Firm Qualifications

Expression of Interest

Commissioning Services
RJC2016
for

The West Virginia Regional Jail and Correctional Facility Authority
Kenneth "Honey" Rubenstein Center

July 1, 2008

TOWER ENGINEERING

115 Evergreen Heights Drive
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TOWER ENGINEERING
315 Evergreen Heights Drive • Suite 400 • Pittsburgh Pennsylvania 15229

July 1, 2008

Mr. John Abbott, Buyer
Department of Administration
Purchasing Division
P O. Box 50130
2019 Washington Street, East
Charleston, WV 25305-0130

Re: Expression of Interest (EOI)
WV Regional and Correctional Facility Authority
Kenneth "Honey" Rubenstein Center Project
Commissioning Services

Dear Mr Abbott:

Tower Engineering, located in Pittsburgh, Pennsylvania, is pleased to submit our response to your request for expressions of interest and qualifications to provide Commissioning Services for the Kenneth "Honey" Rubenstein Center project.

About Our Firm

Tower Engineering was founded in 1931 and since that time has been continually serving clients in Pennsylvania, West Virginia, Ohio and New York. We are a multi-disciplined firm and offer engineering services for electrical, HVAC, plumbing, fire protection and telecommunications systems. We have specialists on staff for lighting design, network design, energy management, and building systems commissioning.

Through the years, Tower Engineering has built a reputation for quality service – not only in the expertise of our design, but also in our attentiveness to the client's needs. This service continues from the earliest design meetings through to the commissioning of the systems. We work with each client's operating personnel and the contractor to ensure that systems are designed with their specific requirements taken into consideration, installed in accordance with plans and specifications; that they operate properly in relationship with their subsystems; that they operate through a wide range of operating conditions as well as design conditions; and, that the operating and maintenance personnel have been properly trained.

Our repeat clients are evidence of our clients' satisfaction with our engineering services, concern for project budgets, and compliance with performance schedules.

We have included additional information about our firm and the engineering services we offer in the section entitled "About Our Firm."

Understanding of Federal and State Regulations Regarding Construction Projects

Having designed systems for thousands of buildings in Pennsylvania, West Virginia and New York since 1931, Tower Engineering is very familiar with code issues that apply to construction projects and has excellent working relationships with major mechanical and electrical contractors who bid projects located in those states.

Tower Engineering is currently providing engineering services for renovation and new construction projects for eleven counties in West Virginia, as well as projects at WVU and Fairmont State University. We are also currently providing mechanical/electrical engineering services for the Canaan Valley Institute's new headquarters building located on the same road as the Kenneth "Honey" Rubenstein Center for Youth, including the fundamental commissioning of the building energy systems as required for LEED-NC v2.1 prerequisite Eap1

Understanding of General, Mechanical, Plumbing, and Electrical Systems for a Juvenile Services Facility

Tower Engineering understands that when providing for the mechanical and electrical systems design of Juvenile Services facilities, the engineer must consider the various occupancy types of the facility, such as recreational, educational, and living quarters. While accommodating the needs of each space, the engineer must bring provide design that brings the systems together to allow for economic, operational, and maintenance efficiency. Because the facility is occupied and operated twenty-four hours per day, the mechanical/electrical system must provide redundancy to account for the potential for equipment failures. The design must also provide for easy equipment replacement to minimize potential downtime. Because of the complexity of moving residents from the facilities should a failure occur, the mechanical/electrical systems should provide redundancy at the plant level and for ease of change out at the space/zone level.

Along with considerations relating to the spaces contained and need for twenty-four hour operation, the mechanical/electrical systems must also account for and accommodate regional issues related to the weather realized at the site. This may require modifications to traditional designs to handle local conditions that could be viewed as extreme only an hour's drive away.

An additional concern when providing for the design of mechanical/electrical systems for Juvenile Services facility is the need to maintain safety and security levels while integrating

the MEP equipment into the facility, and yet downplaying the institutional role to present a normal environment Tower Engineering believes it is essential that the onsite maintenance staff is provided the ability to monitor and control the systems. The added feature of having offsite control would assist in allowing staff to quickly respond to performance outside acceptable bounds to avoid failures in the systems.

Our Experience in the Commissioning Process and Commissioning Tasks

Tower Engineering has experience providing design and commissioning services on numerous projects. Our extensive design experience insures that we will be familiar with all aspects of each project's mechanical and electrical design

Systems or technologies for which our firm has provided commissioning services include:

- Packaged or split HVAC
- Boiler System
- Variable Air Volume Systems
- Variable Speed Fans
- Electrical, Emergency Power
- Chiller System
- Hydronic Systems
- Energy Management System
- Lighting Controls

Our team for this project will include Thomas J. Gorski, P.E., Daniel J. Kendra, P.E., and Stephen J. Kisak, P E Individual resumes describing their qualifications and experience are included in the section entitled "About Our Firm."

Our Understanding of the Operational, Security and Functional Requirements of Modern Juvenile Facilities

An effective juvenile facility incorporates a holistic view of the overall goal of rehabilitating youth while providing safety and security to residents and staff. Unlike adult facilities, juvenile facility residents will most likely be reintegrated into their community. This makes it important to provide an environment that presents a less institutional surrounding, while maintaining the security and control required. The mechanical, electrical and plumbing systems must provide the performance and security required. The working environment for needs to be designed to allow the staff to feel safe and secure, while promoting their goal of working with the residents in a positive manner

Proposed Commissioning Plan & Approach

Tower Engineering proposes that the Commissioning Agent's responsibilities commence during the Design Phase of each project and continue through the Construction and Acceptance Phases This process is similar to Tower Engineering's past commissioning projects

For many of Tower Engineering's projects (whether or not the project is commissioned), the responsibility for complete Testing and Balancing has become part of Tower Engineering's Scope of Work We feel that this is a logical division of responsibilities for the following reasons:

- When the TAB Contractor is a Subcontractor to the installing HVAC Contractor, the question of whether or not the balancing reports will be executed properly and in the owner's best interest is present. In many cases, the TAB Contractor has past and present relationships with the installing HVAC Contractor that will make it difficult for them to be truly independent. Frequently, we find that TAB Subcontractors are very hesitant to be critical of work performed by the installing HVAC Contractor If performed as part of the Commissioning Agent's responsibilities, TAB is a truly independent and impartial activity.
- On Bid Day, HVAC Contractors must choose between TAB proposals that frequently are not consistent with each other and risk losing a project if they do not select the lowest price TAB proposal Frequently, this results in a TAB contract that does not sufficiently meet the intent of the specifications. We have found that most HVAC Contractors would prefer that the TAB portion of the project be pulled from the HVAC Contractor's responsibilities.
- The act of Testing, Adjusting and Balancing an HVAC system necessitates that almost every single piece of equipment be visited and observed by the TAB entity If combined with the Commissioning Agent's responsibilities, TAB provides additional pre-functional testing that eliminates some of the overlap inherent between the activities of the Commissioning Agent and the TAB Contractor.

On numerous projects where Tower Engineering has acted as the Design Engineer and/or the Commissioning Agent (including the WVU Recreation Center), we have been responsible for TAB activities and have found that the results are far superior to projects where the HVAC Contractor holds the TAB contract.

We recommend that discussions take place during the Design Phase of the project regarding the TAB responsibilities

Commissioning Projects Experience

Tower Engineering has provided commissioning services for educational and commercial facilities ranging from 60,000 s.f. to 200,000 s f. Information regarding our experience with the commissioning of building systems is included in the section entitled "Commissioning Services."

Representative Client References

Bon Meade Elementary School
Completed 2003, 66,000 s f Existing School
Mr. Alan Bennett
Moon Area School District
Coraopolis, Pennsylvania
412/264-9440

Cranberry Woods III
Completed 2003, 120,000 s f., New Office Building
James Murray Coleman, Senior Vice-President
Trammell Crow
Cranberry Township, Pennsylvania
724/778-4100

West Virginia University Student Recreation Center
Completed 2001, 160,000 s f , New Exercise Center
Mr. Gary Boyd, Facilities Manager
West Virginia University
Morgantown, West Virginia
304/292-8123

Our team is capable of providing all professional services that may be required for this project. We have included representative projects and complete resumes from all team members.

Tower Engineering has not been involved in any litigation or arbitration proceedings related to our performance of a contract for Commissioning Services. Additionally, we have not been debarred from bidding or proposing governmental contracts for the federal government or any state. No procurement laws in the State of West Virginia would affect the potential award of a contract to our firm for this project.

Thank you again for your consideration of Tower Engineering We look forward to the opportunity to provide commissioning services for this project

Very truly yours,
TOWER ENGINEERING

James N. Kosinski, P.E
Principal

At Tower Engineering, our goal is not to just meet our clients' needs.....but to exceed their expectations.

Tower Engineering has been providing innovative mechanical and electrical engineering solutions and unparalleled client service since 1931.

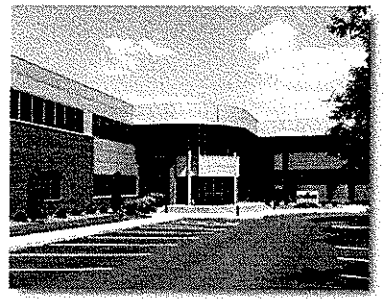
Primary markets of the firm include educational, health care, environments for the aging, and commercial renovations and new construction.

