2019 AGC ACE Awards Submission

Category 2 – Meeting the Challenge of a Difficult Project – Specialty Contractor

Contractor: Murphy Company

Project: STAQ Pharma

STAQ Pharma is a new outsourcing facility which utilizes a cleanroom environment with new age robots and production rooms to provide prefilled syringes and compounded medications to hospitals. STAQ is one of few pharmaceutical facilities built from the ground up on the most recent and more stringent 503B regulations and current good manufacturing practices. STAQ and its representative Vista Engineering realized the stakes of construction, and selected Turner Construction to manage and build their facility. Turner entrusted Murphy Company to implement the complex mechanical facilities; and we built our team of subcontractors with companies with considerable cleanroom construction experience – ATS (controls system) and JPG Engineering (balancing). Our main goal was to support STAQ in achieving its mission of "bringing Safety, Transparency, Availability, and Quality to compounded medications." With our expertise and experience, we were up to the challenge of delivering this difficult project in a timely manner, despite scheduling setbacks, to assist this innovative company in focusing on sterility, precision, and ultimately, our lives!

From the beginning, STAQ was upfront with the urgency of completing the project by their deadline. The entire project was a race against production deadlines! As a startup company, STAQ already had committed to orders and it was paramount they could produce their product and pay for construction and provide their drugs to their customers!

Immediately, Murphy Company had to mobilize and start installing ductwork. There was no time to manually draw and lay out the duct. Murphy utilized its BIM team to model the ductwork in only a few weeks. Murphy then installed the upper mezzanine hanger system in less than a week with only two craftspeople and before a single piece of duct had been delivered. Duct was expedited through Murphy's shop, and entire sections of ductwork were assembled to speed up installation. Murphy was able to stay ahead of schedule while minimizing site presence.

However, late in the schedule, one of two critical roof top units was damaged in the handling of the unit at the crane yard. A team meeting was held, and it was evident there were only two options: order a replacement $60,000 unit with a 16-week lead time or attempt to repair the unit. We convinced STAQ to allow Murphy to repair the unit; and we got right to work! Working closely with AAON, Murphy used its extensive fabrication capabilities and experienced craftspeople to spearhead the efforts. Work included removing and replacing half the unit base rail and the top three roof panels, working out considerable dents and deformities in the side panels, compressor deck, and RA opening, and checking and adjusting the compressors that were affected by the damage. Murphy added sealant and flashing in areas not originally provided by the factory to further reduce any chance of leakage through the unit and into the critical cleanroom space. The repair was a success and Murphy Company and AAON joined forces to provide a 5-year parts and labor warranty on the unit out of confidence in the repair. The unit has already proven itself in reliable function and has survived considerable weather events, notably 2019's infamous Bomb Cyclone! Most importantly, Murphy repaired the unit in less than 2 weeks, saving the schedule and maintaining current deadlines!

We conquered one problem, and another logistics issue materialized: a fire in the Honeywell Controller Plant. This caused considerable setbacks to the Phoenix Valve Factory and prevented them from meeting their production deadline. As the overall project's substantial completion date rapidly approached, the Phoenix delivery was continuously delayed, jeopardizing the schedule. Murphy used extensive planning, negotiations with the factory, collaboration between the affected contractors, and was able to mitigate the month and a half delivery delay.

Once the equipment was wired and installed, startup immediately began. STAQ's mechanical system is unique in design and function with an advanced, $950,000 premier system to provide constant air volumes in and out of all the rooms. Such a system isn't cheap, as lives are at stake; and ensuring the system is consistent means germs cannot get in! The design achieves this with Phoenix Valves' laboratory air control valves that are pressure independent and provide constant air volumes to the cleanrooms they serve. They also are used between a supply and exhaust to create an offset and room positive differential pressure. While Phoenix Valves are not necessarily new technology, the overall air delivery system is new. This system is unique in a combination of ways. They use a pair of RAHU's to recirculate the air instead of exhaust for

energy savings. There are no dedicated exhaust and supply fans. The closed loop, cooling system is atypically achieved via a pair of RTU's that are decoupled and pull from the return, cool the air, then supply it back to the RAHU's, and the room side fan filter units are inline in the system instead of pulling from a neutral plenum. These factors help the system achieve energy efficiency and satisfy energy codes but are unproven and add significant variability to a system meant to be consistent and reliable. Establishing the system tolerances, predicting its behavior to implement controls sequences, and controlling the large number of variables proved to be the largest obstacle the project faced.

In fact, at the initial startup, the system was far from functional. The RAHU's could easily build supply pressure but could not create return pressure without pulling the supply side out of tolerance. Several days of precious schedule were sacrificed in systematically isolating the system issues to no avail. Until the team discovered the system could be manipulated into building return static by relieving the excess supply pressure discovered by opening one of the supply cabinet doors on the RAHU's. This was a way of tricking the fan VFD into ramping up supply pressure without over-pressurizing the valves. As a temporary fix to keep the schedule, the team adjusted the door opening with shims and manipulated the supply pressure until all the Phoenix valves had enough pressure. Furthermore, during the systematic troubleshooting, it was discovered that the RTU economizers were causing system inconsistency and wildly varying pressure even when the RAHU supply doors were opened. Murphy was able to develop a permanent solution to shimming the doors open by adding a VAV to the supply and return sides of the RAHU's that were solely there to relieve and build static pressure on each side of the fan. This effectively added "suspension" to the system, allowing it to compensate for unforeseen losses. A pressure sensor was added and the VAV's were programmed to modulate to maintain the static pressure the team found would satisfy all the valves by trial and error. This system suspension also contributed to compensating for the RTU economizers. Finally, adding programming to the controls system allowed the economizers to be kept in a range to produce consistent system pressure.

