines (OAL). The UAL tank farm includes a pad with 14 pumps to fuel all of the United Airlines flights. The OAL tank farm includes a pad with six pumps that feed the cargo area truck loading rack and the two super satellite systems that fuel the OAL gates and load racks.

Varec's first automated fuel control project at the tank farm took place in 1999. The project included installing a programmable logic controller (PLC) in each of the two tank farms, which communicated to one central control room, as well as the FuelsManager software to manage the inventory, accounting, and reconciliation of their fuel assets.

SITUATION

The PLCs installed in 1999 at the two tank farms are still in use today. However, in the early 2000s, ASIG wanted to upgrade the control system for the super satellite systems and cargo area. The main issue they wanted to address was pump maintenance cost, especially at the super satellite systems. The pumps were running at erratic intervals, starting and stopping too frequently and at inappropriate times. Each satellite system had nine pumps and only one satellite could be on-line at a time. Daily peak demands often required seven, eight, or all nine pumps in the group to be in use.

OAL Tanks at Chicago O'Hare Tank Farm

The satellite systems were located near one another, but were controlled independently. There had been several attempts made by previous companies to integrate the two satellite systems and have them function as one 18-pump system. A single 18-pump system would drastically reduce the impact of pumps being unavailable for maintenance. Unfortunately, all attempts to functionally combine the two satellite systems were unsuccessful.

When Varec was engaged in 2004, a lead-lag system was in place to manage the fuel demand. Using this method, the last pump on would be the first pump off. Often this meant additional pumps were turning on and off too quickly, which had a negative impact on pump performance. This also meant that the first pumps on often remained on, resulting in uneven wear and tear and increased maintenance needs across the 18 pumps. For optimal performance, pumps should have a long run time followed by a cool down period.

The original scope for Varec was to make the two PLCs operate more efficiently as independent systems. The ability for the two systems to work as one no longer seemed like an option. ASIG was hoping Varec could

modify the pump logic so that once a pump was turned on, it would run for at least 15 minutes, reducing the quick start/stop cycles.

SOLUTION

Varec suggested a first-in, first-off (FiFo) pump control method instead of the previously used lead-lag. Using FiFo, the pumps would achieve a more optimal performance versus the last one on being the first one off. It would naturally distribute run times across the pumps and eliminate quick starts and stops for some pumps and long run times for others. In addition, the new system would use a combination of pressure and flow to determine when to start and stop pumps.

RESULTS

Varec was not asked to attempt combining the satellite systems to function as one. However, after understanding the operational demands, Varec recommended updating the scope to include logic changes that would enable the two satellite systems to communicate as one. Varec was able to resolve the issue of the two systems not communicating and deployed the FiFo logic. The two PLCs now have a direct connection to each other and work as one system. Operators can choose to run the systems independently or as one in auto mode. The PLCs pass start and stop control as needed because it is a continuous flow between the pumps, regardless of whether it's a group one or group two pump. FiFo not only helped ASIG reduce pump downtime, it also helped them reduce pump maintenance costs year over year.

The project took approximately six months to complete with the bulk of the logic and programming work completed in Varec's systems engineering lab. The onsite deployment took only two weeks. Over the years, new functionality has been added as needed to support the tank farm, but the core logic and code is still in place over 13 years later.

View of super satellites at O'Hare

2010 – PRESENT

The ASIG and Varec partnership at Chicago O'Hare has continued to thrive over the years. In 2010, Varec was contracted to upgrade ASIG's main systems, which included servers and client-side computers for the tank farm's entire fuel system. In addition, the primary tank gauges were upgraded in 2012.

Varec's FuelsManager software is also utilised at the tank farm. When it was installed in 1999, it was the first automated inventory management solution deployed at the site. FuelsManager is the human machine interface used by the tank farm operators to manage the control system and tank gauges. Since being acquired by Menzies in 2017, FuelsManager now pushes the tank farm's inventory data into the Menzies fuel management and ERP system. In early 2018, Varec will be upgrading FuelsManager when ASIG completes the latest upgrades to its servers and workstations.

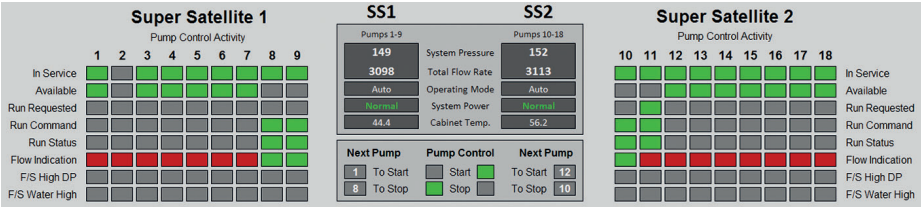

Illustration of the FiFo Pump Control Activity Sequence, SS1 has stop control, pump 8 is next to Stop - SS2 has start control, Pump 11 is starting

FOR MORE INFORMATION

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FIFO LOGIC

Many airport fuel control systems utilise a lead-lag or first-in, last-off methodology for managing when fuel pumps start and stop. In this scenario, a given pump is declared the lead and the next pumps in the sequence are started to provide additional flow as needed. Therefore, 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. After a preset interval of time or when all pumps have stopped, the next pump in sequence will become the lead pump.

In lead-lag, the pumps in the middle of the sequence tend to be started and stopped the most, which doesn't allow the pumps to properly rest between uses. For optimal performance, pumps should have a long run-time, followed by a cool down period. The FiFo system does not have a lead pump. Instead, pumps are started and stopped in numerical order. This methodology requires more complex PLC coding, but the benefits to the overall pump operating system are extremely high. FiFo naturally spreads the run times across all pumps, thus reducing the wear and tear experienced by the same subset of pumps in a lead-lag system. This will reduce maintenance costs as well as pump downtime.