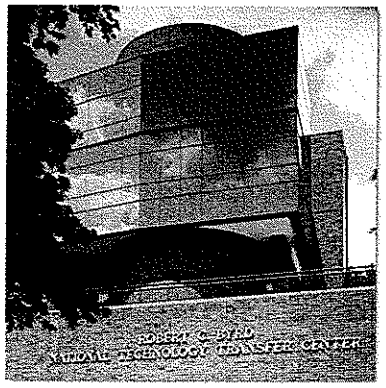
Tower Engineering's highly-trained staff of project managers, designers, and technical support personnel is capable of providing consulting services for every type of project - from a small, single-family residence to a high tech research facility incorporating redundant mechanical and electrical systems, DDC energy management and thermal storage.

Our engineers utilize state-of-the-art computer software programs for the design of lighting, electrical power and mechanical systems. Lighting analysis includes point-by-point calculations, ESI analysis, exterior lighting analysis, and life cycle cost comparisons. Electrical power analysis includes fault current and load flow analysis.

Mechanical analysis includes energy economy analysis, thermal storage analysis, heating and cooling load calculations, refrigerant piping design, water piping design, and ductwork design.

Our professional staff utilizes computer selection of air handling units, coils, pumps, terminal devices, fans, cooling towers, chillers, heat exchangers, kitchen hoods, hydronic and steam specialties, humidification equipment and heat recovery equipment.





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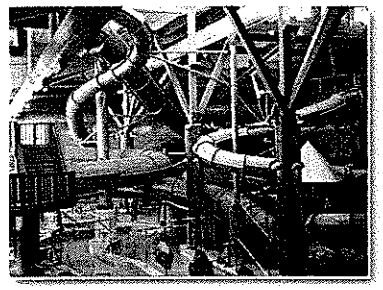
Specific Engineering Services



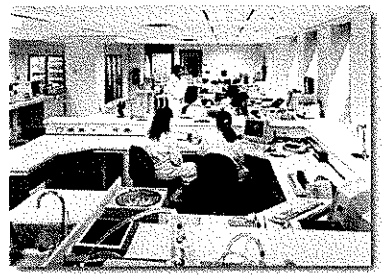
HVAC
- Heating and cooling system design
- Ventilation system design
- Building automation systems
- Control systems and energy monitoring
- Geothermal heat pumps
- Heat recovery systems
- Kitchen and laboratory exhaust systems
- Smoke evacuation systems
- Computer room environmental control systems
- Building commissioning services

Electrical
- Interior and exterior lighting design and studies
- Lighting controls
- Primary and secondary voltage power distribution systems
- Fire detection and alarm systems
- Computer data and power systems
- Uninterruptible power supply systems
- Reinforced and masking sound systems
- Lightning protection systems
- Fault current studies
- System over-current protection coordination

Telecommunications
- Voice communication systems
- Data network systems

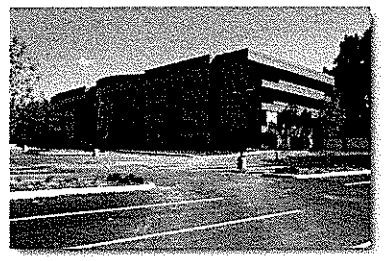
Plumbing
- Water resource efficiency analysis
- Sanitary drainage systems
- Storm water management
- Domestic water systems
- Waste water treatment systems
- Hospital and laboratory piping systems
- Fuel oil piping systems
- Irrigation systems

Fire Protection
- Standpipe and sprinkler systems
- Fire protection systems



Our Design Experience

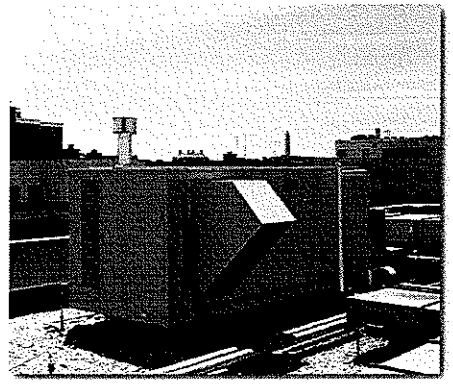
- Agricultural & Science Buildings
- Airport Terminals & Hangers
- Athletic Facilities & Stadiums
- Auditoriums & Theaters
- Call Centers
- Classrooms
- Clean Rooms & Special Environments
- Data Centers
- Dining Halls
- Dormitory Buildings
- Environments for the Aging
- High-Rise & Low-Rise Office Buildings
- Historic Preservation & Adaptive Reuse
- Hotels/Motels
- Judicial & Courtroom Facilities
- Manufacturing & Industrial
- Movie Theaters
- Municipal Complexes
- Museums, Galleries & Libraries
- Nuclear Facilities
- Outpatient & Hospital Facilities
- Parking Garages
- Postal Facilities
- Prisons & Correctional Institutions
- Public Safety Buildings
- Recreational Facilities
- Religious Facilities
- Research/Laboratories
- Residential & Multi-Unit Housing
- Retail & Shopping Centers
- Schools
- Student Unions
- TV/Radio Stations
- Vehicle Maintenance Facilities
- Warehouses & Depots



Tower Engineering maintains full CAD capabilities utilizing AutoCAD Release 2008, which is compatible with most micro and mini based computer systems. Our AutoCAD software has been modified in-house to further enhance productivity per discipline. Firm-wide CAD standards are also in place to ensure uniformity

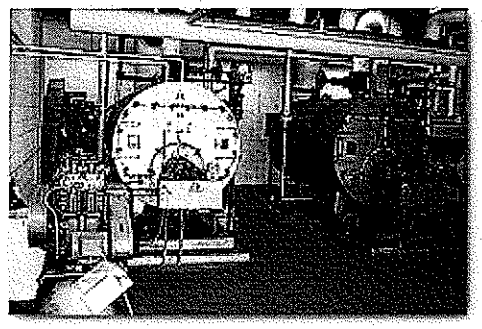
HVAC Systems Design

The design of effective and efficient HVAC systems has become increasingly complex and demanding. With a multitude of systems from which to choose, all with distinct advantages and disadvantages, the challenge of selecting the best possible system can be quite daunting. The design team must carefully consider how system alternatives best meet the immediate and long term needs of the Owner and building occupants, as well as regulatory agencies. Inappropriate, outdated, or misapplied systems result in comfort complaints, indoor air quality issues, control problems, and exorbitant utility costs.



Tower Engineering's team of HVAC engineers and designers address and determine how the final system selection is impacted by such major issues as advancing technology, changes in design standards, higher expectations of comfort levels, greater awareness of environmental concerns, the needs and availability of practical energy conservation measures, forecasting future needs, and maintaining construction and operating costs within budget constraints.

We believe it is the design professionals responsibility to facilitate the selection of the best possible mechanical system, given the constraints of project budget, owner criteria, utility company and site conditions.



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Tower Engineering has provided HVAC systems design for schools, hospitals, offices, laboratories, computer facilities, dormitories, long term and assisted living communities, museums, libraries, recreational facilities, and a wide variety of other buildings

Representative projects include:

- Improvement of the HVAC, ice making and hockey-related equipment for a 7,500 seat convocation center. The ice making chiller utilizes the indirect refrigeration concept. Unlike typical refrigeration units that require as much as 2.5 Kw to produce one ton of refrigeration, the chiller at this facility averages 1.09 Kw/ton at reduced capacity. The rooftop desiccant dehumidification unit is designed to reduce the rink area humidity level, thus reducing the load on the rink ice making chiller.
- Tower provided MEP engineering services for PNC's new Data Center. The design of this new central computer facility included redundant systems, 1000 tons of cooling, and 90,000 s.f. of raised floor with computer room air conditioning units.
- The design of the HVAC systems for Christian Hall at St. Francis College in Loretto, Pennsylvania, takes advantage of the latent energy in the earth. Tower designed a system of geothermal heat pumps to provide the heating and cooling requirements of student rooms. Thirty-two vertical wells were drilled to a depth of 300 feet to supply the thermal energy to the water-source heat pumps.
- Our design of the MEP systems for the new $25M Student Rec Center at West Virginia University includes a 1300 ton cooling system and building and site steam high-pressure steam system.
- In December 2000, Tower completed a detailed study of the Felician Sisters Motherhouse, located in Moon Township. A complete renovation of the 150,000 sf facility is to occur, and the Felician Sisters wanted to compare all HVAC options on a life-cycle basis. Using a sophisticated energy analysis software program, we compared multiple systems (including 4-pipe, water-source heat pumps, geothermal, variable air volume) on the basis of first cost, energy cost, energy use, maintenance cost, equipment longevity, acoustics, aesthetics, reliability, flexibility and most importantly, life cycle cost. After reviewing our detailed report and meeting with us on several occasions, the Sisters chose to proceed with a geothermal system. Currently, we are completing the construction drawings for this project

Central Plants
Heat Generation/Boilers
Refrigeration Chillers
Primary-Secondary Piping Distribution
Thermal Storage Systems

Unitary Air Conditioning Systems
Rooftop Units
Split Systems
Computer Room Air Conditioning
Heat Pumps (Air Source, Water Source, and Geothermal)

Ventilation and Air Distribution
Air Handling Units
Fans
Filtration
Dust Collection

Heating Systems
Steam and Hot Water Distribution
Thermal Heating Units
Fuel Fired Heaters/Furnaces

Heat Recovery
Air-to-Air
Runaround Loop

Building Management & Automatic Temperature Control Systems

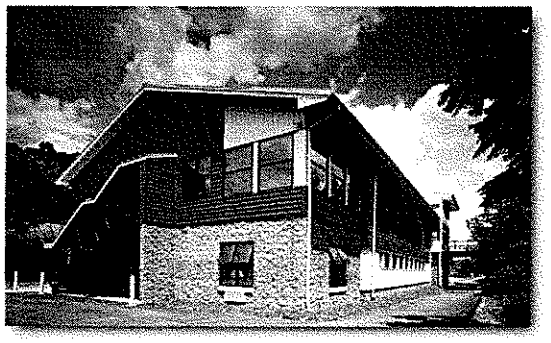
Systems Commissioning

Energy Audits

The purpose of an energy audit is to reduce operating costs by reducing energy consumption. It involves the process of understanding everything about the operation, occupancy, and physical condition of a building (from an energy point of view).

