

## **Procuring Commissioning Services – Who, When, and How**

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### **Synopsis**

Commissioning complex building projects -- when designed and constructed by multi-disciplined project teams with each team member having their own capabilities, responsibilities, and interests -- require careful consideration and planning.

This paper examines different methodologies of procuring and delivering commissioning services from the owner's and provider's points of view, using four actual projects with a total value in excess of \$100 million. In each case, the Texas Tech University System was the owner and Bath Engineering Corporation was the commissioning authority.

### ***About the Authors***

Mike Ellicott, the Texas Tech University System's Vice Chancellor for Facilities Planning and Construction, manages a \$525 million construction program on Tech's five campuses in West Texas. He joined the Texas Tech University System in December 1999 after serving in similar positions at Wayne State University in Detroit, Michigan and at Harvard University and served twenty-six years as a military officer in the Army Corps of Engineers. He holds Bachelors and Masters Degrees in Mechanical Engineering and is a Registered Professional Engineer. He has taught engineering at both the Military Academy at West Point and at Bucknell University in Lewisburg, PA. Texas Tech has used each of the methods described below for commissioning.

Phillip Rothstein, P.E, a Principal of Bath Engineering Corporation, earned a Bachelor of Science in Mechanical Engineering from New Mexico State University and a Master of Business from Southern Methodist University. He is licensed as a Professional Engineer in Texas and has held engineering and/or construction licenses in Arizona, New Mexico, California, Utah, Nevada, Alaska, Louisiana, and Oklahoma. In his thirty-five year professional career, Mr. Rothstein has managed several engineering and construction companies. Mr. Rothstein served as the lead commissioning provider on many projects, including the four projects for Texas Tech University System featured in this presentation.

## **Introduction**

An owner deciding to implement a commissioning program for an on-going construction program must make several critical decisions when preparing to procure commissioning services. After selecting which projects will most benefit from commissioning, the owner must decide if the commissioning program will commence at the beginning of design, at the beginning of construction, or at the beginning of systems startup. Second, the owner must determine the level of experience the commissioning authority should possess and whether the commissioning authority will be an in-house person or department, an independent party, the design firm, the design mechanical/electrical engineer, the construction manager or general contractor, or the mechanical subcontractor. And, third, the owner must decide if testing and balancing of mechanical systems will be performed by in-house personnel, an independent party, or a subcontractor under the mechanical/electrical design engineer, the construction manager or general contractor, or the mechanical subcontractor.

There is no one-size-fits-all set of answers that are common to all projects. Instead, an owner must consider several variables to identify the commissioning model best suited for its project.

### **Basis for Observations**

The Texas Tech University System is in the midst of a significant capital growth period. Following nearly 25 years of inactivity, Texas Tech has completed over \$350 million in projects on all five of its campuses since 1999. The increasing complexity of building systems combined with the increasing difficulty in starting up and properly operating HVAC systems, led Texas Tech to require commissioning for all major building projects. Establishing a commissioning program in an on-going construction program, with projects in various states of design and construction and with Project Managers with varied backgrounds and levels of training, produced several opportunities for creatively implementing project commissioning.

The Texas Tech University System offers an excellent case study opportunity. Texas Tech is comprised of Texas Tech University, a modern, Tier 1 Research University with 28,500 students in Lubbock, Texas, and the Texas Tech University Health Sciences Center, a health sciences university with Schools of Medicine, Nursing, Allied Health, and Pharmacy located on five campuses across West Texas. Each system-managed building project challenges the project team to construct a modern teaching, research, or service building while maintaining the look and feel of the existing campus. Further, the establishment of a new, four-year medical school on a new site in El Paso, Texas offered yet another unique opportunity.

The authors worked together as the owner and as the commissioning provider on four projects in the current construction program. These projects used different procurement and implementation models, so they serve as an ideal laboratory for analyzing procurement options.

### Clinic Renovation and Expansion

This project expanded an existing 120,000 square foot clinic building on the El Paso campus of the Texas Tech University Health Science Center, and, as described below, replaced the building's HVAC system. The basement, first, and second floors housed several teaching clinics, a medical records area, a billing center, related Health Science Center Offices, and the student lounge. The growth of the medical school required expansion of the building; Texas Tech elected to add another 40,000 square foot floor on top of the occupied building. Texas Tech included commissioning in the design team scope of work. As the mechanical/electrical engineering consultant on the design team, Bath Engineering Corporation was selected to act as the commissioning authority.

During the programming phase of the design process, the commissioning authority asked occupants of the building to describe features of the existing building that they specifically wanted replicated or not replicated on the new floor. The building's facilities personnel asked that the mechanical system be provided with a better fresh air subsystem. They went on to explain that the fresh air system of the existing building was inadequate and that the automated control system was dysfunctional. This early phase commissioning process resulted in the redefining of the project to include the replacement of the mechanical system in the existing building. That modification increased the cost of the project by over 50% and significantly increased the difficulty of design and construction because the building had to remain occupied during construction.

