DEFINITIONS

Architect Services, Engineer Services, Land Surveying Services, Assayer Services, Geologist Services and Landscape Architect Services: Those professional services within the scope of the practice of those services as provided in ARS § 32-101.

Branch Office: A geographically distinct place of business or subsidiary office of a firm that has a key role on the team.

Discipline: Primary technical capabilities of key personnel, as evidenced by academic degree, professional registration, certification, and/or extensive experience.

Firm: Defined in ARS § 32-101(B.19.).

Key Personnel: Individuals who will have major contract responsibilities and/or provide unusual or unique expertise.

SPECIFIC INSTRUCTIONS:

1 . Complete this form for each branch office seeking work under this RFQ.

a . – e. **Firm (or Branch Office) Name and Address.** Self-explanatory.

f. **Year Established**. Enter the year the firm (or branch office, if appropriate) was established under the current name.

g. **Ownership**.

(g1). *Type*. Enter the type of ownership or legal structure of the firm (sole proprietor, partnership, corporation, joint venture, etc.).

(g2). *Small Business Status*. A firm is a small business if the firm has less than 100 employees **or** has gross revenues of $4 million or less.

h.-j. **Point of Contact**. Provide this information for a representative of the firm that the Customer can contact for additional information. The representative must be empowered to speak on contractual and policy matters.

k. **Name of Firm**. Enter the name of the firm.

2. **Employees by Discipline**.

a. Select disciplines from the List of Disciplines (Function Code) listed on Page 3 of 4 Instructions. For employees that do not qualify for any of the disciplines, select Other. *Note: The intended searchable database indicated in the RFQ will be populated from the Qualifications Form I Excel attachment only.*

b. Each person can be counted only twice; once for his/her primary function and once for his/her secondary function. Primary and secondary functions should be indicated by including a “P” or an “S” in column b after the Description Title is given.

c-d. If the form is completed for a firm (including all branch offices), enter the number of employees by disciplines in column c. If the form is completed for a branch office, enter the number of employees by discipline in column d and for the firm in column c.

3. **Profile of Firm's Experience and Annual Average Revenue for Last Year**.

a. Enter the approximate number of projects the firm (or branch) has done attributable by Profile Code listed on Page 3 of 4 Instructions over the last year.

b. Enter the appropriate Profile Codes from Instructions Pages 3 of 4 that represent the type of work the firm (or branch) has done over the last year.

c. Using the Revenue Index Number on Page 3 of 6 Form, indicate the approximate revenue the firm has

earned over the last year per Profile Code entered into the table.

4. **Resumes of Key Personnel Proposed for This Contract.** Complete this section for each key person who will participate in this contract.

    a. Self-explanatory.
    b. Self-explanatory
    c. Total years of relevant experience (block c1), and years of relevant experience with current firm, but not necessarily the same branch office (block c2).
    d. Name, City and State of the firm where the person currently works, which must correspond with one of the firms (or branch office or a firm, if appropriate) listed in Section 1.
    e. Provide information on the highest relevant academic degree(s) received. Indicate the area(s) of specialization for each degree.
    f. Provide information on current relevant professional registration(s) and in which State(s) they are current.
    g. Provide information on any other professional qualifications relating to this contract, such as education, professional registration, publications, organizational memberships, certifications, training, awards, and foreign language capabilities.
    h. Provide information on no more than five (5) projects in the last year which the person had a significant role that demonstrates the person's capability relevant to her/his proposed role in this contract. These projects do not necessarily have to be any of the projects presented in Section 5 for the project team if the person was not involved in any of those those projects or the person worked on other projects that were more relevant than the team projects in Section 5. Use the check box provided to indicate if the project was performed with any office of the current firm. If any of the professional services or construction projects are not complete, leave Year Completed blank and indicate the status in Brief Description and Specific Role.

5. **Example Projects Which Best Illustrate Firms Qualification for this contract.** Select project where multiple team members worked together, if possible, that demonstrate the team's capability to perform work similar to that required for this contract. Complete one Section 5 for each project. List no more than five (5) projects.

    a. Title and Locations of project or contract. For an indefinite delivery contract, the location is the geographic scope of the contract.
    b. Enter the year completed of the professional services (such as planning, engineering study, or design), and/or the year completed if construction. If any of the professional services or the construction projects are not complete, leave Year Completed blank and indicate the status in Brief Description of Project and Relevance to This Contract (block f).
    c. Project Owner or user, such as a government agency or installation, an institution, a corporation or private individual.
    d. Provide the original budget or not to exceed dollar amount for the project.
    e. Provide the Total Cost of the Project. If any of the professional services or construction projects is not complete, indicate the percentage compete and whether this project will be on budget, over or under budget.
    f. Brief Description: Indicate scope, size, and length of project, principle elements and special features of the project. Discuss the relevance of the example project to this contract.

6. **Additional Information**. Use this section to provide additional information you feel may be necessary to describe your firm's qualifications for this contract.

7. **Annual Average Professional Services Revenues of Firm for Last 3 Years**. Complete this block for the firm or branch office for which this form is completed. In column a, enter an approximate percentage of total work attributable to State, Federal or Municipal Work. In column b, enter an approximate percentage of total work attributable to Non-Government work. Percentages should take into consideration work completed over the last 3 years.

8. **Authorized Representative**. An authorized representative of the firm or branch office must sign and date the completed form. Signing attests that the information provided is current and factual. Provide the name and title of the authorized representative who signed the form.

List of Disciplines (Function Codes) for Question 7

Aeronautical Engineer
Agricultural Engineer
Archeologist
Architect
Architectural Engineering
Biologist
CADD Technician
Chemical Engineer
Civil Engineer
Construction Manager
Construction Inspector
Control Systems Engineer
Cost Engineer/Estimator
Ecologist
Electrical Engineer
Environmental Engineer
Environmental Scientist
Fire Protection Engineer
Geodetic Surveyor
Geographic Information System Specialist
Geological Engineer
Geologist
Hydrographic Surveyor
Hydraulic Engineer
Hydrologist
Industrial Engineer
Landscape Architect
Mechanical Engineer
Metallurgical Engineer
Mining Engineer
Nuclear Engineer
Petroleum Engineer
Photogrammetrist
Project Manager
Sanitary Engineer
Soils Engineer
Structural Engineer
Technician/Analyst
Transportation Engineer
Water Resources Engineer

List of Experience Categories (Profile Codes for Question 8)

Acoustics, Noise Abatement
Aerial Photography; Airborne Data and Imagery Collection and Analysis
Activity Centers
Air Pollution Control
Airports; Navaids; Airport Lighting; Aircraft Fueling
Airports; Terminals and Hangars; Freight Handling
Agricultural Development; Grain Storage; Farm Mechanization
Animal Facilities
Anti-Terrorism/Force Protection
Area Master Planning
Auditoriums and Theaters
Automation; Controls; Instrumentation
Barracks; Dormitories
Bridge Design: Bridges
Cartography
Cemeteries *(Planning and Relocation)*
Chemical Processing and Storage
Child Care/Development Facilities
Codes; Standards; Ordinances
Cold Storage; Refrigeration and Fast Freeze
Commercial Building *(Low Rise)*; Shopping Centers
Community Facilities
Communications Systems; TV; Microwave
Computer Facilities
Conservation and Resource Management
Construction Management
Construction Surveying
Corrosion Control; Cathodic Protection Electrolysis
Cost Estimating; Cost Engineering and Analysis; Parametric Costing; Forecasting
Cryogenic Facilities
Construction Materials Testing
Dams *(Concrete; Arch)*
Dams *(Earth; Rock)*; Dikes; Levees
Desalinization *(Process and Facilities)*
Design-Build - Preparation of Requests for Proposals
Digital Elevation and Terrain Model Development
Digital Orthophotography
Dining Halls; Clubs; Restaurants
Dredging Studies and Design
Design & Planning Structured Parking Facilities
Detention Security Systems
Disability / Special Needs
Ecological and Archeological Investigations
Educational Facilities; Classrooms
Electrical Studies and Design
Electronics
Elevators; Escalators; People-Movers
Energy / Water Auditing Savings
Energy Conservation; New Energy Sources
Environmental Impact Studies, Assessments or Statements
Fallout Shelters; Blast-Resistant Design
Fire Protection
Fisheries; Fish Ladders
Forensic Engineering
Garages; Vehicles Maintenance Facilities; Parking
Gas Systems *(Propane; Natural, Etc.)*
Geodetic Surveying: Ground and Airborne
Heating; Ventilating; Air Conditioning
Highways; Streets; Airfield Paving; Parking Lots
Historical Preservation
Hospital and Medical Facilities
Hotels; Motels
Housing (Residential, Multi-Family; Apartments; Condominiums)
Hotels; Motels
Hydraulics and Pneumatics
Hydrographic Surveying
Industrial Buildings; Manufacturing Plants
Industrial Processes; Quality Control
Industrial Waste Treatment
Intelligent Transportation Systems
Infrastructure
Irrigation; Drainage
Judicial and Courtroom Facilities
Laboratories; Medical Research Facilities
Land Surveying
Landscape Architecture
Libraries; Museums; Galleries