Energy audits are a physical inspection of the condition and operation of the building. We must understand the efficiency of the building before we look for problems. In this process, deficiencies are identified and we begin to understand the problems. Some problems may be simple daily maintenance items, while others may require more effort to improve.

Tower Engineering has considerable experience in looking at facilities holistically. Having provided engineering design of numerous types of buildings, we are knowledgeable of how energy is used in each specific types of facility, as well as what can be done to reduce utility costs.



Three Rivers Rowing Association
Boat House
Millvale, Pennsylvania

Our goal is to assist building owners in reducing their utility and maintenance costs and to improve the operating efficiency and the overall environment of their facilities.

In order to accurately determine the value of any given energy conservation measure (ECM), the following must be determined:

- Utility baseline - Annual cost for utilities
- Estimated Utility Savings - What you hope to save
- Cost of the ECM - initial outlay
- Maintenance Reductions

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After our site inspection, our engineering staff can utilize sophisticated software to build a computer model to simulate building operations and energy consumption. Simulated results are fine-tuned with actual meter readings, which allow us to accurately predict savings achievable with energy efficiency measures. Results are presented in an easy to read report with cost, savings and payback calculated for each measure.

In evaluation of energy conservation measures, Tower Engineering considers a wide variety of cost saving opportunities including, but not limited to:

- High Efficiency Lighting
- High Efficiency Motors
- HVAC Systems & Chillers
- Compressors & Compressed Air Applications
- Boilers
- Furnaces
- Energy Source Shifting
- Co-Generation
- Off-peak Demand Scheduling of Major Electric Consuming Devices
- Utility Rate Schedules

Tower Engineering's energy audit team is led by Principals Tom Gorski and Jim Kosinski. Each has broad experience in mechanical design and energy engineering. They have designed a wide range of waterside and airside systems including steam boiler plants, chilled plants, and ice storage facilities. Their airside design experience includes constant and variable air volume air conditioning systems, lab hood systems, clean room systems and recording studios. In addition, they have used a wide variety of heat recovery and energy conservation strategies in commercial, educational, institutional, and industrial settings. These strategies include enthalpy wheels, heat pipes, direct digital control programming, desiccant dehumidification and indirect and direct evaporative cooling. They have performed energy audits, designed energy conservation measures, and performed life cycle analyses on those measures for research facilities, hospitals, universities, factories and government office buildings.

Electrical Systems Design

In building design, life safety and occupant comfort are of primary concern. The impact of proper electrical design on these two criteria is significant from proper lighting for visual comfort and safety, to safe and reliable power distribution, to robust communication systems all are necessary for occupant comfort and safety These systems must be designed with budget and maintainability in mind, while also conforming to the multitude of codes and regulations.

Tower Engineering's approach to electrical systems design includes a thorough investigation of the needs of the owner, an analysis of the codes, regulations and utility requirements, and coordination with other architectural and engineering designers. Coordination with other people is crucial since electrical systems interface with systems designed by architects, HVAC engineers, plumbing engineers, food service designs and many other trades.

Tower Engineering provides the design of electrical systems for educational, commercial, institutional, light industrial/manufacturing and multi-family residential facilities. Our electrical engineering expertise ranges from the design of simple power and lighting systems to complex computer power, emergency power, and communications systems. Since the electrical systems and equipment available vary with regard to first-cost, life-cycle cost, redundancy, and maintainability, we strive to work with each client to determine how each of these factors applies to their unique situation. Experience with the following types of systems affords us a knowledge base which we can apply to our clients' requirements:

- Interior and exterior lighting design and studies
- Lighting controls
- Primary and secondary voltage power distribution systems
- Fire detection and alarm systems
- Access control and security systems
- Computer data and power systems
- Uninterruptible power supply systems
- Reinforced and masking sound systems
- Lightning protection systems
- Fault current studies
- System over-current protection coordination
- Voice Communications Systems
- Data Network Systems

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Representative Projects Include:

- Renovations/addition to an 170,000 s f high school Our electrical design includes the total replacement of medium voltage distribution (4160v) in the building, as well as campus style feed to the building Also included were total replacement of all 480v and 208v distribution for the building, and replacement of emergency power distribution.

- Design of a new 5kV substation on the Upper Campus at the University of Pittsburgh Oakland Campus The scope of work for this project includes electrical design (drawings and specifications) for installation of a new Duquesne Light Company transformer vault and University of Pittsburgh 5kV substation, including duct banks and manholes for future extension of 5kV circuits into the Upper Campus area.

- Design of a central computer facility included redundant systems, 1,000 tons of cooling, and 90,000 s.f. of raised floor with computer room air conditioning units. In addition to lighting, power distribution, fire alarm and security, telecommunications and lightning protection, the building's electrical system also incorporates two UPS and battery systems, backed up by four 1500 KW diesel engine generators.

- Engineering services for the construction of a four-story building for Verizon Wireless. The first floor of Verizon's new Call Center facility includes a 4500 square foot cafeteria, three 1000 square foot training rooms; a 3000 square foot fitness center with lockers and shower; computer room, and the server room. Floors 2-4 of this107,000 square foot building will accommodate up to 800 employees who serve Verizon's entire Midwest area. Two-thirds of this facility was designed to operate under emergency power, including all HVAC systems for these spaces. An 1750 kW emergency generator system was designed to provide backup power for the building.

- Consulting engineering services for a multi-site project for the University of Pittsburgh. In general, the project consisted of new and/or modifications and removals to existing emergency lighting and emergency power distribution systems to eleven buildings, as well as the installation of new diesel engine generator sets and removal of natural gas engine generator sets.

- Building systems design for a new Computer Center for Bayer Corporation. Power systems designed include the following: (2) Three-phase, 4.1KV primary services; (2) Three-phase, 4 1V fusible selective air switches; (1) 333KVA, 277/480V air-cooled, dry-type transformer; (1) 938KVA, 277/480V standby diesel generator;(3) Automatic transfer switches and switchgear designed to parallel a future generator,(5) UPS systems with 20-minute batteries (1 normal, 1 redundant 200KVA, 60HZ, 480V, 2 normal, 1 redundant 75KVA, 415HZ, 208V)

Fire Protection engineers make the places where people live, work and play a lot safer from the risk of fire, with their mission focusing on analysis and prevention of fires.

Tower Engineering is dedicated to the cause of life safety and property protection through convention and innovative fire protection engineering solutions.

To design a cost effective and well-engineered fire protection system, the design professional requires a sound technical knowledge of systems, technologies, etc., as well as extensive practical design experience.

Our design capabilities include:

- Fire Sprinkler Systems
- Fire Alarm and Detection
- Lightning Protection
- Halon Replacement
- CO2
- Dry Chemical
- Water Spray
- Fire Pump
- Standpipe Systems

Tower Engineering's experience encompasses the entire design process from conceptual design through installation and testing.

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Fire Protection Engineering

Tower Engineering offers a complete range of fire protection engineering and code analysis services for both new construction and renovation of existing facilities. Typical projects will involve the following services:

- Audits and Surveys - Including the evaluation of buildings and facilities to identify deficiencies and limit losses involving fire safety, property protection and accessibility for the disabled.
- Systems Design - Creative, cost-effective design of fire alarm systems, automatic sprinklers, specialty fire suppression systems and water supply systems for new or existing structures.
- Fire Protection Master Planning - Development and/or review of the fire safety program which addresses applicable codes, specific requirements of the project and alternative approaches to code compliance and design objectives.
- Code Analysis - Determine conformance with applicable codes and standards of the fire protection master plan.
- Negotiation - Communication with the authority having jurisdiction to explain, clarify and interpret how the project's fire safety program relates to code requirements.
- Inspection/Testing - Inspection, performance testing and evaluation of systems including fire alarm, fire detection, fire suppression, smoke control, emergency voice communication, access/ emergency egress and water supply.
- Coordination - Overall coordination of facility's fire protection programs.

