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Planning for MEP Infrastructure Projects in High-Rise Buildings

Arguably the heart of any building is its major mechanical, electrical and plumbing (MEP) systems which allow a building to successfully operate and provide comfort to its occupants. MEP systems include building heating, cooling and ventilation, electrical power, lighting for the facility, and domestic water, waste and vent systems to serve kitchens, bathrooms and amenity spaces throughout.

However, these systems generally operate "behind the scenes" as many of their major components are not visible to occupants and often their importance is only realized when they are not operating as intended. When one or more of a building's MEP systems require repair or replacement, it can represent significant cost and inconvenience to building owners and occupants.

Plan for Replacement Early and Consider Alternatives

To minimize the likelihood of these interruptions, proactive planning for modification and/or replacement of a building's MEP systems should be praciticed by building owners, managers and engineering staff. The first step is to have a recent reserve study/capital plan for the building that accurately projects signficant repair or replacement needs over a specified period (typically 10-20 years) based on equipment condition and reported operational issues. The reserve study/capital plan also presents budgets for the replacement of building components so that building owners can prepare for the financial impact of these projects ahead of time. We recommend that the reserve study or caplital plan be updated a minimum of every five years.

However, planning should not stop at the study level or financial budgeting. When considering MEP systems, often times several alternatives exist, each with their own benefits and drawbacks. A detailed review of applicable alternatives based on current conditions is needed to evaluate these alternatives for a specific property and application. System alternatives that include consideration of new technologies could have a significant impact on implementation, operating costs (including applicability to energy efficient incentive funding) and lead times on equipment delivery thus impacting decisions for the basis of design.

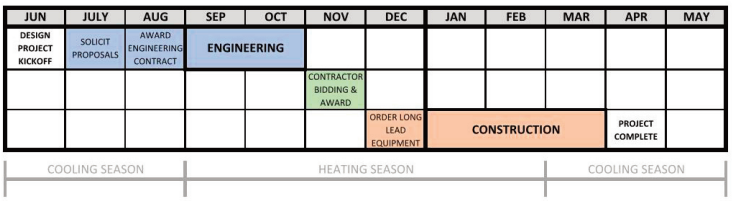
A reserve study/capital plan typically only includes consideration for replacement with like-for-like systems and equipment which may no longer be applicable or present a good fit for the building or most importantly, be consistent with Ownership's goals. Therefore, a detailed specific system study by a professional engineer should be commissioned a minimum of one year and no more than two years in advance of the scheduled replacement and should include the following:

- an evaluation of system alternatives based on current technologies,
- the building's specific conditions, and
- the goals of Ownership.

Equally important, this focused study should include an updated budget for the project based on current costs and consideration of applicable incentive programs. The completed study will arm Ownership with the information it needs to make an informed decision on the appropriate system for their building which when made, will then represent the basis of design moving forward into the next stage of engineering.

Regardless of whether equipment is replaced like-for-like or with an alternative system type, Building Owners should enlist the services of a professional engineer to prepare design documentation (the next stage of engineering) well in advance of the anticipated project construction and completion period. Several weeks, and in some cases months, are necessary for the professional engineer to detail existing conditions, perform calculations and prepare detailed engineering drawings that can be competitively bid to contractors. For example, a sample chiller replacement schedule for a typical high-rise building that requires cooling for Spring is reflected below:

In the above example, the Building Owner – ideally after an initial study was performed -- initiated the chiller replacement project detailed design documentation almost a year in advance of the new equipment being installed and operational. Of course, every building's needs are different and project schedules are impacted by Board meeting dates, equipment lead times, heating/cooling needs and the complexity of the design and



construction project.

Where necessary, expedited engineering design approaches can be implemented to shorten the implementation schedule through avenues like pre-purchase of long-lead equipment by Building Ownership prior to construction contracts being awarded to a successful contractor. The design engineer may suggest this based on known equipment lead times and can assist Building Ownership in navigating the pre-purchase under these circumstances. However, there are inherant risks associated with pre-purchase of equipment.

Value Based Equipment Selection

An additional benefit to early planning is the ability, during the engineering design, to evaluate and select major equipment that represents the best value to building ownership and truly "fits" a particular building's needs.

As with most products in the market today, there are numerous manufacturers and options available when it comes to MEP equipment. Though similar in purpose, each piece of equipment offers its own benefits and drawbacks that must be considered by the design engineer when determining what equipment is right for a particular application. Some important considerations include energy efficiency, redundancy, physical size, weight, warranty, long term manitnenace, occupant comfort and implementation cost. The engineer must also consider impacts that equipment selection may have that result in additional cost or complexity outside of the equipment itself.

For example, a "packaged" air handling unit (AHU) may be less in material cost but may require a crane or helicopter to lift it to its final location whereas a "knock-down" AHU that can be taken apart may be greater in material cost but will avoid the secondary cost of a crane or helicopter lift. Thus, the knock-down AHU may, in fact, represent the more cost effective and less risky option. Similarly a heavier AHU may be lower in material cost but require structural modifications to support its additional weight compared to a lighter, more costly AHU. In all cases, energy efficiency and associated maintenance and operating cost, as well as occupant comfort, should be evaluated based on the specific circumstances and the priorities of the building's stakeholders.

The value-based selection of MEP equipment centered on a building's specific needs is the ideal approach to provide building owners and occupants with equipment that meets or exceeds their needs at the greatest value. However, as this process occurs as part of the initial design activities, it requires proactive planning to ensure that there is adequate time for the engineer to perform a value-based equipment analysis and that equipment lead times do not limit the product selection. The design engineer can then specify the equipment that has been mutually agreed upon as part of the engineering documentation issued for contractor bidding. In this process, what gets specified gets installed because it has been thoughtfully selected by the engineer and coordinated with the building stakeholders. This process provides the greatest chance of a sucessful project.

Custom, knock-down air handling unit specified to facilitate ingress.

Modular hot water boilers specified to facilitate ingress and allow for both redundancy and future expansion.

One of two high-efficiency chillers specified for performance and redundancy.

Recommended Tips

Given the multitude of alternatives that exist for MEP system replacements within high-rise buildings, it is best to start planning early and to proactively involve all stakeholders to ensure that projects deliver the intended results and represent the best value for your particular building:

- Have a current reserve study/capital plan on file and budget for MEP projects.
- Commission a focused engineering study from a professional engineer approximately 1 to 2 years in advance of the project implementation
- Enlist a professional design engineer approximately 9 to 12 months in advance of the project implementation and perform value based equipment selection prior to bidding the project to contractors
- Involve all stakeholders (Ownership, building engineers, building management, etc) in the initial engineering phases

Although like-for-like equipment may be appropriate at times, the advancement of technology continually offers new opportunities to improve comfort and save energy at the same time, and in some cases, at a reduced cost. Proactive planning and value based equipment selection allows Building Owners to identify, implement and benefit from these opportunities.

Additional information on Value-Based Equipment Selection can be found in the December 2019 publication of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Journal.