LOGISTICS and PLANNING Considerations for Major INFRASTRUCTURE UPGRADES

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Upgrading campus infrastructure can be one of the most challenging aspects of facilities management on a campus. Whether the upgrade involves chillers and boilers in the main power plant, underground piping or power distribution throughout campus, or individual building infrastructure, the disruption to campus stakeholders is significant. Most consulting engineers know how to get a project done from a technical perspective but don't always understand how infrastructure projects impact a campus. Consequently, construction documents may not address all the logistics necessary to limit impact. This can lead to heartache when the campus is disrupted, stakeholders get angry, and the facilities professional is on the receiving end of unhappy calls. Upfront planning before engaging the design professionals and additional planning with them during the design process can help assure a more successful project.

SHUTDOWNS AND DISRUPTIONS—PLANNING TO MINIMIZE THE IMPACT

Rarely (probably never) do you have the luxury of shutting down a building for an extended period to replace the infrastructure. Digging up large sections of the campus to replace underground utilities can create unsightly and even dangerous areas that can cause problems where heavy foot traffic is common. Understanding the useful life of infrastructure and planning for replacement before failure is essential to limiting negative impact.

Planning ahead allows for an organized approach and provides enough time for temporary provisions to be put in place and long lead items to be procured. Including affected campus stakeholders in the planning process whenever possible allows them to get a clear understanding of the challenges to successful completion of the project, and with this knowledge, they can be "ambassadors" of the project to others on campus.

For underground infrastructure distribution, whether steam, high-temperature hot water, chilled water, electric or fiber, you need to determine whether the system is a loop that can be backfed and where isolation points are located. Ideally the project will be timed such that contractors start excavating the day after commencement and have all openings filled by mid-August. This will usually require the contractor to be on board by late December or early January at the latest. Shop drawings need to be created, submitted, and approved, and material can be ordered for delivery by the start of excavation. Depending on the individual


Utility infrastructure upgrades on a main campus roadway.

circumstances of the institution, it may be prudent to plan the infrastructure replacement in sections over several years, so that disruption can be limited to the summer when most campuses have much smaller populations.

One of the issues that can delay an underground infrastructure project is the discovery of unexpected asbestos or other hazardous material. Planning for that possibility is critical, and including a process for handling hazardous material in the construction documents can prevent an unexpected stoppage in the progress of the project during construction.

If aging systems need replacement and are not part of a loop, it may be prudent to construct new sections to create a loop prior to replacing the existing sections. While more expensive than simply replacing the aged sections, creating a loop provides long-term benefits to the institution in the form of resiliency and options when problems arise in the system.

Some systems can be fed by temporary means. Temporary boilers, chillers, and generators can provide the ability to keep buildings occupied and working while equipment is replaced. Electric and hydronic systems are generally easier to feed on a temporary basis than air systems, but in some cases even air systems can be fed on a temporary basis. There is a cost impact to the project when temporary equipment is used, so it's always beneficial if projects can be planned to limit shutdown time. Some buildings cannot tolerate any shutdown no matter how short: Typically this means laboratory and research buildings. For those buildings it is imperative to start the planning process long before the necessity of replacing infrastructure occurs and to include the building stakeholders in the planning from the beginning. They should be fully aware of the challenges and buy into the process, including any temporary feeds for infrastructure and the contingency plan for possible issues.

THE INS AND OUTS—GETTING OLD EQUIPMENT OUT AND NEW EQUIPMENT IN

What do boilers, chillers, and air handlers have in common? Unlike a rooftop air conditioning unit, which can simply be plucked from the roof, many of these items are located within buildings with no apparent way of easily removing and replacing them. Before beginning an infrastructure replacement project, gather available drawings from the initial construction of the building to see if any provision was made for the removal of equipment. Sometimes removable panels are designed into a building during construction, and finding them can feel like winning the lottery! Most central boiler/chiller plants have this feature. Sometimes individual buildings do, especially if they are science or research buildings.

If there is no removable panel, most equipment can be dismantled or cut apart to be removed. However, it's important to understand the environmental impact of dismantling equipment to remove it. The equipment may have asbestos or other hazardous substances that will need to be addressed prior to dismantling and removal.

Getting the new equipment into a building without a removable panel is more challenging than getting the old out. The equipment must be able to travel from the loading dock or other delivery area and through the building to the mechanical room. It needs to fit through doors and may need to fit around corners. Some equipment is available to be shipped broken down in pieces for site assembly, to allow for travel through buildings.

Centrifugal chillers can be separated into bundles and assembled onsite after rigging into the mechanical room. Alternately, the system may be modified to use modular chillers, which are designed to fit through existing doorways. There are capital cost and efficiency differences between the different chiller types, but it may come down to what you can get into the building.