Representative Experience

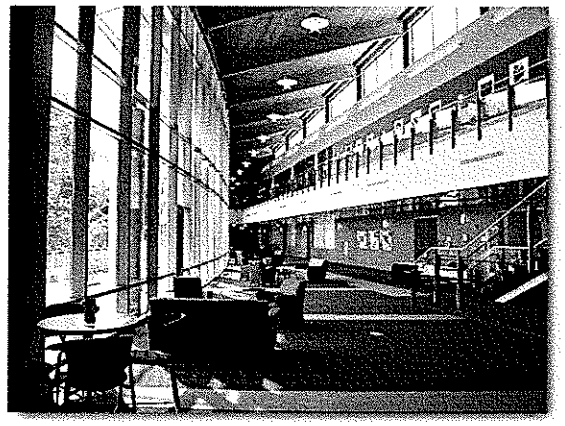
Examples of our past experience include:

- Design of an analog/addressable intelligent fire alarm/life safety system network for a 64-story office building.
- Design of a dry chemical fire suppression system in combination with modifications to the electrical and fuel oil systems associated with emergency generator systems.
- Design of a fire pump to fulfill water pressure requirements for sprinklers installed in a new 47,000 square foot, 156-bed residential complex for a local university
- Development of detailed sequences of controls to replace and automate a complete smoke control for a 565,247 square foot office building.
- Installation of a fire alarm and security monitoring system for 35 existing laboratory, production and administration buildings. The selected system utilized a multi-plex format with transponders in each of the buildings to allow for not only fire alar
- Fire protection system for a 90,000 square foot food services facility serving 40,000 students of a local school district. Design included dry pipe sprinkler systems for the freezer and cooler areas, a preaction system for the computer room, and wet pipe sprinkler systems for the office, kitchen areas, and the high rack storage areas

In certain high-value or critical areas susceptible to damage from smoke, the detection of a potential fire in advance of damage to expensive equipment is vitally important

LEED™ Rated Design

Working together with our clients, Tower Engineering takes great pride in implementing environmentally conscious solutions to building issues. To sustain our environment, we design building systems that use material, energy and water resources efficiently, minimize site impacts and address health issues relating to the indoor environment.



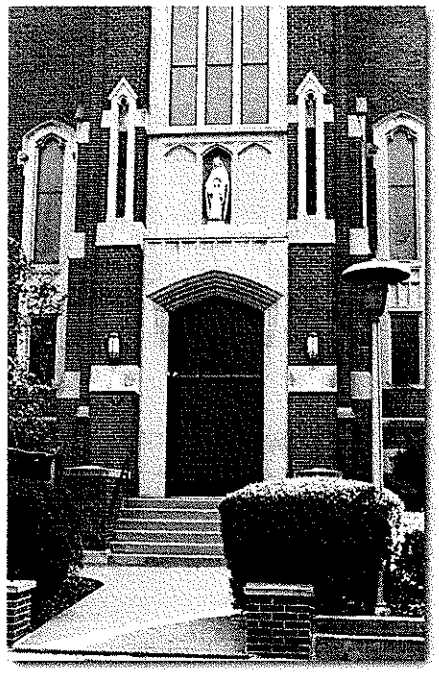
Regional Learning Alliance

Over the last decade, various groups have worked to develop strategies to promote and facilitate the design of sustainable, high performance buildings. One such organization, The **U.S. Green Building Council**, has created a nationally recognized certification process for evaluating sustainable and high performance buildings, a program called "**Leadership in Energy and Environmental Design**," commonly known by its acronym "**LEED**". In addition to being a member of the U.S. Green Building Council (USGBC), Tower Engineering's staff includes LEED accredited professionals.

The LEED certification process rates the levels of sustainability achieved in a building: LEED Certified, LEED Silver, LEED Gold, and the highest rating, LEED platinum. Awards are based upon achieving "sustainability points" in the areas of Site, Water, Energy & Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation & Design Process.

Tower Engineering has provided engineering services for the following LEED rated projects:

- Felician Sisters Motherhouse (LEED Gold)
- Three Rivers Rowing Association Boat Storage & Maintenance Building (LEED Certified)
- Carnegie Mellon University Henderson House Renovations (LEED Silver)
- Carnegie Mellon University Posner Conference Center Rare Books Room (LEED Certified)
- Pittsburgh Children's Museum Renovation & Expansion (LEED Silver)
- Regional Learning Alliance at Cranberry Woods (LEED Silver)
- Millcreek School District J S Wilson Middle School (LEED Gold Anticipated)
- Pine Richland School District Upper Elementary School (LEED Silver) Anticipated)



TOWER
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Fax (412) 939-2525

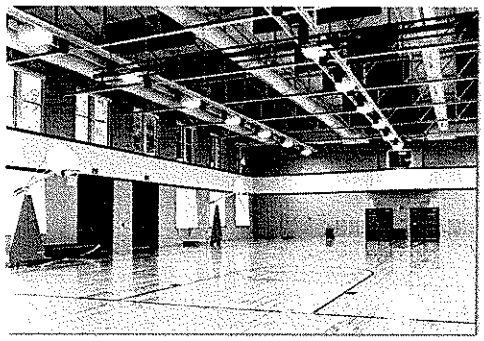
Felician Sisters' Motherhouse
Coraopolis, Pennsylvania

- Super-high efficiency modular boilers to maintain 60 degrees F low-end water temperature.
- Carefully sized individual heat pumps to provide adequate compressor runtimes to ensure summer dehumidification and cooling without short cycling.
- Specification of premium efficient motors for pumps and larger RTU fans.
- Specification of Ventilation Heat Pump Rooftop Units with factory-installed energy recovery sections.
- Utilization of carbon dioxide sensors to reduce outside air quantities in multi-use spaces when not fully occupied.
- Specification of fully automated temperature controls system to provide computerized monitoring and control of mechanical equipment for maximum energy savings and systems optimization.
- Engineered lighting levels to exceed ASHRAE 90.1-1999 using the most efficient lamp and fixture combinations.

The Project Team has achieved a LEED™ Gold rating.

Tower Engineering has a long history of providing engineering services in West Virginia For more than five decades, educational, commercial and institutional facilities owners have depended on us to engineer mechanical and electrical systems which are effective, as well as efficient

During the past two years alone, 34% of our project workload has been in West Virginia. Currently, Tower Engineering is providing mechanical and electrical systems engineering for boards of education in 11counties, as well as for West Virginia University, Fairmont State University, the West Virginia Hi-Tech Consortium, Rocket Center, and Canaan Valley Institute. We recently completed projects at Glenville State College and the City of Fairmont.



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Recent Projects in West Virginia Have Included:

- Airport Renovations
- Research/Laboratories
- K-12 Schools
- Commercial Offices
- Community Centers
- Retail Buildings
- Stadiums & Athletic Buildings
- Military Training Facilities
- Nursing Homes
- Light Industrial and Warehouses

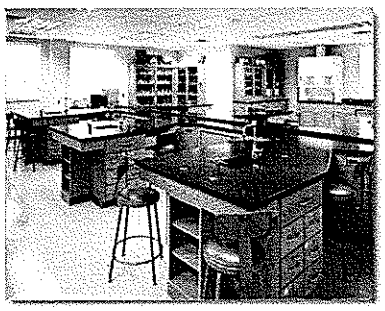
Engineering West Virginia

Located in Pittsburgh....But Not *Just* A Pittsburgh Firm

T-Indicates counties in which Tower Engineering has provided services.

"My grandfather kept diaries from the 1930s until his death in 1963. I've really enjoyed reading of his trips to Charleston to provide services in West Virginia. He would catch the train from Pittsburgh to Charleston and stay overnight, often meeting with multiple clients. The diaries include fascinating information about the architects he worked with... and the exciting projects he engineered."

David E. Tower
Principal, Retired



THOMAS J. GORSKI, P.E.

Principal, President
Mechanical Engineering Department Head
Senior Project Manager

EDUCATION

BS, Mechanical Engineering
Penn State University
1982

REGISTRATION

PE, Pennsylvania
PE-040568-E

PE, West Virginia
PE-11973

NCEES Registration

AFFILIATION

American Society of Heating, Refrigeration & Air Conditioning Engineers (ASHRAE)
Pittsburgh Chapter
Past President

Mr. Gorski has twenty-five (25) years of experience as a mechanical engineer His primary responsibilities are the design of HVAC systems and their components for schools, universities, commercial and light industrial office buildings, laboratory buildings, health care facilities and military facilities He has designed HVAC systems including constant and variable air volume, air handling and exhaust systems; chilled water and hot water systems and steam distribution systems; electric/electronic control, pneumatic control and DDC systems

Mr. Gorski's design responsibilities include load calculations, equipment selection and system layout, project specifications, cost estimates, direction of the project drafting effort, coordination with architectural and other engineering disciplines, and construction administration He also performs system analysis and energy studies, maintains client contact, and supervises the engineering effort of the Mechanical Engineering groups

REPRESENTATIVE EXPERIENCE:

West Virginia University, Morgantown, West Virginia
New Student Recreation Center Design & Systems Commissioning

Gateway School District, Monroeville, Pennsylvania
High School Renovation/Addition Systems Commissioning

Ross Township, Pennsylvania
New Municipal Complex (includes Community Center)

Ebensburg Center, Ebensburg, Pennsylvania
Heating System Replacement in Dormitory Buildings 1-7

Allegheny Kiski Medical Center, Natrona Heights, Pennsylvania
Emergency Room Renovation, Endoscopy Suite Renovation, Nuclear Camera Replacement, Radiology Room #5 Renovation, Radiology Room Renovation, Steam Condensate Return Piping Study

University of Pittsburgh, Pittsburgh, Pennsylvania
New Upper Campus Housing Phases I and II

Pennsylvania Army National Guard, Connellsville, Pennsylvania
New Readiness Center

VA Pittsburgh HealthCare Services, Pittsburgh, Pennsylvania
New Parking Garage

TOWER
ENGINEERING

DANIEL J. KENDRA, P.E., LEED™ AP

Senior Project Manager
Mechanical Engineering

Mr Kendra has twenty-two (22) years of experience as a mechanical engineer. His primary responsibilities are the design of mechanical systems and their components for schools, universities, commercial and light industrial office buildings, and housing facilities. He has designed HVAC systems including constant and variable air volume, air handling and exhaust systems; chilled water and hot water systems; electric/electronic control, pneumatic control and DDC systems.