Lighting *(Interior; Display; Theater, Etc.)*
Lighting *(Exteriors; Streets; Memorials; Athletic Fields, Etc.)*
Labs - General
Labs – Research – Dry
Labs – Research – Wet
LEED Accredited A/E
LEED Independent 3rd Party Building Commissioning
Mapping Location/Addressing Systems
Materials Handling Systems; Conveyors; Sorters
Metallurgy
Materials Testing
Measurement / Verification / Conservation Water Consumption Savings
Mining and Mineralogy
Medical Related
Modular Systems Design; Fabricated Structures or Components
Mold Investigation
Museums
Nuclear Facilities; Nuclear Shielding
Office Buildings; Industrial Parks
Outdoor Recreation
Petroleum and Fuel *(Storage and Distribution)*
Photogrammetry
Pipelines *(Cross-Country - Liquid and Gas)*
Phase I Environmental
Prisons & Correctional Facilities
Plumbing and Piping Design
Prisons and Correctional Facilities
Product, Machine Equipment Design Pneumatic
Structures, Air-Support Buildings Power Generation,
Transmission, Distribution Public Safety Facilities
Radar; Sonar; Radio and Radar Telescopes
Radio Frequency Systems and Shielding's
Railroad; Rapid Transit
Recreation Facilities *(Parks, Marinas, Etc.)*
Refrigeration Plants/Systems
Rehabilitation *(Buildings; Structures; Facilities)*
Research Facilities
Resources Recovery; Recycling
Roof Infrared Imaging to Identify Water Leaks
Roofing
Safety Engineering; Accident Studies; OSHA Studies
Security Systems; Intruder and Smoke Detection
Seismic Designs and Studies
Sewage Collection, Treatment and Disposal
Soils and Geologic Studies; Foundations
Solar Energy Utilization
Solid Wastes; Incineration; Landfill
Special Environments; Clean Rooms, Etc.
Structural Design; Special Structures
Surveying; Platting; Mapping; Flood Plain Studies
Sustainable Design
Swimming Pools
Storm Water Handling and Facilities
Specifications Writing
Toxicology
Testing and Inspection Services
Traffic and Transportation Engineering
Topographic Surveying and Mapping
Towers *(Self-Supporting and Guyed Systems)*
Tunnels and Subways
Traffic Studies
Transportation
Urban renewals; Community Development
Utilities *(Gas and Steam)*
Value Analysis; Life-Cycle Costing
Warehouse and Depots
Water Resources; Hydrology; Ground Water
Water Supply; Treatment and Distribution
Wind Tunnels; Research/Testing Facilities Design
Waste Water Treatment Facility
Water Well Rehabilitation; Water Well Work
Zoning; Land Use Studies

(If a firm has branch offices, complete for each specific branch office seeking work.)

1. REVISED ADSPO13-00003465*: Annual Request for Qualifications*

a.	FIRM (OR BRANCH OFFICE) NAME:	Energy-Environment-Economics, L.L.C.
b.	FIRM (OR BRANCH OFFICE) STREET:	18818 N. 34th Way
c.	FIRM (OR BRANCH OFFICE) CITY:	Phoenix
d.	FIRM (OR BRANCH OFFICE) STATE:	Arizona
e.	FIRM (OR BRANCH OFFICE) ZIP CODE:	85050

f.	YEAR ESTABLISHED:	1999

(g1).	OWNERSHIP - TYPE:	L.L.C.
(g2)	OWNERSHIP - SMALL BUSINESS STATUS:	Small Business

h.	POINT OF CONTACT NAME AND TITLE:	D. Michael Ledbetter, P.E.
i.	POINT OF CONTACT TELEPHONE NUMBER:	602-570-4886
j.	POINT OF CONTACT E-MAIL ADDRESS:	Ethree1@cox.net

k.	NAME OF FIRM *(If block 1a is a branch office)*:	

2. EMPLOYEES BY DISCIPLINE

a. Discipline Title	b. Function: Primary (P) or Secondary (S)	c. No. of Employees - Firm	d. No. of Employees - Branch
Mechanical Engineer	P	2	
Electrical Engineer	P	1	
Total		3	

3. PROFILE OF FIRM'S EXPERIENCE AND ANNUAL AVERAGE REVENUE FOR LAST YEAR

a. Approximate No. of Projects	b. Experience	c. Revenue Index Number *(see below)*
5	Energy (resource) conservation and management	3
1	Construction Management	1
5	HVAC Engineering	1
7	LEED Independent 3rd Party Building Commissioning	3

PROFESSIONAL SERVICES REVENUE INDEX NUMBER

1. Less than $100,000
2. $100,000 to less than $250,000
3. $250,000 to less than $500,000
4. $500,000 to less than $1 million
5. $1 million to less than $2 million
6. $2 million to less than $5 million
7. $5 million to less than $10 million
8. $10 million to less than $25 million
9. $25 million to less than $50 million
10. $50 million or greater

4. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT (*Complete one Section 4 for each key person.)*

a. NAME D. Michael Ledbetter, P.E.	b. ROLE IN THIS CONTRACT: Engineer in Charge	c. YEARS EXPERIENCE	
		1. TOTAL: 28	2. WITH CURRENT FIRM: 14

d. FIRM NAME AND LOCATION *(City and State)* *Energy-Environment-Economics$_{LLC}$* *Phoenix, AZ.*

e. EDUCATION *(DEGREE AND SPECIALIZATION)*
BSME (1987) Texas Tech University
Specialization in HVAC Systems Analysis and Design,
Expert in HVAC Control Systems, Commissioning and Optimization of Commercial and Industrial HVAC Systems. Energy conservation (HVAC) expert,

f. CURRENT PROFESSIONAL REGISTRATION *(STATE AND DISCIPLINE)*
#41041 State of Arizona, Mechanical

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*

H. RELEVANT PROJECTS

1)

(1) TITLE AND LOCATION *(City and State)*
JCNTF Building, PPMR (National Guard) Phoenix, AZ

(2) Year Completed: 2012

Professional Services: Design (construction documents provided), Commissioning, Optimization Services provided

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[X] Check if project performed with current firm

HVAC system redesign and modernization including the central plant, air distribution system, and control system.
Central plant converted to variable primary, chilled water coils replaced with higher capacities to extend use of new plate/frame heat exchanger, pneumatic control system replaced with DDC system, VAV boxes replaced with pressure independent type. Entire system was Commissioned and Optimized by *Energy-Environment-Economics$_{LLC}$*. Total project cost was approximately 400,000$.

2)

(1) TITLE AND LOCATION *(City and State)*
Douglas Unified School District, Douglas, AZ.

(2) Year Completed: 2011

Professional Services: Develop the Investment Grade Audit, perform 3rd party professional Commissioning services

Construction (*if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[X] Check if project performed with current firm

Complete 3rd party independent HVAC Commissioning services – per the requirements spelled out by the Arizona School Facilities Board (SFB) for the entire district including DDC system point-to-point verification and DDC sequences of operations vetting. Part of the SFB's requirements included a thorough review, comment and approval of the investment grade audit (IGA) that was prepared by the performance contractor. The reviewed documentation included HVAC and lighting systems description, current utility data, projected utility consumption for the proposed energy conservation measures (ECM's), description of the proposed ECM's, and a financial summary. The information provided served to support the conclusion that the anticipated savings that can be realized upon implementation of the ECM's. the project was approximately 1,000,000 square feet and our fees were approximately 100,000$.

3)

(1) TITLE AND LOCATION *(City and State)*
AZ DEMA – WAATS Administration/Flight Training/Dorms – L4500, Marana, AZ.

(2) Year Completed: 2010

Professional Services: Engineering Analysis, Design, Commissioning and Optimization services

Construction *(if applicable)*

(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE

[X] Check if project performed with current firm

Energy-Environment-Economics provided a detailed engineering study and report of the HVAC System's current (existing) condition and operation including: HVAC system design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs and economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $1,000,000 Energy Conservation Project including Retro-Commissioning and Optimissioning^{SM} - a combination of HVAC system commissioning and optimization - of the facility. The project included the engineering required for the modernization and automation of the chilled water central plant, air distribution system, and DDC system complete. Also, project coordination and test & balance services were provided in addition to the commissioning and optimization services provided.

4)	(1) TITLE AND LOCATION *(City and State)* ***Holbrook Unified School District, Holbrook, AZ***	(2) Year Completed: 2013	
		Professional Services: IGA review and final approval, 3rd party professional Commissioning services	Construction *(if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE HUSD was selected as one of several districts throughout Arizona to receive ARRA funds up to 30% of the total cost for a comprehensive Performance Contract (PC). The PC was based upon a guaranteed energy savings methodology. Energy conservation measures included a District-wide EMS and a lighting systems upgrade. The vast majority of the energy conservation measures were implemented at the High School and the Junior High School. The numerous buildings comprising the High School were equipped with an EMS, and some buildings had new equipment installed. The Junior High School also included the installation of an EMS, and the P, G, and S classroom buildings were retrofitted with new gas fired engine driven heat pump systems that now provide mechanical air conditioning and heating in lieu of the original evaporative cooling/natural gas heating systems.	[X] Check if project performed with current firm	
5)	(1) TITLE AND LOCATION *(City and State)* ***AZ Heart Hospital, Phoenix, AZ.***	(2) Year Completed: 2004	
		Professional Services: Engineering Analysis, Design, Commissioning and Optimization services	Construction *(if applicable)*
	(3) BRIEF DESCRIPTION *(Brief scope, size, cost, etc.)* AND SPECIFIC ROLE *Energy-Environment-Economics* provided a detailed study and report of the HVAC System's existing conditions and operations including design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs and economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $1,800,000 HVAC system redesign and modifications for the facility, including construction document preparation, commissioning and Optimissioning^{SM} of the entire facility. The central plant was converted to direct variable primary and a new plate/frame heat exchanger was installed. Fire/smoke dampers were replaced throughout the facility to shift the system curve so the air handling units could deliver the required airflows. Existing inlet guide vanes were removed and replaced with variable frequency drives. Airflow measuring stations were added among other measures to get positive control of the outside air quantities provided. DDC algorithms were completely rewritten and optimized. The entire scope of work was performed without shutting down the hospital.	[X] Check if project performed with current firm	

a. NAME Tripp Armstrong, BSEE	b. ROLE IN THIS CONTRACT: Electrical/Controls Engineer	c. YEARS EXPERIENCE	
		1. TOTAL: 22	2. WITH CURRENT FIRM: 7
d. FIRM NAME AND LOCATION *(City and State)* *Energy-Environment-Economics$_{LLC}$* *Phoenix, AZ.*			

e. EDUCATION *(DEGREE AND SPECIALIZATION)*
BSEE (1988) Arizona State University
Specialization in HVAC Controls Systems and DDC System Design, Expertise in Commissioning and troubleshooting of DDC Systems.