Some types of boilers can be carried into the mechanical room in sections and assembled in place. Depending on the system served, replacing the boiler with modular boilers may be the best option. Modular boilers typically fit through existing doorways. Boiler systems should be looked at for opportunities to improve efficiency, and modular boilers can allow for better load matching and efficiency.

Replacement air handlers can be ordered in sections or completely broken down and shipped on a pallet for constructing in the field. Many times, air handlers can be reconstructed in place if the overall casing is intact. Almost all the air handler components can be replaced in the existing housing, including fans, coils, condensate pans, dampers, and controls.

A consideration for any equipment that is broken down for shipment and reassembled in the field is to require full factory testing prior to dismantling for shipment in addition to testing after reassembly. It's a good idea to have someone representing the campus (the consulting engineer or a knowledgeable member of the campus facilities staff) witness the factory test. It's essential to ensure that the equipment is tested at the factory before disassembly and that factory representatives supervise the reassembly. This helps avoid finger pointing if the equipment doesn't perform as expected after it's installed.

Make sure the bid documents your design professional prepares details any limits and constraints. They should show allowable passages for equipment removal and show travel in for new installation. Let contractors know whether they can or cannot use elevators or if there are areas they cannot go through. Let contractors know if there is any limit to the time they can access the building. Can they bring equipment in during the day when the building is occupied, or do they need to work after hours? Make sure the equipment specified by the design professional can be rigged in through the allowable passageway.

The bid documents should also require that any proposed substitution made by the contractor be accompanied by evidence showing that the substituted equipment will fit through the identified allowable passage and that it will operate as effectively as the originally specified equipment.

Some design professionals will resist showing allowable passages and the information described in the preceding paragraph, arguing that these items are contractors' means and methods. That is not the case. Telling a contractor he has to rig something in using a specific method or that he needs to have five workers on the rigging crew is means and methods; making sure there is at least one solution that works for getting the basis of design equipment into the building is not. The contractor may propose a different route once he's on board or propose a substitute piece of equipment, but those changes should be accompanied by the contractor's detailed plans for making them work. If the bid documents identify a workable solution, then any proposed changes by the contractor should also be accompanied by the deduction in cost and/or reduction in schedule to be gained if the institution accepts the change.

THE WAITING GAME—PLANNING PROJECTS AROUND EXTENDED EQUIPMENT AND MATERIAL LEAD TIMES

Project schedules will vary based on many factors, including an institution's procurement policies, the length of time needed for a thorough design/bid package, the institutional and permit review process, and the contractor's schedule. Working backward from the ideal completion date, include all the necessary construction milestones as well as procurement, permitting, design and documentation of the project, funding requests, and up-front planning by the facilities department. In general, for any work desired to be completed over the summer, contractors should be on board no later than late December or early January—ideally earlier.

One of the longest time frames in the construction process can be that connected with the approval and procurement of the material and equipment. Contractors will often try to substitute equipment, and the approval process can take a number of iterations in order to determine that the substituted equipment is equal to that specified and will fit. Once the equipment is approved and the contractor places an order, it may take 12 to 26 weeks or more for the equipment to be shipped. Piping systems for high-temperature hot water and steam also involve extremely long lead items, often taking more than 26 weeks for delivery.

Some institutions prefer to prepurchase long-lead equipment. This can be a good strategy, but it's not without risks. Prepurchasing guarantees that the equipment is as specified and that approval and ordering can take place prior to having a contractor on board. This can reduce the overall schedule and can often save money in terms of contractor's profit on the purchase price. Ideally, the project bid specifications will assign the equipment contract to the contractor, and the contractor will be responsible for receiving and handling it. The prepurchase equipment specifications given to manufacturers should also include the requirement that the equipment contract be assigned to the contractor. The contractor can schedule delivery such that the equipment can be unloaded and rigged into place when the contractor is ready for it. If the specifications don't assign the responsibility to the contractor, the institution will need to receive the equipment, rig it, and store it prior to the contractor installing it. This creates an opportunity for finger pointing if something happens to the equipment or it doesn't perform as required.

CONCLUSION

Replacing campus infrastructure is one of the most challenging parts of a facilities manager's job. These projects are disruptive, and the end product is not a beautiful new building that everyone can admire. Infrastructure is essential to the proper functioning of the campus; but ironically, when infrastructure projects are completed, they're most successful when no one notices—because they're working as designed. Infrastructure upgrade projects can be less painful when you plan well ahead of the needed replacement, consider contingency plans to help mitigate the impact on campus stakeholders, and overcommunicate the need, progress, and benefits of the upgrade. Include the affected campus stakeholders in the planning process whenever possible, so they get a clear understanding of the challenges to successful completion of the project.

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