#### Key Points:

1. The commissioning authority was a subconsultant to the design firm,
2. The commissioning authority was the mechanical/electrical design engineer, and
3. The commissioning authority was selected when the project was conceived. The owner hired the Test and Balance Firm with the Commissioning authority providing oversight of the test and balance process.

This project is now in the warranty phase.

### Student Union Renovation and Expansion

The Student Union Building on the university's Lubbock campus has been constructed over the past fifty years in four phases. As a result of an increase in enrollment from 24,000 students to 28,500 students, the University determined that the existing building should be modernized and expanded with a 90,000 GSF contiguous wing. When completed, the new building will have over 250,000 square feet of space. Texas Tech selected its design team and hired a construction manager. The project schedule called for the new wing to be constructed and occupied before portions of the existing building were closed for renovation. Commissioning was not initially part of this project's program, but concerns about the complexity of the building control systems led Texas Tech to solicit proposals for commissioning limited aspects of the mechanical and

electrical systems. Bath was selected when construction of the new wing was approaching completion.

Key Points:

1. The commissioning authority was retained directly by the owner,
2. The commissioning authority was not otherwise involved in the project's design or construction, and
3. The commissioning authority was selected when the project was partly constructed.

The new wing of this project is now in the warranty phase, and the renovation portion of the project is in the systems startup phase.

Medical Science Building

The Medical Science Building is a new four-story basic sciences faculty research building, the first of several buildings planned to support a new four-year medical school in El Paso, Texas. This will be the first new medical school established in the United States in over 25 years. Texas Tech included commissioning in the design team scope of work. The design team leader, the SmithGroup of Detroit, determined that mechanical/electrical design engineering would be performed by its in-house staff, but that commissioning would be performed by an independent party. Bath Engineering Corporation was selected by SmithGroup to act as the commissioning authority.

Key Points:

1. The commissioning authority was a subconsultant to the design firm,
2. The commissioning authority was not otherwise involved in the project's design or construction, and
3. The commissioning authority was selected when the project was in the initial design phase.

This project is now midway through the construction phase.

Medical Education Building

The Medical Education Building is a new four-story building, the second major building for the new four-year El Paso medical school. Texas Tech elected to procure commissioning independent from procurement of design services. A request for proposals for commissioning was issued when the design was in the schematic design phase. Bath Engineering Corporation was selected to act as the commissioning authority.

Key Points:

1. The commissioning authority was retained directly by the owner,

2. The commissioning authority was not otherwise involved in the project's design or construction, and
3. The commissioning authority was selected at the end of schematic design.

This project is now in the design development phase.

## **When should commissioning begin?**

The obvious answer would seem to be that commissioning would best be procured at the beginning of the project and integrated with the design phase. Often however, circumstances may prevent the owner from engaging a commissioning authority at the start of a project. In that event, hiring a commissioning authority during construction is usually helpful and rarely a waste of money. This is evidenced by the increasing popularity of Retro-Commissioning, the commissioning of buildings already built and in operation. Again, implementing a commissioning program as part of an on-going construction program created challenges and offered opportunities for several commissioning methodologies.

The design of the Student Union Expansion and Renovation project was in progress when the owner decided to implement a commissioning program. Further, there were other more pressing issues concerning the on-going construction program (start up of other critical projects, creation of modern project management and contracting processes, hiring qualified project managers, to name a few) that delayed the hiring and implementation of commissioning on this project. Commissioning the Student Union Addition allowed the identification of several HVAC issues prior to move in. The commissioning process also identified a problem with the atrium smoke evacuation system. Unfortunately, the late addition of the commissioning did not allow all identified problems to be corrected prior to occupancy of the Student Union. The owner and construction manager were able to prioritize corrective actions to those that needed to be done, both for code compliance and ease of correction, prior to the opening of the building. Even when started late in the project, commissioning provides both the owner and the entire project team with specific data to make informed decisions on resource allocation, contract document enforcement, and even dates of substantial completion.

The El Paso Clinic Expansion and Renovation project provided a unique opportunity to commission both the new addition and the HVAC System in the existing building. The commissioning authority discovered the requirement for the replacement of the existing HVAC system during the initial stages of the commissioning process. Since the Clinic remained open and in daily operation throughout the project, commissioning played an important role in quickly turning over completed areas of the building without extensive post-occupancy punchlist work. Further, having the MEP design engineer serve as the commissioning authority was particularly helpful in dealing with a difficult contractor.

Texas Tech procured commissioning for both buildings at the new El Paso School of Medicine at or near the beginning of the design process. This has allowed the commissioning authority to

understand all of the client's requirements and participate in the many decisions made to match the scope and budget. The project team was able to commission the design of the Medical Science Building at each stage of the design and the same will be true as the design of the Medical Education Building progresses. Further, initial interviews on the part of the commissioning authority uncovered requirements, concerns, and opportunities that previous design meetings had not discovered. These items related to the intended operation of the facility, preferred (or rejected) brands of equipment, and similar issues effecting building systems.

Commissioning, no matter when started, serves as a useful tool in designing and constructing modern, high-tech education buildings. While commissioning is generally better done as early as possible, commissioning at any stage of the project has proven to be a useful tool in maximizing the value of the building project.