f. CURRENT PROFESSIONAL REGISTRATION *(STATE AND DISCIPLINE)*

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*

a. NAME Brad Hindes, BSME	b. ROLE IN THIS CONTRACT: HVAC Equipment Application Engineer	c. YEARS EXPERIENCE	
		1. TOTAL: 33	2. WITH CURRENT FIRM: 5
d. FIRM NAME AND LOCATION *(City and State)* *Energy-Environment-Economics$_{LLC}$* *Phoenix, AZ.*			

e. EDUCATION *(DEGREE AND SPECIALIZATION)*
BSME (1988) Texas Tech University
Specialization in HVAC Systems Equipment and Control Systems, Commissioning Commercial and Industrial HVAC equipment. HVAC equipment application expert.

f. CURRENT PROFESSIONAL REGISTRATION *(STATE AND DISCIPLINE)*

g. OTHER PROFESSIONAL QUALIFICATIONS *(Publications, Organizations, Training, Awards, etc.)*

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT

(Present no more than five (5) projects. Complete one Section 5 for each project.)

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
DEMA-PPMR – Jeff Seaton	$98,000	$350,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

JCNTF Building, PPMR (National Guard)

Building Description

Located in Phoenix, AZ., the JCNTF facility consists of approximately 50,000 square feet square feet. It appears that the original HVAC system was designed to the highest energy efficiency standards and capabilities available circa 1977. The system incorporated renewable energy sources in addition to these cutting edge efficiency technologies. However, the system has fallen into disrepair, perhaps due to the inability of the original pneumatic control system to manage such a complex HVAC system. The pneumatic controls are completely inoperable at this time, so it should come as no surprise that numerous supplemental heating/cooling units – ductless "mini" split systems – have been installed throughout the facility.

Project Overview

Central Plant Scope of Work:

A new cooling tower (as specified and scheduled) was provided and installed, a new plate/frame heat exchanger (as specified and scheduled was provided and installed, a new chilled water pump and a new condenser water pump (as specified and scheduled) were provided and installed, new central plant control valves (provided by the controls contractor, installed by the mechanical contractor) were installed, and new variable frequency drives (provided by the controls contractor, controls contractor installed)) were installed for the new cooling tower and chilled water pump as shown on the construction documents. To accomplish this work required:

1. A chilled water system shutdown and subsequent demolition of the existing cooling tower and piping, demolition of the existing chilled water and condenser water pumps and piping, and demolition of the existing chilled water and hot water piping coil connections serving air handling units #1-3.

2. Installation of the new cooling tower including all required piping, installation of the new chilled water and condenser water pumps complete with piping and accessories as detailed, installation of the new plate/frame heat exchanger including all piping and controls contractor furnished control valves, and installation of the new hot water and chilled water piping and controls contractor furnished control valves serving air handling units #1-3. NOTE: Refer to Air Distribution System Scope of Work for coordination requirements of piping work required and related chilled water coil replacement work required.

3. Pipe hangers shall be installed as required for support of the new plate/frame heat exchanger piping. All disturbed chilled water piping insulation shall be repaired to match existing insulation. All new chilled water piping, pump accessories and control valves shall be insulated to match the existing insulation.

4. The existing cooling tower, pumps and associated piping shall be removed as shown on the construction documents.

5. New cooling tower, pumps, plate/frame heat exchanger, control valves, variable frequency drives, and associated piping shall be installed as detailed on the construction documents.

Air Distribution System Scope of Work:

Install new chilled water coils (as specified and scheduled) one each for the three existing air handling unit chilled water coils to be replaced. Air handling unit chilled water coils must comply with the specific dimensional requirements as required by the physical size and installation requirements of the existing Carrier air handling units. Also, the existing VAV boxes shall be removed and replaced with new pressure independent, single duct VAV boxes as shown on the construction documents. Finally, the existing sir-to-air heat exchangers serving the air handling units and associated ductwork is to be removed. Refer to the construction documents for specific requirements. To accomplish this work will require:

6. Replace the existing chilled water coils at air handling unit #1-3 with new chilled water coils as specified and scheduled. Ideally, this work would be done in conjunction with the new chilled water and hot water coil piping complete with new control valves (controls contractor furnished, mechanical contractor installed) and accessories as shown on the construction documents.

7. Remove and replace air handling unit sections and existing ductwork as required to provide sufficient access for coil removal and coil installation.

8. Remove existing VAV boxes and install new VAV boxes as specified and scheduled. Contractor bidders should expect that some inlet (primary) air connection transition to the new VAV box will be required. VAV boxes and hot water piping packages (if required) shall be supported and hung per manufacturer's recommendations and all applicable Codes.

9. Remove air-to-air heat exchangers as shown, cap and provide insect screens as shown on the construction documents.

10. Provide a general and thorough "clean-up" of the air handling units including power washing of the air handling units and existing hot water coils, new fan motor belts, sheaves and new filters.

DDC Scope of Work

The scope of the DDC work required for this project included:

1. Provide main and control power to the twenty-three (23) new VAV boxes provided by the controls contractor and installed by the mechanical contractor in the facility. Provide the necessary programming and graphics to incorporate the new VAV boxes into new sequences of operations.

2. Provide new modulating motorized control valves (installed by the mechanical contractor) in the central plant and provide control power. Provide the necessary programming and graphics to incorporate the new valves into the new DDC sequences of operations.

3. Provide new chilled water (3 total) control valves and new hot water (3 total) control valves serving air handling units #1-3 to be installed by the mechanical contractor. Valves shall be pressure independent type. Install new DDC system communication wire to all new valves. Terminate new control valves as required.

4. Install new DDC system communication wire to all air handling units, chiller, cooling tower, pumps, VAV boxes and associated control valves.

5. Provide and install five new variable frequency drives for the three air handling units, new chilled water pump, and new cooling tower including main and control power and disconnecting means requirements.

6. Provide and install three new premium efficiency (inverter duty) fan motors at each air handling unit (3 total).
7. Provide and install new temperature (air and water) sensors serving the central plant and at the air handling units and VAV boxes as shown on the construction documents; provide and install new outside air temperature sensor and humidity sensor used for wet-bulb calculation. Integrate all new devices into the new DDC system and new sequences of operations.

8. Provide the necessary programming to support revised central plant/air handling unit sequences of operations as developed by the Optimissioning^{SM} team. Provide all updates to front-end graphics.

Solutions Provided

Energy-Environment-Economics provided a detailed engineering analysis and report of the HVAC System's existing conditions and operations including original design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs, economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $800,000 HVAC system redesign and modifications for the facility, with *Energy-Environment-Economics*$_{LLC}$ providing Design (Construction) Document preparation, Commissioning and Optimissioning^{SM} services for the entire facility. The designed and implemented renovations and energy conservation measures has resulted in a fully functional and highly efficient HVAC system that has eliminated the need for the previously existing ductless split systems and reduced the facility's <u>total</u> energy costs by approximately 33%.

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT

(Present no more than five (5) projects. Complete one Section 5 for each project.)

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
Arizona Heart Hospital	$455,000	$1,800,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

Arizona Heart Hospital

Building Description

The facility is a 54-bed heart hospital with four operating theaters; Cath and diagnostic labs, ICU, CCU, and an around the clock emergency room serviced by air and ground transportation. The facility is approximately 160,000 square feet multi-story (basement and two floors above grade) building. The heating, ventilating and air conditioning (HVAC) system consists of:

- Constant flow chilled water/hot water systems including 2 parallel piped water cooled water chillers, approximately 320 tons each.
- 8 central station air-handling units, all of which equipped for variable volume (VAV) using either variable frequency drives or inlet guide vanes, all having both supply and return fans and 100% outside air economizer capabilities.
- Approximately 240 constant and variable volume boxes, most with reheat coils.
- Complete direct digitally controlled Energy Management System (EMS).