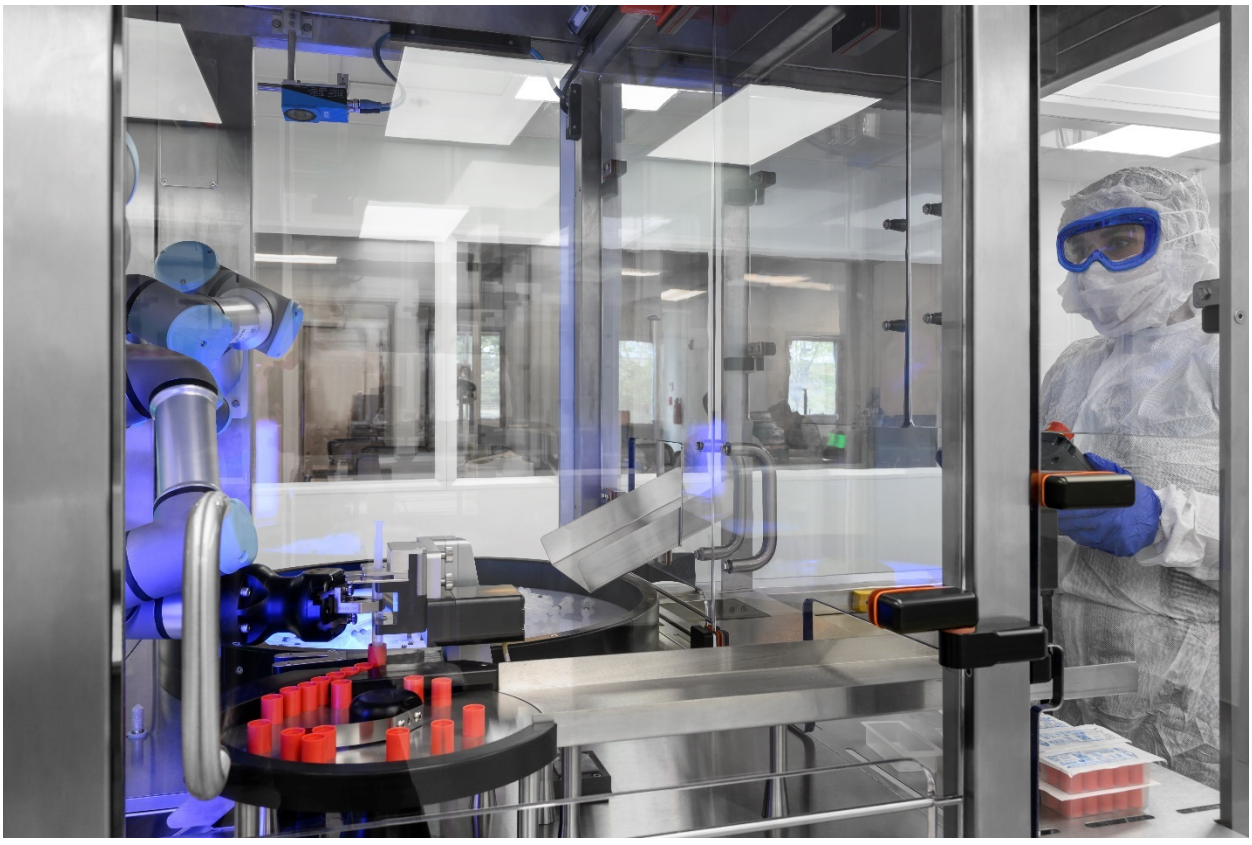
The next step was balancing the cleanroom system so air traveled per the room ISO classification. The layout of STAQ's cleanrooms was complex. There are multiple common corridors that share doors to rooms with different ISO classifications. Therefore, the pressure

cascade was complex and proved challenging to balance. The air balance had to be a near perfect scenario of adjusting room offsets slowly back and forth until the entire system falls into spec, then dropping rooms into idle mode and adjusting that until both modes were in check. This effort was up against the final and hardest deadline of all: turning the building over to validation. Missing this deadline, most importantly, would draw out the validation and cause STAQ to fall short of its goal of becoming a 503B facility in the calendar year! Working until 8:30 PM the night of the deadline, the team finally got the system balanced. There were zero days left for error.

The success of this project can be attributed to the overall collaboration and safety of the entire team. From the beginning, buy-in of Turner's plan of construction from all subcontractors allowed extensive coordination between the entire team. Without above and beyond efforts from ATS, JPG, Murphy, Turner, Mangan, and Vista, this project would never have been completed on time and the complex design would likely have been scrapped. One of the critical components, especially in the commissioning effort, was the buy-in Murphy Company was able to get out of its subcontractors. Without the extra hours, our help in resolving issues that weren't necessarily within scope, and a relentless approach to a solution, the project would never have been a success.

Safety, Transparency, Availability, and Quality – that's what STAQ stands for. From the start, STAQ sought after contractors who stand for the same values. Long hours, late nights, extensive coordination were all crucial to dealing with the challenges of this project, most of which were out of the team's control. True, total team buy-in to the STAQ values and to the project execution led to a true construction effort – collaborative, supportive, and all vested in the product, despite any difficulty or roadblocks encountered.


RAHU
RETURN
RTU SUPPLY
RTU SUPPLY




SUPPLY
SUPPLY


RETURN
RAHU
RETURN
RTU
SUPPLY
RTU
SUPPLY
RTU
SUPPLY


RTU
SUPPLY


EXIT