Mr Kendra's design responsibilities include load calculations, equipment selection and system layout, project specifications, cost estimates, direction of the project drafting effort, coordination with architectural and other engineering disciplines, and construction administration. He also performs feasibility studies and energy studies, and maintains client contact.

EDUCATION

BS, Mechanical Engineering
University of Pittsburgh
1985

REGISTRATION

PE, Pennsylvania
PE-49669-E

PE, West Virginia
PE-14406

PE, Ohio
PE-64337

LEED™ Accredited Professional
2005

CERTIFICATION

Construction Documents Technology,
March 2007

AFFILIATION

American Society of Heating,
Refrigeration & Air Conditioning
Engineers (ASHRAE)
Pittsburgh Chapter
Newsletter Editor

American Society of Plumbing
Engineers (ASPE)
Pittsburgh Chapter

REPRESENTATIVE EXPERIENCE

Roman Catholic Diocese of Allentown, Easton, Pennsylvania
Saint Jane Frances De Chantal HVAC Systems Commissioning

Roman Catholic Diocese of Greensburg, Belle Vernon, Pennsylvania
Saint Sebastian Catholic Church HVAC Systems Commissioning

Moon Area School District, Moon Township, Pennsylvania
Bon Meade Elementary Mechanical Systems Retro-commissioning

Cinnaminson Township Public Schools, Cinnaminson, New Jersey
Computer Room HVAC Retro-commissioning

Spring-Ford Area School District, Collegeville, Pennsylvania
Senior High School Investigative Review

Canaan Valley Institute, Davis, West Virginia
New Headquarters and Educational Facility

American Eagle, Pittsburgh, Pennsylvania
Quantum II Fitup
Quantum III Base Building Systems & Fitup

North Hills School District, Pittsburgh, Pennsylvania
Administration Building HVAC Renovation
Highcliff Elementary School Addition/Renovation
McIntyre Elementary School Addition/Renovation
Ross Elementary School Boiler Replacement
West View Elementary School Ventilation

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ENGINEERING

STEPHEN J. KISAK, P.E.

Principal
Electrical Engineering Department Head
Senior Project Manager

EDUCATION

Master of Business Administration
Frostburg University
1997

BS, Electrical Engineering
University of Pittsburgh
1988

REGISTRATION

PE, Pennsylvania
PE-052645-E

PE, Virginia
PE-0402-026204

An electrical designer/engineer for 19 years, including 3 years as a high voltage electrical designer, Mr Kisak has provided engineering services for the design of educational facilities, office buildings, college and university facilities, health care, assisted living/nursing homes, and commercial facilities His primary responsibility is for the preparation of electrical opinions of cost, technical specifications, engineering drawings, field observation, and coordination with architectural and other engineering disciplines

Mr Kisak's design responsibilities including lighting layout and fixture selection, including calculations and system coordination studies and calculations; computer rooms and associated support facilities; fire alarm and detection systems; emergency power, public address, audio-visual, security and closed circuit television systems. Additional responsibilities include client contact, field observation, and project management.

REPRESENTATIVE EXPERIENCE

University of Pittsburgh, Pittsburgh, Pennsylvania
Upper Campus Housing (Phases 1 and 2)
Electrical Engineering Services for more than fifty Renovation, New Construction & Systems Evaluation Projects

Carnegie Mellon University, Pittsburgh, Pennsylvania
Henderson House Renovation (LEED)
Welch Hall Renovation

The Children's Home of Pittsburgh, Pittsburgh, Pennsylvania
New Programs & Services Facility

PA National Guard, Connellsville, Pennsylvania
New Readiness Center

VA Pittsburgh Medical Center, Pittsburgh, Pennsylvania
New Parking Garage & New Substation

Stryker Brigade Combat Team, Cambridge Springs, Pennsylvania
Readiness Center & OMS

H. J. Heinz Lofts, Pittsburgh, Pennsylvania
Adaptive Reuse/Renovation

Felician Sisters, Pittsburgh, Pennsylvania
Motherhouse & Our Lady Sacred Heart High School Renovations (LEED)

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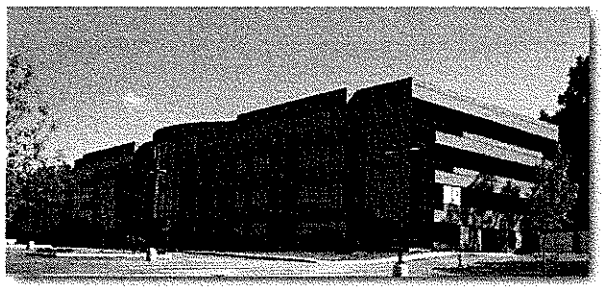
When building systems are commissioned, they save money, according to the U.S. Department of Energy.

Building Commissioning can best be described as a quality-assurance process designed to increase the likelihood that a newly constructed or renovated building will meet the client's expectations. It is the analysis of the design, installation and operation of building systems, with the intent of achieving the maximum design efficiency and expected operational performance. The commissioning process can be applied to nearly any building system.

Encompassing the entire design and construction process, commissioning begins with the selection of a commissioning consultant - typically hired by the Owner at the same time the project's goals and objectives are being developed. The commissioning consultant serves as the Owner's technical liaison throughout the design, construction and start-up phases.

According to the U.S. Department of Energy, commissioning even 1 percent per year of all existing U.S. commercial buildings over 25,000 square feet would result in $46 million in annual energy savings. Commissioning 7 percent of all new buildings greater than 25,000 square feet would save an annual $4.3 million in energy costs. However, the benefits of building commissioning are not limited to energy savings. Additional benefits include:

- Smooth Turnover of Building
- Improved Building Performance
- Reduces Contractor Call backs
- Provides Safe, Healthy Facility
- Improves Worker Productivity
- Improves Energy Performance
- Improves Operating Strategies
- Provides Good Building Documentation
- Improves Operation Training



Tower Engineering provided systems commissioning for Verizon Wireless's Call Center at Cranberry Woods

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Building Commissioning

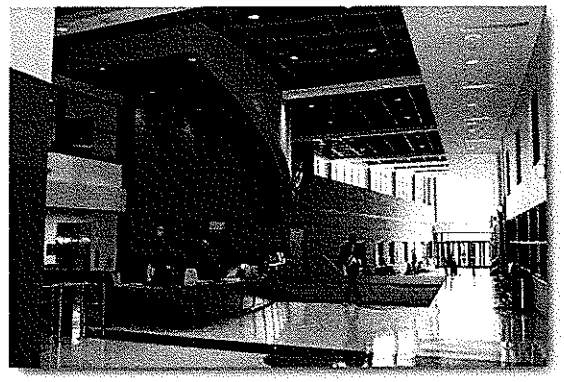
How Does Commissioning Work?

Ideally, the commissioning process will begin in the design phase, with a review of the design intent and constructability and maintainability issues. The process then continues through the construction and acceptance phases, with submittal and the documented verification of proper systems installation and functional performance. Typically, commissioning then concludes with O&M manual review and verification of operator training, and may include additional support through the warranty period

What Buildings Should be Commissioned?

- Buildings where health and safety are of primary concern
- Facilities where improper operation would pose risks
- Any building with complex control strategies
- Facilities where building operators require more concentrated training
- Buildings in which monthly energy optimization is a chief goal.

The goal of commissioning is to satisfy the needs of building occupants, as well as facility owners and managers, while minimizing energy operating costs.



West Virginia University's
new Student Recreation Center

Our Approach to Commissioning

Tower Engineering's approach to commissioning is to form a team involving the owner, O&M staff, design team, and contractors to create effective and efficient buildings.

Tower coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultation with all parties, frequently updated timelines, schedules and technical expertise.

Depending upon the project, Tower Engineering can provide commissioning services as either the design engineer or a Third Party Consultant.