Project Problems/Issues

- Inability to satisfy all of the facility's temperature, humidity requirements, including ICU areas due to original HVAC system design and installation
- Space pressure problems, i.e. pressures between sterile areas inverse from required
- Questionable design practices
- Risk management and regulatory agency compliance issues due to the above
- Excessive utility costs

Project Overview

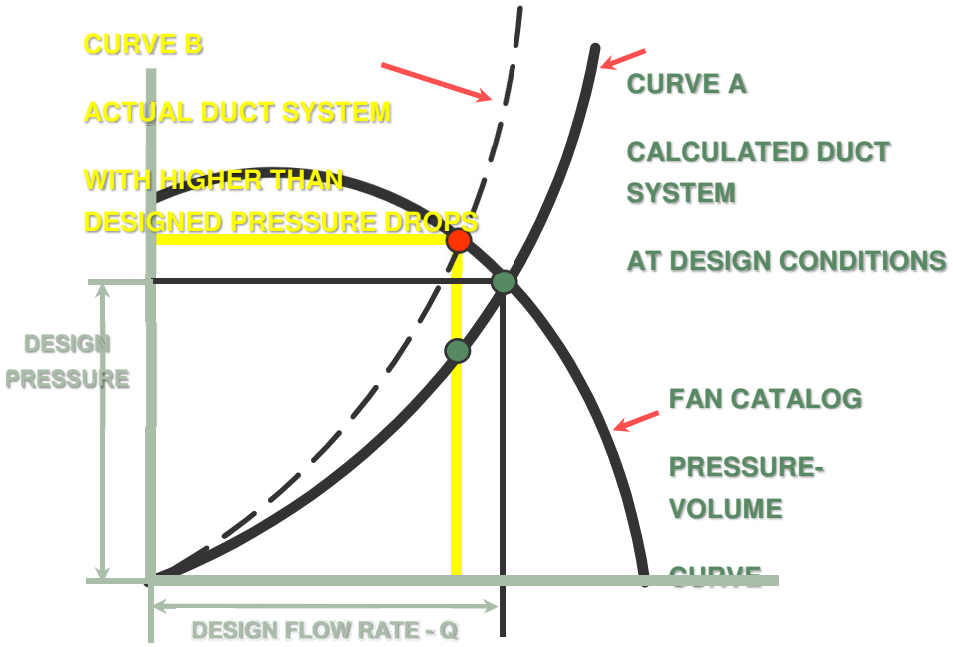
Energy-Environment-Economics provided a detailed study and report of the HVAC System's existing conditions and operations including design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs and economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $1,800,000 HVAC system redesign and modifications for the facility, including construction document preparation, commissioning and Optimissioning^{SM} of the entire facility.

Solutions Provided

The modifications included replacement of numerous in-duct fire/smoke dampers (FSD) and air handling unit supply air discharge ducts to reduce the air distribution system's total pressure drop. The analysis determined that the total system pressure drop was significantly higher than the design intent, and as a result the air handling units did not have the capability to provide the airflow required to all zones, especially those distant from the air handling units. The higher than design system pressures were also causing serious duct leakage, up to 25% on some systems, exacerbating the comfort issues. The following graph illustrates the design and calculated (actual) conditions:

System Pressure Drops

- high static supply fans designed at 6.5", returns at 2"
- systems operating at approximately 10.5" total static
- extreme – up to 1" - FSD pressure drops
- high pressure drops at discharge plenums, i.e. system effect
- high losses at elbows due to high velocities



This lack of capacity, even at 100% fan speeds, resulted in an inability to maintain temperature/humidity requirements as well as poor ventilation control and indoor air quality. Also, with these conditions there was no way to capitalize on the energy management capabilities (VAV) of the air handling units. To complicate matters, large space pressure differences were existing between sterile areas due to return air fan control schemes and the original outside air system design criteria.

The original design for outside air included a large, passive (not forced air) outside air "plenum" to which individual outside air ducts attached to all air handling units. Preliminary testing showed that this "sharing" of the main outside air duct was resulting in some air handling units actually introducing return air from other air handling units via the outside air system. In other words, among other noted problems, sterile (surgery, etc.) areas were introducing air from less sterile areas. The entire outside air deliver system was egregiously deficient.

Part of the HVAC system redesign required that the outside air ducts to each air handling unit be replaced with smaller ducts and were equipped with outside air flow measuring stations. The smaller sizes provided the minimum velocities necessary to make the stations work correctly and to permit outside air control and monitoring. Also, *Energy-Environment-Economics* designed and implemented innovative outside air/return air/mixed air damper control algorithms, combined with a revised supply air fan/return air fan tracking algorithm, that solved the outside air delivery issues.

Through exhaustive field work, the engineering study also identified select areas where space was available to increase the size and lower the subsequent pressure drops of the FSD's that had especially high pressure drops and would have the most effect on shifting the system curve back to design as shown above. Affected areas were systematically taken off-line during low census and off-hour times, and these FSD's were replaced and the system brought back on-line in the morning. Accurate construction documents were mandatory, as was scheduling of all related shutdown activities. During this process, the ductwork was also re-sealed to minimize the extreme leakage.

System testing during analysis also revealed large pressure drops at the supply air discharge ducts at each air handling unit, caused by system effect pressure losses due to duct configurations. New designs were developed, and these changes were made simultaneously during the system shutdowns. Finally, to maximize the system shift, existing inlet guide vanes were removed and replaced with variable frequency drives. The net result of the air distribution system modifications was to shift the system curve within design, allowing sufficient air at required temperatures to be supplied to all zones.

The outside air delivery system corrections, combined with the modifications to the EMS, solved the IAQ and space pressure control issues. All corrections to the air distribution system collectively solved the very serious problems, and were also very successful in reducing the energy consumption of the system.

System performance and efficiency was vastly improved through the proper application of variable air technologies and converting the constant volume chilled water system to variable primary. Inefficient equipment such as 3-way control valves and fan inlet guide vanes were replaced with pressure-independent 2-way control valves and variable frequency drives respectively. The installation of properly sized cooling towers and plate frame heat exchanger provided non-existent redundancy and reduced operating costs. All new devices - variable frequency drives, outside air flow measuring and control devices, et. al. – were integrated into the Energy Management System (EMS) sequences of operations.

The sequences of operations were completely rewritten for maximum performance and efficiency during the Optimissioning^{SM} process, including reset schedules for the air handling units. EMS communication with the chillers was established, enabling reset schedules to be established and more reliable control over central plant operations. Space pressure sensors and control algorithms were incorporated, as were air handling unit outside air control algorithms. Differential pressure sensors were installed into the revised chilled water system, and all facets of the new system's controls requirements were designed, implemented and optimized. All critical EMS setpoints, including economizer changeover, chilled water supply, supply air temperature, and air handling unit static were painstakingly established for maximum energy efficiency. All VAV/FPVAV boxes were calibrated during the HVAC system wide Test & Balance process.

Results

These system improvements were completed with no interruption in services, as affected areas were systematically taken off-line during low census periods and returned to operation the following morning(s). the new control algorithms for the entire system(s), coupled with the installation of new and/or relocated controls devices, allowed us to properly monitor, control and most importantly satisfy all space temperature and pressure and outside air flow requirements throughout the entire facility at all times and any conditions. The project resulted in eliminating all deficiencies associated with the HVAC system and reduced energy costs by approximately $100,000/year, but most importantly all compliance and risk management issues were addressed and corrected.

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT

(Present no more than five (5) projects. Complete one Section 5 for each project.)

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
DEMA – WAATS – Jeff Seaton	$74,000	$366,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

AZ DEMA – WAATS CMSB – L4525, Marana, AZ.

Building Description

The building is a Mission Critical 24/7 Flight Simulator Training Facility with three full-motion Simulators and two supporting Data (Computer) Rooms. The devices provide flight training to the military of the U.S. and numerous allied countries. Training, office and conference areas make up the balance of the facility.
The HVAC system consists of:

- The central plant includes three water chillers with associated pumps and cooling towers, and is primary-secondary pumped and piped. The secondary pumps and the cooling tower fans are all equipped with variable frequency drives.
- There is a hydronic plate/frame heat exchanger to provide "free" cooling during the appropriate ambient conditions.
- The hot water system is comprised of one boiler and associated pumps and provides space heating used for Data Rooms' humidity control (reheat) and zone heating.
- 4 central station air handling units, one of which is VAV and serves the VAV boxes in the office/training areas.
- 10 chilled water/hot water computer room a/c (CRAC) units serving the Data Rooms
- Complete direct digitally controlled EMS.

Project Problems/Issues

- Inability to maintain temperature and humidity control in the Data Rooms
- Central plant was suffering from reverse decoupling due to original design
- All three 110-ton chillers had 30,000+ hours of operation, building peaks at 110 tons
- Inability to utilize the existing waterside economizer

- Outrageous (approximately 6$/s.f./year) utility costs

Project Overview

Energy-Environment-Economics provided a detailed engineering study and report on the HVAC System's current (existing) condition and operation including: HVAC system design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs and economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $500,000 Energy Conservation Project, including Retro-Commissioning and Optimissioning^{SM} - a combination of HVAC system commissioning and optimization - of the facility. The project included the engineering required for the repair, modernization and automation of the chilled water central plant, the air distribution system, and the critical Data Rooms' HVAC components.

Solutions Provided

The study identified that the central plant was incorrectly piped and as a result was suffering from "reverse" decoupling. This condition is actually quite common in primary-secondary systems, and under various operating conditions elevates the supply chilled water temperature above what is required. The elevated water temperatures prevented the Data Rooms from maintaining temperature and humidity setpoints that were critical to operations. To compensate, additional chiller systems must be started and operated.

This central plant, intentionally or not, was equipped with 200% redundant capabilities. The Data Rooms were equipped with approximately 200% redundancy as well, yet not even this massive amount of available capacity could overcome the poor design and lacking EMS practices and setpoints. Naturally, HVAC related energy costs were extreme as a result. During Optimissioning^{SM} the central plant was re-piped to eliminate this reverse decoupling, and valves were added to allow the secondary pumps alone to provide the necessary chilled water to the facility during heat exchanger mode of operation.

An inability to ever use the heat exchanger was cited by one consultant as a root cause of the excessive utility costs, and a recommendation to add an

additional air-cooled water chiller dedicated to the CRAC units so as to enable the heat exchanger to serve the balance of the facility – and thereby save energy – was provided to the client. Our study and the subsequent Optimissioning^{SM} now allows the chilled water system to operate in heat exchanger mode approximately 4 months of the year, sans any additional chiller, saving energy and wear and tear on the chiller systems.

The study proposed using the available excess capacity of the CRAC units to satisfy the Data Rooms cooling needs during heat exchanger mode, as the warmer than design chilled water temperature delivered during this mode results in elevated supply air temperatures. Ambient conditions suitable for heat exchanger operation are low humidity, making humidity control of the Data Rooms a non-issue at these times. Iterations of the chilled water coils and load analysis of the Data Rooms showed that up to 62-degree supply air temperatures were sufficient to satisfy cooling demands, so the CRAC's were equipped with staging (on-off) controls that enable units to be cycled as needed to meet need, saving significant energy without affecting temperature/humidity requirements. The analysis also allowed the chiller-heat exchanger wet-bulb (WB) temperature changeover setpoint to be established and optimized for maximum energy efficiency.