### **Who should be the commissioning provider?**

The owner has several options for selecting a commissioning authority. The ideal commissioning authority would be a specialized team of in-house operations and maintenance workers familiar with the owner's requirements and with a vested interest in ensuring that the buildings are properly designed and constructed. Few owners have the size staff or construction programs to justify this expense. Texas Tech is no exception and has relied on external commissioning authorities for its recent projects. To partially compensate for this situation, Texas Tech attempts to use members of the in-house maintenance staff during the commissioning of the project.

Hiring a third party commissioning authority, separate and distinct from the design team, offers the commissioning authority independence to properly evaluate the design and construction. The independent commissioning authority can provide the owner with an accurate assessment of the design, a key component of commissioning, as well as the contractor's/construction manager's performance. The disadvantage of the third party approach is the commissioning authority's lack of familiarity with the project – the client's requirements and budget constraints for example. The owner must ensure the independent commissioning authority is a full partner in the process of designing and constructing the project. This means the commissioning authority must attend and actively participate in partnering sessions, scoping meetings, value engineering, and design review meetings.

Including the commissioning authority's duties as part of the design professional's contract is also an option. Ideally, the commissioning arm of the design firm will have sufficient autonomy to be objective in reviewing the MEP design. Many large firms have a separate commissioning authority within their firm. Other firms, regardless of size, may hire the commissioning authority to fill a void in their own firms or to meet M/WBE or local firm goals. The key is to ensure the commissioning authority has the independence and information required to commission the project.

It goes without saying that a commissioning authority must possess both technical qualifications and experience. These projects show that it is essential for the commissioning authority to have a technical knowledge of the products and systems, as well as experience constructing such systems. That means that the ideal commissioning authority for mechanical systems should be a mechanical engineer who has both design and construction experience on projects of similar scope and complexity. An engineer who has no construction management experience, or a contractor who has no design experience, could not have navigated the complex commissioning issues identified in the subject projects.

Because the commissioning authority interacts with the construction manager, the general contractor, and the mechanical subcontractor, it is important for the commissioning authority to have construction management and/or construction administration experience on projects of similar scope and complexity.

### **How should commissioning be packaged?**

Each member of the project team has unique responsibilities in the commissioning process. The owner must establish clear commissioning requirements and a clear chain of command for commissioning activities. Without a clear understanding of the requirements and responsibilities, a key member of the team may “assume away” problems or responsibilities to solve a problem. While generally the knowledge that the project will be commissioned will improve the design and construction teams’ performance, occasionally a team member may be tempted to let the commissioning process find and/or solve a problem. The owner’s continual review of the entire project team’s performance will significantly reduce the likelihood of this occurring.

The design professional is clearly responsible for designing the project to meet the owner’s requirements, including the requirement to be commissioned. The design professional must include in the documents the necessary specifications to support commissioning, as well as the commissioning plan itself. The contract documents must clearly spell out the commissioning process so that the contractor/construction manager can be held to the requirements of the process. The design professional must also provide clear narratives and drawings that show the proper operation of building systems under all operating conditions so that the entire team is clear on what to commission and how.

The commissioning authority must lead the commissioning process, commissioning both the design and the construction. The commissioning authority must understand the owner’s requirements and develop a commissioning plan to evaluate the building systems against these requirements. Further, the commissioning authority must also lead the entire project team through commissioning the project. This includes monitoring construction progress to conduct commissioning activities at the optimum time, working with the trade contractors; the test and balance firm, and the in-house maintenance staff to properly accomplish the testing as well as writing a clear and comprehensive report of commissioning activities and following up to ensure

discrepancies uncovered are promptly and correctly resolved. The commissioning authority must recognize the importance of the timely performance of commissioning functions so as not to delay the construction process. On the other hand, the commissioning authority must be strong enough to stop the project if the commissioning process identifies serious or recurring problems.

Although the construction industry historically has considered testing and balancing to be a subcontract performed by the contractor/construction manager or the mechanical contractor, testing and balancing should never be procured by the construction manager, general contractor, or mechanical subcontractor because of actual and perceived conflicts of interest. Under Texas law, testing services for state projects must be hired either directly by the owner or through the design professional. Further, these services must be hired as a professional service through a qualifications-based selection process. This applies to materials testing as well as testing and balancing services.

Testing and balancing should be procured either by the owner or by the commissioning authority, but it should always be performed by an independent third party that is not otherwise involved in design, construction, or commissioning. The authors have achieved success by having the testing and balancing contractor be hired by or work for, the commissioning authority.

## **Conclusion**

The Texas Tech University System has determined that it is generally preferable for an owner to retain an independent commissioning authority while the design professional is retained. However, there are occasions when it is appropriate to procure commissioning under the design professional contract and/or to procure commissioning at the commencement of construction. In any event, there must always be a positive working relationship between the parties and the commissioning authority must be autonomous, having a direct line of communication with the owner. The commissioning provider should retain and oversee the work of an independent test and balance contractor to mitigate coordination and communication problems inherent in large complex projects.