More information about Building Commissioning is available from:

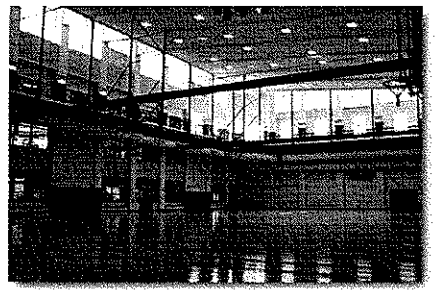
- Building Commissioning Guide, U.S. General Services Administration and U.S. Dept of Energy, 1995
- The Building Commissioning Handbook, 1996
- The Proceedings of the National Conference on Building Commissioning, 1993-1996
- The Building Commissioning Process, ASHRAE, 1996
- Local Utility Companies
- State/Federal Energy Offices

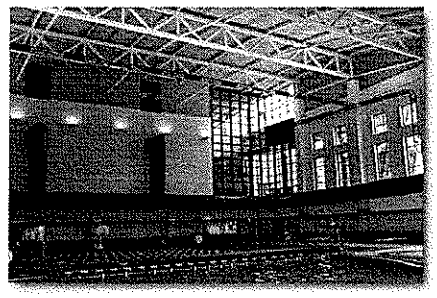
West Virginia University Student Recreation Center

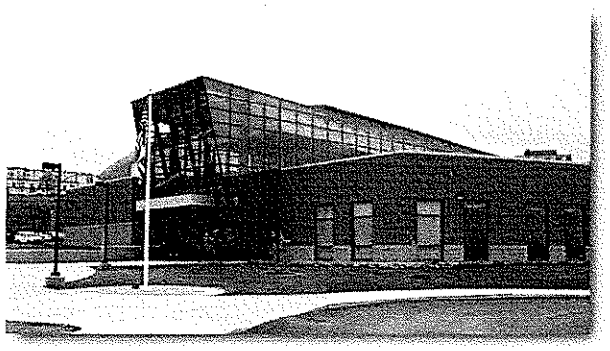
When West Virginia University hired Tower Engineering, they chose a Commissioning Agent who eliminated duplication of effort, guaranteed precise measurements, provided an accurate report from the Testing and Balancing contractor, and ensured the major mechanical equipment operated as designed and specified.

Tower Engineering was selected by West Virginia University to provide commissioning services for the new $26 million Student Recreation Center. This facility was designed to significantly improve the quality of life for current students and attract new students to the University. Tower Engineering provided mechanical/electrical systems design for this AIA Merit Award winner.

WVU chose to hire a commissioning agent to ensure the mechanical systems were installed, functionally tested, and operated in conformance with the design intent. By choosing Tower Engineering to provide these services, WVU selected a firm already familiar with the job including the equipment operation and sequence of operation. The Testing and Balancing contract was bundled with the Building Commissioning, and Tower retained the services of Northstar Environmental to balance the air and water systems.







West Virginia University got a building that works right...the *first* time.

TOWER ENGINEERING

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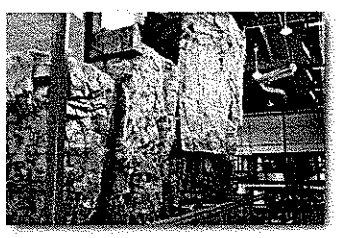
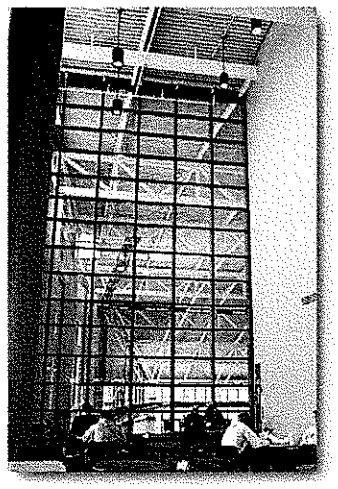
Building Commissioning Case Study

WVU Rec Center Commissioning Scope of Work

- Provide commissioning of major equipment including steam-to-hot water heat exchangers, hot water pumps, chillers, chilled water pumps, cooling tower, condensing water pumps, all air handling units, variable speed drives, water-to-water heat exchangers, and the pool filters and circulating pumps
- Verify sensor and actuator calibration and operation
- Functional Performance Test major mechanical equipment including the sequence of operation step-by-step by simulating summer and winter conditions to ensure the automatic temperature control (ATC) software is written correctly
- Coordinate comprehensive Owner Training - including walk-thru and major equipment including the chiller and energy management system to ensure maximum participation
- Organize complete project document including Commissioning Plan, regular Deficiency Reports, Verification and Functional Performance Test Checksheets, O&M Manuals, and As-built mechanical plans.





Over a Five-month period, Tower Engineering identified 61 deficiencies which were then corrected by the responsible parties

Deficiencies Identified & Corrected

- Outdoor air temperature sensor was mounted on a masonry wall and registered more than 15 degrees higher than actual outdoor temperature in the heat of the day. This would have affected numerous control sequences, included economizer (free cooling).
- Two duct sensors were more than 10 degrees out of calibration and had to be replaced.
- The space static pressure transducer was provided in a range that was too high for accurate measurement. This would have resulted in substantial building pressure fluctuations.
- The outside air and return air dampers on an AHU did not track and further mechanical adjustments were necessary.
- Current switches indicating fan status were wired in the wrong place and picked up both high speed and low speed status simultaneously.
- A deadband between cooling and heating setpoints was not programmed into AHU software. This would have resulted in short cycling of equipment and noticeable temperature fluctuations.
- Glycol tank pump was not automatically activating when hot water line was low on fluid. Over time, this may have resulted in low antifreeze levels and costly coil ruptures during freezing weather.
- Chiller software required fine-tuning to optimize chiller lead/lag sequence.
- The outside air humidity sensor was not reading accurately below 80% RH affecting the AHUs' enthalpy economizer switch-over point. The temperature setpoint adjust was not available for all the units on the associated graphic display at the head-end computer.
- The chilled water flow monitor transducer was not installed.
- No alarms were registering at the Central Workstation.
- Automatic Temperature Control software was not thoroughly tested for each AHU for every heating and cooling scenario. Subsequent testing by Commissioning Agent revealed programming flaws that were easily changed by the ATC technician.
- Two AHUs that served the same areas each had their own PID loop controlling the units making it possible that one unit was in heating and the other in cooling.

Project Experience

Tower Engineering has experience providing design and commissioning services on numerous projects. Our extensive design experience insures that we will be familiar with all aspects of each project's mechanical and electrical design.

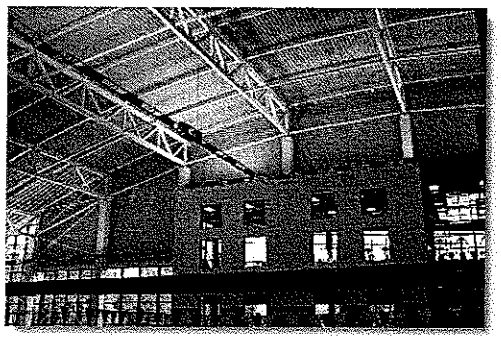
Systems or technologies for which our firm has provided commissioning services include:

- Packaged or split HVAC
- Chiller System
- Boiler System
- Hydronic systems
- Variable Air Volume Systems
- Energy Management System
- Variable Speed Pumping
- Variable Speed Fans
- Lighting Controls
- Electrical, Emergency Power

Tower Engineering provided commissioning services for the following projects:

Gateway School District Gateway High School - This project involved commissioning services for approximately 200,000 SF of new and renovated space. As part of this project, Tower Engineering provided full commissioning services for all HVAC equipment including air handling units, variable volume boxes, chillers, boilers, pumps, unit ventilators, fan-coil units and DDC controls.

West Virginia University Student Recreation Center Commissioning - Tower Engineering provided commissioning services for the 160,000 s.f. Student Recreation Center. Systems commissioned included: chiller, cooling tower, glycol, heat exchanger, pumps, air handling units, pool water, witness startup and controls.



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Building Commissioning

Moon Area School District Bon Meade Elementary School - Tower Engineering provided commissioning of rooftop units, air handling units, unit ventilators, chiller, and boiler, for renovation of 66,000 s.f.

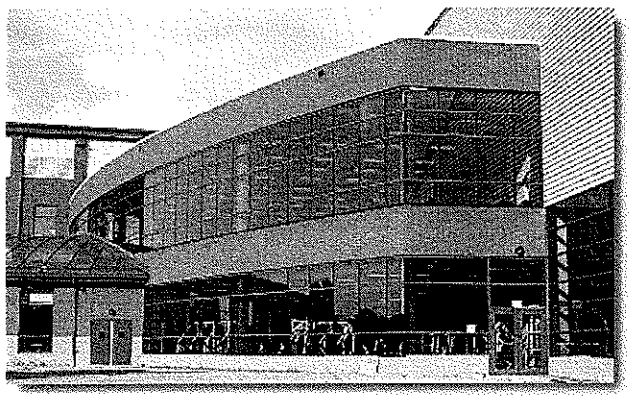
Barbour County Board of Education, Philip Barbour High School Complex - Systems commissioned for this 180,000 s.f. renovation/addition project included rooftop units, unit ventilators, heat recovery units, chiller, and boiler.