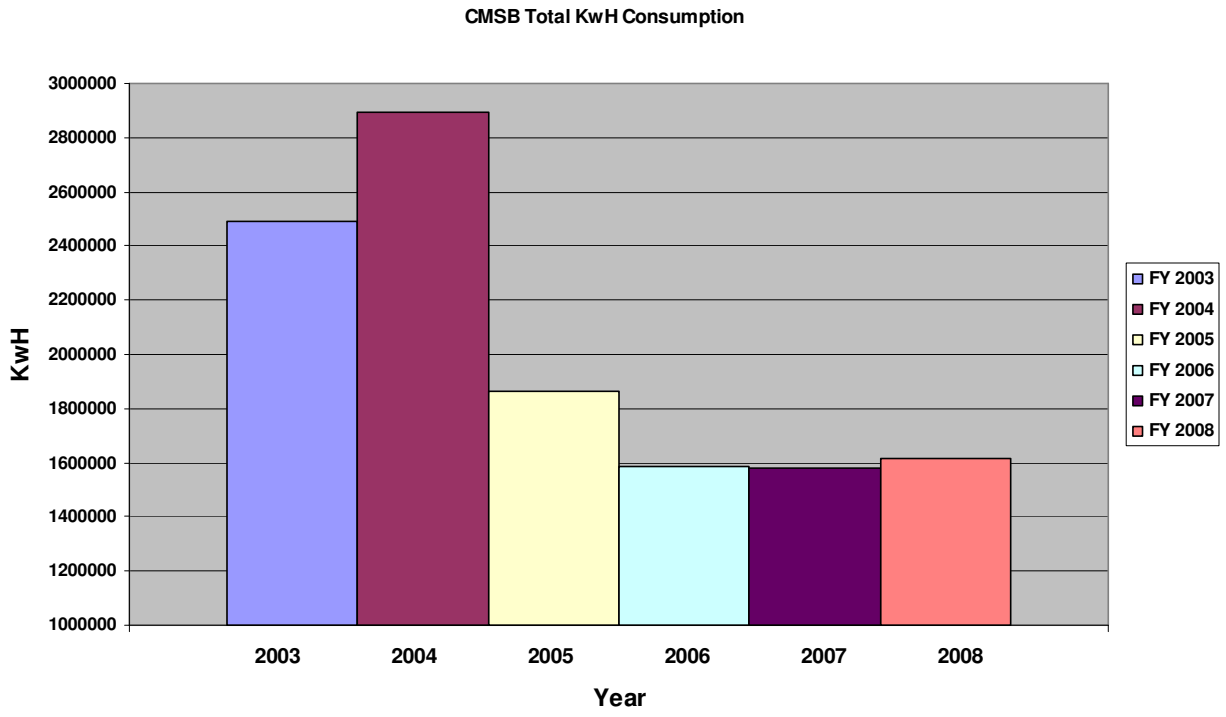
All critical EMS setpoints were similarly established and optimized, and all central plant algorithms were revised. Notably, the differential pressure setpoint used to control the speed of the secondary pumps' variable frequency drives, was eventually lowered from 12.5 PSI to 4 PSI. A combination of factors enabled this dramatic reduction, including an engineering innovation devised to force the CRAC units' chilled water control valves closed when the unit was off. This capability did not exist previously, and manufacturing engineers had stated that it was impossible to accomplish without a control valve replacement.

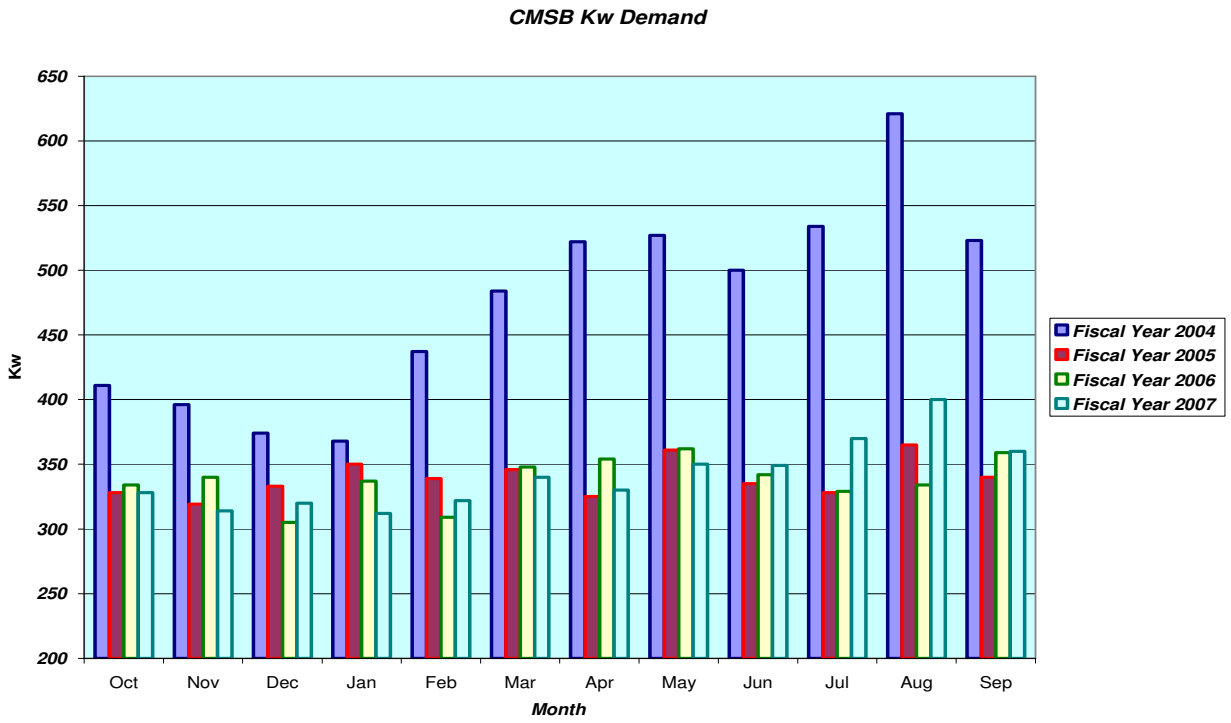
To maintain 4 PSI one secondary pump easily satisfies the demand of the facility. At 12.5 PSI both secondary pumps (one is intentionally redundant) operated – usually at 60 Hz – in an attempt to meet the setpoint. All of the electrical loads that were shed as a result of this Optimissioning^{SM} project, chillers, pumps, cooling tower fans, and CRAC units, resulted in outstanding energy savings and corrected all existing deficiencies. The Optimissioning^{SM} project consisted of the study, the engineering, the commissioning, the Test & Balance and the optimization of the facility. Also, project coordination services were provided by *Energy-Environment-Economics* in addition to the HVAC commissioning and optimization services provided.

Results

Results of the project reflected a 70% reduction in HVAC related energy costs with improved reliability and space conditions. After commencing in November of 2004 and being released to full control March of 2005, the project has had an immediate and staggering impact on energy consumption and utility costs. Space comfort has improved, including the Data Rooms' ability to maintain temperature and humidity within specified limits. The project has conserved approximately 1.5 million KwH every year in fully automatic operation. The Kw demand has almost been cut in ½, from approximately 620 Kw to 350 Kw.

Considering that only the HVAC system was Optimissioned^{SM}, and that lighting and approximately 400 HP of hydraulic pumping (serving the simulators) capability was left untouched, these results are nothing short of spectacular. Due to the concerted efforts of the Optimissioning^{SM} team, including Mr. Jeff Seaton (Energy Manager, State of AZ., NGB), approximately 2/3 of all major HVAC equipment was turned off, thereby generating these savings, extending the life expectancy of the existing equipment, and reducing their associated maintenance requirements and costs. The following charts were created from actual utility data provided by Mr. Seaton, and generated by his Utility Manager software:


CMSB Total KwH Consumption
3000000
2800000
2600000
2400000
2200000
2000000
1800000
1600000
1400000
1200000
1000000
KwH
2003
2004
2005
2006
2007
2008
Year
FY 2003
FY 2004
FY 2005
FY 2006
FY 2007
FY 2008


CMSB Kw Demand
650
600
550
500
450
400
350
300
250
200
Kw
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Fiscal Year 2004
Fiscal Year 2005
Fiscal Year 2006
Fiscal Year 2007

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT

(Present no more than five (5) projects. Complete one Section 5 for each project.)

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
DEMA – WAATS – Jeff Seaton	$175,000	$1,000,000

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

AZ DEMA – WAATS Administration/Flight Training/Dorms – L4500, Marana, AZ.

Building Description

L4500 is a critical 24/7 Flight Simulator Training Facility with one supporting Data Room, Administrative Offices, Training and Conference areas and Dorm Rooms to house the troops being flight trained. As would be expected of such a facility, the HVAC requirements of the various areas differ significantly. The HVAC system consists of:

- The central plant included two water chillers with associated pumps and cooling towers, and is primary-secondary pumped and piped. All pumps were constant volume, and the cooling tower fans were equipped with variable frequency drives.
- The hot water system is comprised of one boiler and associated pumps and provides space heating used for Data Rooms' humidity control (reheat) and zone heating.
- 8 central station air handling units, one of which is constant volume, the VAV air handling units serves the VAV boxes in the office/training areas. All air handling units used inlet guide vanes for capacity control, and all were equipped with 100% outside air economizers.
- 75 room fan coil units located in each Dorm room.
- 4 chilled water/hot water computer room a/c (CRAC) units serving the Data Rooms
- Incomplete direct digitally controlled EMS.

Project Problems/Issues

- 30 year old central plant, no automation or energy conservation capabilities, lack of redundancy and excessive maintenance costs
- Dilapidated air handling units, most equipped with inlet guide vanes. Most control valve, damper and inlet guide vane actuators were inoperable
- 2-pipe system serving the Dorm Rooms resulted in constant comfort complaints
- General lack of energy management capabilities
- Inability to provide accurate and repeatable temperature and humidity control to the newly installed Data Room serving the newly installed Simulator

Project Overview

Energy-Environment-Economics provided a detailed engineering study and report of the HVAC System's current (existing) condition and operation including: HVAC system design and DDC system deficiencies, potential energy conservation opportunities with budgeted project costs and economic analysis, and maintenance related operational and efficiency analysis. The result of this study became an approximately $1,000,000 Energy Conservation Project including Retro-Commissioning and Optimissioning^{SM} - a combination of HVAC system commissioning and optimization - of the facility. The project included the engineering required for the modernization and automation of the chilled water central plant and the air distribution system. Also, project coordination and test & balance services were provided in addition to the commissioning and optimization services provided.

Solutions Provided

The study quantified in great detail the extent of deterioration of the HVAC system, identified existing maintenance deficiencies and generated schematic designs with cost estimates to repair and modernize the system. These estimates were used to provide the economic justification to move the project forward, as energy conservation potential, reliability concerns, and avoided maintenance costs made modernizing the HVAC system fiscally responsible. However, the critical nature of the facility and the required scope of work to implement the recommendations mandated precise scheduling and provision of temporary utilities.

So in addition to providing the final construction documents, Energy-Environment-Economics also provided project coordination services, eliminating the need and additional cost for a general contractor. Preparation of the construction documents was critical to meeting the project's energy conservation goals, maintaining the schedule and meeting budget requirements, so Energy-Environment-Economics worked closely with equipment suppliers to generate precise pre-purchase specifications for the new central plant equipment and air handling units. To reduce construction costs, the new air handling units were designed to utilize the existing roof curbs, eliminating any roofing costs or potential risks.

Because the facility's loads had increased significantly over 30 years, and the central plant was going to incorporate a hydronic economizer capability, the air handling units were increased in airflow and coil size and capacity. Larger coils result in lower pressure drops and required fan HP, but also result in lower velocities and closer approach temperatures that extend the potential for operating in hydronic economizer mode. The air handling units were equipped with factory installed variable frequency drives, and new pressure independent control valves were installed inside the air handling units' pipe vestibules to protect them from the weather.

These specific control valves were part of the overall central plant modernization plan, and were important to final chilled water coil selection criteria. Because low chilled water system temperature differentials (DT) result in capacity loss and increased energy costs, and because redundancy was critical to the uninterrupted operations of the facility, the valves and chilled water coils were carefully selected to compliment the new central plant design. The design intent was to provide 100% redundant capacity in the chillers, pumps and cooling towers, and the design day load was calculated exactly and did not contain any typical safety factors, so the chilled water system's correct operation – at a minimum maintaining the design (12degrees) DT - was of the utmost importance.

Demolition of the central plant began after a temporary air-cooled chiller, with power provided from abandoned circuits, was installed to provide temporary cooling to critical areas. Once demolished, construction of the new state of the art variable flow primary only chilled water central plant began. Three new chiller modules were provided, and a dual circuited fluid cooler was installed to serve the dual purpose of heat rejection during chiller mode as well as act as the hydronic economizer. Eight new automated control valves were added, as was a flow measuring station and bypass valve intended to ensure a minimum flow rate to the chiller during low load periods if needed.

Because each of the fluid cooler's circuits were sized for a design day, and that the entire tube bundle was to be used during hydronic economizer(heat exchanger) mode, a chiller low flow condition was unlikely. In addition to the large surface area of the fluid cooler's tube bundle, the condenser water pumps were equipped with variable frequency drives that would modulate to provide and maintain the chilled water system's differential pressure setpoint during heat exchanger mode, as the chilled water/condenser water system is now one closed loop. During heat exchanger mode only the condenser water pump operates, variably, reducing flow rates and velocities thru the tube bundle. The extended surface and reduced velocities create conditions where we have achieved 2-degree approaches between ambient wet-bulb (WB) temperatures and leaving "chilled" (in heat exchanger mode) water temperatures. In a typical open cooling tower/plate/frame heat exchanger/constant volume condenser water pumping system a 10-degree approach would be more common.

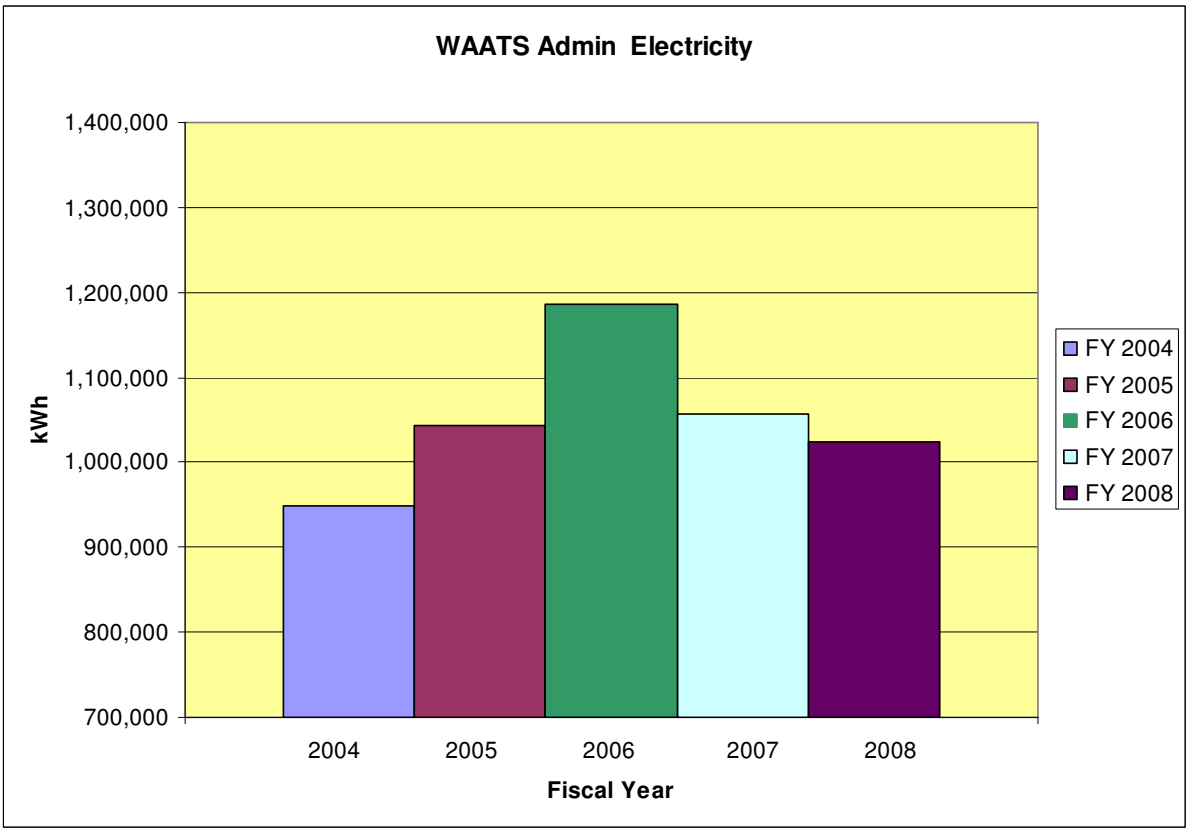
Obviously this capability greatly extends the hours when economizer mode is available to be used, even considering the sensitive nature of the Data Room's temperature and humidity requirements. It also allowed us to stage – if needed – one of the two air handling units dedicated to the Simulator Bay on or off according to need. Prior to OptimissioningSM both existing air handling units operated 24/7 in a constant volume mode. Our analysis and carefully selected air handling units now cycle as needed, and were converted into a single zone VAV configuration to save even more energy.

To complement the new HVAC system's capabilities, new EMS algorithms were written and all vital system setpoints were optimized for maximum energy efficiency. Innovative reset schedules for chiller and heat exchanger modes of operations were devised and implemented, and Energy-Environment-Economics Test & Balance services were used to optimize the control setpoints and reset schedules of the air handling units. While not the prime focus of the project, the hot water system was outfitted with reset schedules to save energy but also to reduce the constant complaints of the Dorm occupants due to the either cooling or heating capability of the 2-pipe system serving that area of the facility.

Results

Results of the project reflected an approximate 30% reduction in HVAC related energy costs with improved reliability and space conditions. After commencing in November of 2006 and being released to full control March of 2007, the project has had an immediate impact on energy consumption and utility costs. Space comfort has improved, including the Data Rooms' ability to maintain temperature and humidity within specified limits.

Considering that only the HVAC system was OptimissionedSM, and that lighting and approximately 100 HP of hydraulic pumping (serving the flight simulator) capability was left untouched, these results are exceptional. Due to the concerted efforts of the OptimissioningSM team, including Mr. Jeff Seaton (Energy Manager, State of AZ., NGB), the HVAC system was made much more efficient and reliable. The following charts were created from actual utility data provided by Mr. Seaton, and generated by his Utility Manager software. The new Flight Simulator and Computer Room was added in 2006, note the increase in energy consumption. The OptimissioningSM project was completed in 2007


WAATS Admin Electricity
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
kWh
2004
2005
2006
2007
2008
Fiscal Year
FY 2004
FY 2005
FY 2006
FY 2007
FY 2008

5. EXAMPLE PROJECTS WHICH BEST ILLUSTRATE PROPOSED TEAM'S QUALIFICATIONS FOR THIS CONTRACT

(Present no more than five (5) projects. Complete one Section 5 for each project.)