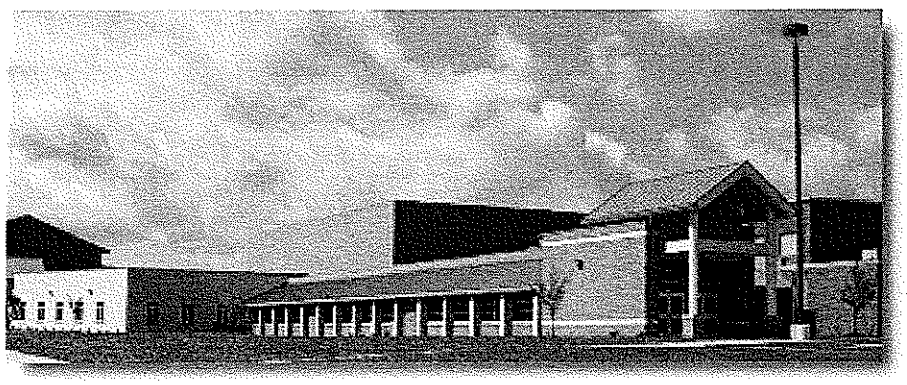
Pleasants County Board of Education Middle School - Tower Engineering commissioned rooftop units and pooh dehumidification units associated with this 60,000 s.f. renovation project.

Upshur County Board of Education Buckhannon High School - Tower Engineering is currently providing HVAC commissioning services associated with a full replacement of the original HVAC system in this 142,000 s.f renovation project.

Verizon Call Center - Commissioning of this 120,000 s.f. new facility was completed in 2002. Systems commissioned included rooftop units, fan-powered boxes, computer room air conditioning units, exhaust systems and DDC controls.

Cranberry Woods III - Rooftop units, fan-powered boxes, exhaust fans and DDC controls were commissioned for this new 120,000 s.f. office building





SECTION 15005 – GENERAL REQUIREMENTS FOR BUILDING COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of the commissioning process is to provide the Owner of the facility with a high level of assurance that the mechanical system has been installed in the prescribed manner and will operate within the performance guidelines set in the design intent. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. The Commissioning Agent shall be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers and equipment suppliers.

1.2 SCOPE

A. The Commissioning Agent is referred to as an independent contractor in this Division and shall work under a separate contract directly for the Owner. The Commissioning Agent shall be hired and shall work with Owner and Contractors as per this document.

B. The Commissioning Agent shall hire the Test and Balance (TAB) Contractor and work together to provide commissioning and TAB services. Specification section 15040 Test and Balance will be met as part of this contract.

C. The functions and responsibilities of the Commissioning Agent shall include:

1. Identify the Commissioning team members and their responsibilities. Typically, the Commissioning team members include the Owner, the Design Engineer, the General Contractor, Mechanical Contractor, the Automatic Temperature Controls Contractor, Construction Manager, and the Commissioning Agent.
2. Schedule the Construction Phase Commissioning Coordination Meeting within 120 days of the award of the contract at a time and place convenient to the school district. This meeting shall convene the Commissioning team members to review the complete mechanical commissioning program. At this meeting the Contractors and the Commissioning Agent shall establish tentative schedules for mechanical systems orientation and inspections, O&M submittals, training sessions, Testing and Balancing (TAB) work, and verification and functional performance testing.
3. Conduct periodic inspections of work in progress. Once equipment is started and systems are functional, Commissioning personnel shall visit site on a regular basis to verify and test the performance of the mechanical systems. After each site visit, a Commissioning Progress Report shall be written by Commissioning Agent and submitted to the Owner, Mechanical Contractor, and ATC Contractor. As necessary, a Commissioning Issues Log – Deficiency Report shall be issued as well.
4. Develop detailed checklist data sheets to document verification tests. The tests are basically hardware checks. Verification testing includes measuring temperatures and comparing sensor values vs. computer readings, testing actuator operation, and verifying relay start/stop functions. Conduct verification tests of sensors and actuators for each system to be commissioned.
5. Develop detailed checklist data sheets to document functional performance tests. The tests shall include verification of specified sequence of control. Testing shall also include a Central Workstation check to verify trending, history logs, alarm initiation, the accessibility of the Operator's Terminal, and the completeness of the graphics. Submit detailed functional

test procedures for review and acceptance by the facilities department. Conduct functional performance tests of each system's mechanical equipment as shown below. Accommodate seasonal conditions. If Commissioning Agent identifies performance deficiencies, Owner shall arrange corrective action by Mechanical Contractor and/or ATC, and Commissioning Agent shall retest up to 10% of the systems/components originally tested. Retesting costs beyond 10% of the systems/components originally tested will be paid by the prime contractor responsible for the deficiency. Submit functional performance test report in final Commissioning Report.

6. Schedule the O&M training sessions on mechanical equipment and Automatic Temperature Controls. These training sessions are to be attended by Owner's personnel, Commissioning Agent, Mechanical Contractor, and ATC Contractor as necessary.
7. Verify TAB report and, with TAB Contractor, repeat any measurements that are not within tolerance. Submit standard Test and Balance report in final Commissioning Report. If necessary, the Mechanical Contractor shall make adjustments and/or corrective actions prior to retesting.
8. Assemble and submit the final project documentation including final Commissioning Report, TAB Report, and As-Built records.

1.3 SYSTEMS TO BE INCLUDED IN COMMISSIONING PROCESS

A. The following pieces of equipment and systems shall be commissioned:

Mechanical Equipment	Total Quantity on job	Quantity Commissioned
Energy Recovery Unit	ERU-1 thru 5	5
Rooftop Units	RTU-1 thru 21	21
Unit Ventilators	UV-1 thru 42	10
Make-up Air Units	MAU-1 thru 5	5
Hot Water Coils	HWC-1 thru 59	10
Exhaust Fans	EF-1 thru 27	10
Supply Fans	SF-1 & 2	2
Roof Ventilators	RV-1 thru 44	10
Automatic Air Dampers	21 AAD	7
Electric Duct Coils	EDC-1 thru 24	8
Radiant Ceiling Panels	RCP-1 thru 8	2
Kitchen Ventilator System	KSU-1	1
Hot Water System	HWS	1
Chilled Water System	CHWS	1
Exterior Lighting	Lighting	1

1.4 COORDINATION

A. The Commissioning Agent shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings directly from the design professionals and Construction Manager.

1.5 SCHEDULE

A. The Commissioning Agent shall coordinate the schedule of commissioning activities with the construction schedule.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. Commissioning requires support from the contractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner. Guidelines related to the cooperation and coordination requirements with the Commissioning Agent:

1.	Mechanical Contractor	Section 15000
2	Automatic Temperature Controls Contractor	Sections 15900 and 15950

1.7 REQUIRED COMMISSIONING DOCUMENTATION

A. The following lists the documentation required to be submitted by Commissioning Agent to the Owner.

1. Commissioning Plan
2. Commissioning Meeting minutes
3. Commissioning Ledger Checklist with activities and dates
4. Verification Checklists for each piece of mechanical equipment required to be commissioned
5. Functional Performance Checklists for each piece of mechanical equipment required to be commissioned
6. Commissioning Progress Report
7. Deficiency Reports
8. Test and Balance Report
9. Final Commissioning Report

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All industry standard test equipment required for performing the specified tests shall be provided by the Commissioning Agent and TAB Contractor as specified in Specification Section 15040. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.

B. Commissioning Agent's instrumentation shall be of sufficient quality and accuracy to test and measure system performance within tolerances required.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND SCHEDULE

A. The Commissioning Agent shall develop and submit a Commissioning Plan detailing team responsibilities and the scope of the commissioning. It shall include a schedule for the commissioning process which is integrated with the construction schedule.

3.2 TEST AND BALANCE

A. The Commissioning Agent shall satisfy the Test and Balance (TAB) portion of the project and shall fulfill the requirements of this spec section and section 15040 Test and Balance.

3.3 VERIFICATION AND FUNCTIONAL PERFORMANCE TESTING

A. Personnel experienced in the technical aspects of each system to be commissioned shall develop and document the commissioning procedures to be used. Included shall be Verification and Functional Performance Checklists for each system based on actual system configuration.

3.4 OPERATION AND MAINTENANCE TRAINING

A. The Commissioning Agent shall review the Mechanical Systems and the ATC O & M manuals for compliance with the project specifications.

B. The O & M manual review and coordination efforts shall be completed prior to Owner training.

C. The Commissioning Agent shall schedule and coordinate training sessions for the Owner's staff for each system.

END OF SECTION 15005

SECTION 15040 - ADJUSTING, BALANCING AND SYSTEM TESTING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, other Division 1 Specification sections, and requirements listed in Section 15000 apply to work of this section.

B. The Commissioning Agent will provide the balancing services for the air and water systems on this project. The Mechanical Contractor shall cooperate completely and shall coordinate his work with the Commissioning Agent.

C. The Mechanical Contractor shall be responsible for notifying the Commissioning Agent when a system is ready to be balanced and/or commissioned. If the Commissioning Agent arrives on site and determines that the system is not ready to be balanced and/or commissioned, the Mechanical Contractor shall reimburse the Commissioning Agent for any expenses incurred for that site visit, including all time and travel expenses.

D. Refer to Section 15005 (General Requirements for Building Commissioning).

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL

A. Review drawings and specifications with regard to adjusting and balancing.

B. Additional balancing devices which, in the opinion of the Commissioning Agent, would aid in the adjusting and balancing of the systems shall be provided by the Mechanical Contractor, subject to the approval of the Architect, at no additional cost to the Owner.