23. PROJECT OWNER'S INFORMATION		
c .PROJECT OWNER	d .DOLLAR AMOUNT OF PROJECT	e. TOTAL COST OF PROJECT
Douglas Unified School District	$100,000	Energy Savings Performance Contract

f. BRIEF DESCRIPTION OF PROJECT AND RELEVANCE TO THIS CONTRACT (include scope, size, and length of project)

Douglas Unified School District (DUSD)

Buildings Description

Located in Douglas, AZ., DUSD contains 10 schools K-12 with a total square footage of approximately 1,000,000 square feet. The schools vary widely in age, HVAC system types, and current operational capabilities. The HVAC systems include packaged (heating/cooling) rooftop units, split systems (both gas and heat pump), hot water fan coil units, evaporative cooling and direct fired heating units. There are small variable air volume (VAV) systems on two of the Gyms, as well as natural gas fired hot water boilers at two of the schools. None of the schools was equipped with an energy management system (EMS).

Project Overview

DUSD was selected as one of several districts throughout Arizona to receive ARRA funds up to 30% of the total cost for a comprehensive Performance Contract (PC). The PC was based upon a guaranteed energy savings methodology. Energy conservation measures included a District-wide EMS and a lighting systems upgrade.

Solutions Provided

Complete 3rd party independent HVAC Commissioning services – per the requirements spelled out by the Arizona School Facilities Board (SFB) for the entire district including DDC system point-to-point verification and DDC sequences of operations vetting. Part of the SFB's requirements included a thorough review, comment and approval of the investment grade audit (IGA) that was prepared by the performance contractor. The reviewed documentation included HVAC and lighting systems description, current utility data, projected utility consumption for the proposed energy conservation measures (ECM's), description of the proposed ECM's, and a financial summary. The information provided served to support the conclusion that the anticipated savings that can be realized upon implementation of the ECM's.

6. ADDITIONAL INFORMATION

a. PROVIDE ANY ADDITIONAL INFORMATION YOU FEEL MAY BE NECESSARY TO DESCRIBE YOUR FIRMS QUALIFICATIONS. *(ATTACH ADDITIONAL SHEETS AS NEEDED.)*

7. ANNUAL AVERAGE PROFESSIONAL SERVICES REVENUES OF FIRM FOR LAST 3 YEARS

a.	Percentage of Total Work Attributable to State, Federal and Municipal Government Work:	60%
b.	Percentage of Total Work Attributable to Non-Government Work:	40%

8. AUTHORIZED REPRESENTATIVE. The foregoing is a statement of facts.

Signature:___*D. Michael Ledbetter* _____ Date:___12/5/2013_____

Name: _D. Michael Ledbetter, P.E._____ Title: ____President_____

Energy-Environment-Economics

Energy and Commissioning Services

FIRM PROFILE

Energy-Environment-Economics is a firm that is unique in today's HVAC marketplace. We are a professionally licensed specialty engineering firm staffed with engineers who are experts in the mechanical, electrical and controls disciplines. The founding members have combined experience of over 75 years in the analysis, design and installation of mechanical projects. As such, we have intimate familiarity with HVAC systems. It is because of this experience, and an intuitive understanding of the cause and effect relationships of HVAC design, controls strategies, connected loads, and mechanical equipment that we can optimize your HVAC system.

An optimized system is one that satisfies all temperature, humidity and indoor air quality requirements to all zones at all times, and does so as efficiently as possible. Most if not all HVAC systems are lacking to varying degrees in one or both of these criteria, always resulting from one or all of the following:

- Shoddy and unimaginative designs
- Mis-application of energy management controls strategies
- Lack of thorough commissioning
- Installation deficiencies

The fundamental skill required on the road to optimization is the ability to analyze the complete system as it functions, not just the individual components, and not from a theoretical model. Field engineering experience is an absolute must. When done correctly the analysis becomes the planning tool needed to correct existing deficiencies and develop design solutions that will improve efficiency and comfort. Our staff was carefully selected with the very different yet requisite skill sets necessary to achieve energy efficiency and environmental responsibility.

Our commitment to environmental responsibility is unwavering. As the project economics dictate we will evaluate any and all opportunities to incorporate renewable resource technologies into our design solutions. To date our experience has overwhelmingly been that our innovative design and controls solutions, combined with our exclusive Optimal Performance Integration (OPI) techniques, achieves the greatest atmospheric and economic benefit for our clients. In other words, identifying and eliminating inefficiencies attains far greater greenhouse gas (GHG) reductions per dollar invested.

Our Systems Analysis services will identify these inefficiencies. Our Engineering services will design corrective measures and opportunities for increasing your HVAC system's efficiency. Our Commissioning services will ensure that your system is operating as intended, and our Optimissioning^{SM} services will provide you with unmatched efficiencies and system performance.

Energy-Environment-Economics is also a licensed General Contractor, fully capable of not only engineering related services but also the construction related services ultimately required by our designs. The benefit is obvious: we have all-inclusive familiarity with the project and are fully vested in the ultimate outcome.

COMPANY VISION STATEMENT

To partner with our clients to produce a state of the art HVAC system that provides optimum performance under all conditions, and does so with an unwavering commitment to economic realities and environmental sensitivity. We will produce this end product through comprehensive, accurate and insightful project analysis, coupled with ***Energy-Environment-Economics*** innovative design strategies. Our client partners will dictate our level of participation. As defined, our commitment will continue from project feasibility, installation, through system Optimissioning^{SM}, and culminate in an intensive education of all involved personnel.

Contact

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License #B1-ROC203139

Energy Services

HVAC Energy Costs

Buildings must be climate controlled, and sustaining a safe and comfortable environment requires the consumption of energy by an HVAC system. Of course system types and applications differ broadly, as does the cost component the HVAC system comprises of any building's total energy costs. They may account for 20%-80% of the total, the fact is that HVAC costs are always substantial.

Given the inherent complexities of many system types, the possibility of less than ideal system performance is all but guaranteed. Inefficiency wastes energy, costs money and causes collateral damage; compromised reliability and redundancy, less productive employees, and reduced equipment life expectancy among them to name but a few.

Identifying existing inefficiencies and wasteful practices and correcting them will have a positive impact on your energy costs, and the expense to do so is usually minimal from a near-term fiscal perspective. Of course achieving ideal HVAC system performance, which we define to be as efficient as possible with no sacrifice in comfort, can be more costly but typically has very attractive returns on investment ratios.

Energy-Environment-Economics' services can save you 25-50% of your HVAC related energy costs

How Do We Do It?

1) Identify system inefficiencies, all HVAC systems suffer from varying degrees of inefficiency. Most if not all systems are currently performing substandard, causing comfort delivery issues and a myriad of associated problems: lack of capacity/redundancy, humidity control, Indoor Air Quality (IAQ), and of course excessive utility costs. Our collective ability to identify these performance issues and devise solutions is a core competency of Energy-Environment-Economics and is the essential beginning by which we can and will optimize your facilities

2) Correct pre-existing design, installation and energy management deficiencies. *Energy-Environment-Economics* HVAC Systems acumen and Energy Management System (EMS) expertise allows us the ability to evaluate and critique past, present, and future design strategies. We believe that there are omnipresent instances of poor design practices, some even bordering on the ridiculous. Poor design, coupled with poor to marginal EMS application, system installation methods and non-existent project commissioning is, quite frankly, a recipe for our business. Our innovative designs incorporate the very latest energy efficiency technologies

3) Verify proper operations. Commissioning services provide independent third party technical validation that installed equipment and systems operate as specified and will perform per the construction documents and designer's intent. Commissioning can be provided in conjunction with our suite of services, as it is during the Optimissioning^{SM} of a system, or may be provided as a stand-alone professional service. LEED compliance peer-to-peer and all required field Commissioning activities are available. Once the HVAC system is free of any defects, the optimization process can proceed unencumbered.

4) Optimize your system's performance. There are inherent cause and effect relationships between mechanical equipment, connected loads, air and water distribution design and control strategy. These complex HVAC sub-system relationships can all wreak havoc on performance and efficiency efforts. The key to HVAC system optimization and energy efficiency is an intuitive understanding of these relationships as they interact and affect HVAC System performance, not merely applying time honored prevailing wisdom to generally distinctive situations. It is impossible to optimize a system, from both energy and comfort perspectives, without total comprehension of the very complicated inner workings of these systems.

Optimissioning^{SM} is an exclusive Energy-Environment-Economics prescriptive methodology that combines "commissioning" with "optimization" to achieve a work product far superior to that produced by traditional commissioning-only processes. The Optimissioning^{SM} of the HVAC system involves developing sequences of operations, testing, and evaluating the system's response under as many conditions as possible. It is an iterative and time-consuming process we use to optimize critical setpoints, implement reset schedules, and identify just how far we can push the operational "envelope". This is when and only when the goal of maximum efficiency with no sacrifice in comfort can be achieved.

Commissioning Services

Commissioning Defined

Building commissioning is considered a critical part of any successful facility design and construction project. Too often this critical portion of a facility start-up is passed on to an entity that does not have the owners true interests in mind.

Factors which have brought commissioning into the spotlight include increasing system complexities and interdepencies, added focus on indoor air quality, and continued downward pressure on design and construction costs. The commissioning process developed and employed by ***Energy-Environment-Economics*** is a proactive, systematic and collaborative effort designed to ensure that all building systems perform interactively according to the designer's intent and the owner's operational needs. We draw upon the collective expertise of the members of our firm to provide superior commissioning services.