C. Minor modifications in system design which, in the opinion of the Commissioning Agent, would aid in the adjusting and balancing of the systems shall be provided by the Mechanical Contractor, subject to approval of the Architect, at no additional cost to the Owner. Design modifications shall not lessen the operating efficiency of the systems.

D. For each belt-driven fan, the Mechanical Contractor shall furnish a set of belts and sheaves, in addition to the set provided with the fan, when requested by the Commissioning Agent. The Commissioning Agent will install the belts and sheaves.

1. The Commissioning Agent will require this additional set of belts and sheaves based on the results of the balancing process.

E. For each pump, the Mechanical Contractor shall provide an impeller trim when requested by the Commissioning Agent.

1. The Commissioning Agent will require this impeller trim based on the results of the balancing process.

F. Functional Performance Testing

1. The Commissioning Agent will provide functional performance testing of all HVAC equipment and systems. The Mechanical Contractor shall be present during all functional performance testing and shall provide all necessary equipment manipulations as determined by the Commissioning Agent.

END OF SECTION

FUNCTIONAL TEST AHU-1 FT-1

Project West Virginia University Student Rec Center
Related Tests: AHU-2
AHU-1 serves 4-court gym

1) Participants

Party	*Participation*
Danelle Ardell (DA)	ATC/Energy Management Specialist
Harry Bolette (HB)	Test and Balance Technician
Jerry Rotruck (JR)	Invensys Technician

Party completing form & witnessing	DA, HB, JR	Date of Test	6/21/01
Party completing form & witnessing	DA	Date of Retest	6/26/01
Party completing form & witnessing	DA	Date of Retest	7/31/01

2) Prerequisite Checklist

a. ☐ The following have been started up and startup reports submitted and approved ready for functional testing:
- ☐ Chilled Water System
- ☐ Cooling Towers
- ■ Hot Water System
- ☐ Condenser Water Pumps
- ☐ Chilled Water Piping and Valves

b ■ All control system functions for this and all interlocking systems are programmed and operable per control documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed Prefunctional checklists submitted and approved

Jerry Rotruck	Verbal	7/23/01
Controls Contractor	***Signature or Verbal***	***Date***

c ■ Piping system flushing complete and required reports approved
d ■ Water treatment system complete and operational
f. ■ Test and balance (TAB) completed and approved for the hydronic systems and terminal units connected
g ■ All A/E punchlist items for this equipment corrected
h ■ These functional test procedures reviewed and approved by installing contractor
j ■ Test requirements and sequences of operation attached
k ■ Schedules and setpoints attached.
l. ☐ Have all energy savings control strategies, setpoints and schedules been incorporated that this equipment and control system are capable of? If not, list recommendations below
m ■ Control Program Review Review the software control program(s) for this equipment Parameters, setpoints and logic sequences appear to follow the specified written sequences.
l ❑ Record of all Values for Current Setpoints (SP); Control Parameters, Limits, Delays, Lockouts, Schedules, etc , changed to accommodate testing:

NOTES
If more energy savings are desired, the setpoints can be modified to maintain a higher summer temperature and a lower winter setpoint.

Parameter	Pre-Test Values	Returned to Pre-Test Values √		Parameter	Pre-Test Values	Returned to Pre-Test Values √
Discharge air temp.	75.2	X		Return air humidity	71.2%	X
Space temp.	72.7	X		Return air temp.	74.2	X
Mixed air temp.	74.7	X				
OAT	78.8	X				
OARH	49.6%	X				

3) Sensor Calibration Checks. *Check the sensors listed below for calibration and adequate location.*

Sensor & Location	Location Ok?	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N	Sensor & Location	Location Ok?[1]	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N
DAT	X	87 8	87 2	87 8	Y	Room Temp	X	66 4	66 5	66 4	Y
RAT	X	84 9	84 3	84 9	Y	RARH	X	49 3	51 0	49 3	Y
MAT	X	84 3	84 0	84 3	Y	Setpoint Adjust		63 3	62 0		*
						Override					*

4) Device Calibration Checks. *The actuators or devices listed below checked for calibration and operation.*

Device or Actuator & Location	Procedure/State	1st BAS Value	Site Observation	Final BAS Reading	Pass Y/N
Heating coil valve position or command and stroke	1) Intermediate Position				Y
	2) Full Open				Y
	3) Increase pressure (closed)				Y
	4) Closed				Y
	5) Remove power or air (open)				Y
	6) Visual check – valve not leaking				Y
Cooling coil valve (CCV) position or command and stroke	1) Intermediate position				Y
	2) Full open				Y
	3) Increase pressure (open)				Y
	4) Closed				Y

NOTES

* Room sensor slider programmed out so occupants cannot change setpoints
AHU-1 sensor located by Entry Doors

Device or Actuator & Location	Procedure/State	1st BAS Value	Site Observation	Final BAS Reading	Pass Y/N
	5) Remove power or air (closed)				Y
	6) Visual check – valve not leaking				Y
Main OA damper position	1) Closed				Y
30% MIN POS	2) Full open				Y
Return air damper position	1) Closed				Y
	2) Full open				Y
Filter DP	1) Normal/No alarm				Y
	2) DP over setpoint/Alarm				Y
Supply Fan Status	1) Fan On				Y
	2) Fan Off				Y
Freezestat	3) Normal/No alarm				Y
	4) DAT under setpoint/Alarm				Y

5) Verification of Miscellaneous Prefunctional Checks

Review of verification checklist and startup reports completed successfully Pass? ❑ No ■ Yes

6) Functional Testing Record

Seq. ID from Specs	Mode ID	Test Procedure *(including special conditions)*	Expected Response	Pass Y/N	Note
3.1 E, F, G	**Fan off**	Standby Check. With Units Commanded off by BAS	Verify by visual inspection that: return air damper in AHU is open, outside air damper is closed, cooling coil valve is closed, hot water coil valve is open, fan is off	Y	
3.1 C, D	**Unit Startup**	Units Commanded on by BAS	Supply fan starts per anticipation schedule in warm-up mode RAD open, OAD closed, HW valve open until occupancy or RAT>68°	Y	
3.1 E	**Temperature Control Enthalpy Economizer**		Outdoor air damper and return air damper should modulate to maintain enthalpy setpoint Cooling coil valve should be closed OAD should not close below min position	Y	

NOTES

6) Functional Testing Record

Seq. ID from Specs	Mode ID	Test Procedure *(including special conditions)*	Expected Response	Pass Y/N	Note
		1. Utilizing BAS, Record OA & RA Temp. and OA & RA Humidity	OAT 56° RAT 76.2° OARH 50% RARH 63.4%		
		2. Calculate enthalpy of OA	OA Enthalpy 18.6		
		3. Utilizing enthalpy calculations modulate dampers such that enthalpy of OSA is less than enthalpy of return air at revised conditions	Dampers modulate ■Yes ❑No		
3.1 E	**Maximum Economizer**	Simulate conditions that will open economizer dampers fully	OAT 73° RAT 75° OARH 50% RARH 50% OA Enthalpy 26.8 Dampers fully open ■Yes ❑No	Y	
3.1 E	**Minimum Economizer**	Simulate conditions that will close economizer dampers to minimum position	OAT 80 RAT 78° OARH 80% RARH 50% OA Enthalpy 40 Dampers min position ■Yes ❑No Cooling valve operates ■Yes ❑No	Y	
3.1 F, G	**Max Cooling**	With chiller on, when space temperature rises above setpoint, cooling valve will modulate	Simulate high SpT 76 Cooling valve modulates to full open ■Yes ❑No	Y	
3.1 F, G	**Max Heating**	With hot water available, when space temperature drops below setpoint, heating valve will modulate	Simulate low SpT 71.7 Heating valve modulates to full open ■Yes ❑No	Y	
3.1 G	**Humidity Override**	When RAH >55%, chilled water valve opens to 100% Normal control returns when RAH<50%	Verify that chilled water valve opens If space temp <74F, reheat valve modulates to maintain space temp Verify alarm when RAH >65%	Y Y	
3.1 I	**Freeze Condition**	Simulate a condition at low limit detection thermostat of below 35°F.	Verify that system alarms, fan stop, OSA dampers close, RA dampers open and heating valve opens.	Y	

NOTES

6) Functional Testing Record					
Seq. ID from Specs	Mode ID	Test Procedure *(including special conditions)*	Expected Response	Pass Y/N	Note
3.1 K	AHU Filter Drop	Reset the Filter Differential Pressure to exceed the setting recommended by the filter manufacturer – 1.6"	Verify that the BAS reports an alarm	Y	
	AHU Unoccupied Mode	AHU comes on during Unoccupied for Night Setback	Verify by visual inspection that: RAD opens, OAD closes, HW valve opens, CHW valve closes, fan on	Y	
	Review	Review schedules, current setpoints and sequences with Specification Section 15950-3.1 and Control Drawings prepared by ATC.	Submit approved differences to be incorporated into As-Builts		
	AHU-1 and 2 Operate Together		Verify units run simultaneously	Y	

~End of Test~

NOTES