A well thought-out and applied commissioning program will more than pay for itself through improved pre-construction coordination/communication. This translates into a reduction in costly change orders, while maintaining the project's construction schedule. Ongoing operational benefits include decreased energy use, improved documentation and more thorough training of building staff. Ultimately, commissioning is part of a sustainable design approach because it aids in the construction of a building that possesses the lowest life cycle cost of ownership. Key factors which we feel help to ensure the success of our commissioning services program include:

Early Adoption
The full benefits of commissioning can be fully realized if the Commissioning Agent (C/A) is retained during the planning phase of a project. This helps to ensure necessary funding and the full integration of commissioning into the project through the buy-in of all stakeholders (owner, architect, engineer, construction manager, etc.).

Collaborative Approach
The C/A is focused on solving problems as part of a team approach to successful completion of the project. The ability of this person to conduct the detailed QA/QC processes in ways which ***complement*** other team members' activities during project design and construction is crucial.

Technical Skills
Because of the holistic approach taken toward commissioning and the focus on performance-based outcomes, the C/A must possess both a solid foundation in engineering design principles, as well as extensive operational experience with complex building systems such as HVAC and Building Automation Systems. Our staff is highly skilled in the requisite disciplines of Control Systems and Test and Balance, skills we deem absolutely vital for commissioning today's complex systems.

Operator Training
The C/A plays an important role in assuring that personnel responsible for the efficient operation of the facility are properly equipped for their tasks. Activities include the development and implementation of operator training early in the construction phase and the compilation and dissemination of comprehensive system manuals. Such manuals typically include as-built design documents, O & M manuals, results of functional performance testing and the final commissioning report.

Commissioning is a core competency of Energy-Environment-Economics

Traditional Commissioning Activities

- Review of construction documents
- Assure owner's intent is communicated to and understood by all relevant parties
- Develop a commissioning specification
- Develop a commissioning planning document that includes:
  - identifying team members, their roles and responsibilities.
  - an overview of the commissioning process and protocols
  - a description of the systems to be commissioned
  - a commissioning tasks schedule
- Facilitate regularly scheduled commissioning team meetings
- Develop the final commissioning plan including field inspection forms, startup forms, and functional test forms
- Perform field inspections of items being commissioned
- Witness startup of equipment being commissioned
- Perform a control system point-to-point communication verification
- Verify Test and Balance procedures and protocols
- Develop and witness the functional performance tests (FPT's)
- Assist the owner's representative in developing commissioning schedules
- Provide periodic commissioning report including deficiencies and recommended remedies
- Facilitate owner training and project turnover

Success Stories

It is important to remember that your HVAC system's energy consumption is a significant percentage of your facility's total, and the percentage can vary widely. Commissioning and then optimizing the system's performance can achieve dramatic results, as shown below. Because few HVAC systems are metered independently it is impossible to know for sure, but it is certain that these projects all resulted in HVAC energy cost savings of between 35-70%. The utility data is actual and is available for review anytime.

Combat Mission Training Facility

- Central plant modified
- Data Rooms' CRAC units modified
- Complete EMS overhaul
- HVAC system Commissioning/Optimissioning℠
- The facility's KwH consumption was reduced by 50%
- The facility's KW demand was reduced by 40%
- The project resulted in a ONE YEAR simple payback

Bank Call Center

- 200K s.f. 2nd floor addition
- Central plant addition
- Complex emergency power scenarios
- HVAC system Commissioning included system installation verification, functional performance testing of HVAC system complete and EMS conformance to requirements

"Energy-Environment-Economics ability to identify pre-existing design deficiencies has played a key role in our energy management strategy. Identifying root causes for poor performance and subsequently developing solutions enables us to optimize our facilities. The results have been nothing short of spectacular."

Jeff Seaton, CEM, LAP
Energy Manager, State of Arizona NGB

Dining/Dorm Facility

- Central plant modified
- Complete EMS overhaul
- Numerous maintenance deficiencies identified and corrected
- HVAC system Commissioning/Optimissioning℠
- The facility's KwH consumption was reduced by 35%

Mixed Use Facility

- HVAC system commissioned
- Complete EMS overhaul
- HVAC system Commissioning/Optimissioning℠
- The facility's natural gas consumption was reduced by 33%
- The facility's KwH consumption was reduced by 16%

"The Energy-Environment-Economics concept of providing services where compensation for their efforts is paid for out of energy savings is not unusual. But having the combined resources to identify problems, develop alternative solutions, estimate the construction costs and energy savings dollars, arrange and coordinate the work required to fix the problems, and on occasion arrange the financial side as well is unusual and admirable."

David S. Pearson, P.E.
President, Pearson Engineering Associates

Administration/Training Facility

- Central plant renovated
- Air handling units replaced
- HVAC system commissioned
- Complete EMS overhaul
- HVAC system Commissioning/Optimissioning℠
- The facility's KwH consumption was reduced by 18%

Heart Hospital

- Major modifications to the air distribution system
- Central plant converted to variable primary
- Substantial ventilation system modifications
- EMS modified, sequences completely rewritten
- HVAC system Commissioning/Optimissioning℠
- Pervasive code compliance issues resolved
- Serious risk management issues resolved
- All modifications completed with no ops downtime
- The project reduced the facility's energy costs 15%

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SUMMARY OF SERVICES

Energy-Environment-Economics offers a full range of energy engineering services that can be tailored to meet our individual clients' needs. Our very name is derived from and based upon what our experience and capabilities will mean to our clients: energy cost and consumption reductions, environmental responsibility and tangible, measurable economic benefit. Our staff of experienced professionals possesses a varied set of skills, including rigorous professional training combined with a holistic understanding of how complex HVAC sub-systems interact within a facility. These skills allow our team to generate solutions to existing performance deficiencies that when corrected will provide the greatest net benefit to our clients.

Energy-Environment-Economics is not an energy services company (ESCO), but an HVAC Systems specialty engineering firm. We can increase your business revenues and bottom line performance by identifying energy conservation opportunities that have been discounted, or overlooked entirely, due to traditional engineering and contractor practices. Other opportunities stemming from the contractor driven "low bid" mentality of today's market place and the resulting installation and application deficiencies can be identified and evaluated, and usually require minimal investment to correct to further reduce operating costs. It is imperative to understand that any and all system deficiencies will preclude the HVAC system operating at peak performance. Our services will guarantee that level of performance, including:

HVAC System Analysis experts begin the optimization process at this phase of the project, which is very much a forensic investigation. Most if not all systems are currently performing substandard, causing comfort delivery issues and a myriad of associated problems: lack of capacity/redundancy, humidity control, Indoor Air Quality (IAQ), and of course excessive utility costs. Our collective ability to identify these performance issues and devise solutions is a core competency of ***Energy-Environment-Economics*** and is the essential means by which we can and will start to optimize your facilities. Facility audits provide an accurate baseline understanding of the existing systems and insights into energy and operations-related cost reduction opportunities.

Systems Commissioning services provide independent third party technical validation that installed equipment and systems operate as specified and will perform per the construction documents and designer's intent. Commissioning can be provided in conjunction with our suite of services, as it is during the Optimissioning℠ of a system, or may be provided as a stand-alone professional service. LEED compliance peer-to-peer and all required field Commissioning activities are available.

HVAC System Optimissioning℠ – a combination of Commissioning and our exclusive Optimal Performance Integration (OPI) techniques - services combine our analysis, innovative design, commissioning, and energy management acumen to obtain the desired outcome of the absolute lowest life cycle cost of ownership with no sacrifice of comfort. Our approaches to problem solving are driven from the group's unique combination of analytical skills, in-depth knowledge of building systems and the proper application of advanced technologies designed to help facility owners and managers minimize their HVAC-related operating costs, allocate capital more effectively and manage associated risks

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Energy Management Systems (EMS) Consulting Services help our clients to better understand how new and emerging technologies can be used to manage their operating costs more effectively. We routinely encounter EMS that are improperly applied, usually under-utilized, and in many cases are themselves contributors to excessive energy consumption. A detailed review of current EMS capabilities and usage will provide energy managers with an effective tool to maximize existing energy management capabilities.

Construction Administration Services assure sub-contractor compliance with the project's usually rigid schedule and with the construction documents' design and intent. Our B-1 licensed field inspectors provide detailed records of all construction activities, and quality control improves when we provide the engineering and project oversight. Combining these activities, as well as Commissioning and Optimissioning℠ activities, creates an environment that makes communication and problem solving seamless, flexible and very efficient. Our staff can deliver fast track projects from the initial assessment to full implementation, on-budget and on-schedule.

Risk Management and Compliance services provide our clients with important training and tools to help identify potentially dangerous or litigious situations and to more effectively manage their facilities. Code compliance and regulatory agency compliance reviews protect your business, and environmentally responsible (GHG) business practices will enhance your company's portfolio and standing in industry.

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Basic Company Information

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Key Personnel Information

In addition to our diverse staff experience, *Energy-Energy-Environment-Economics* maintains a network of sales, engineering, and construction alliances that affords a level of quality and experience unmatched by any company. As our staff has designed, installed, controlled, and commissioned hundreds of projects, we are a company that can provide true continuity throughout a project. Beginning with our project analysis, continuing into design development and complete construction document preparation, and culminating with our comprehensive Commissioning, Optimissioning℠ and construction management services, our systems and processes allow us to develop and implement HVAC optimization projects. At *Energy-Energy-Environment-Economics* we are capable of and committed to providing insightful technical analysis of design strategies, complete construction management for accelerated project completion, team building, and attainment of all project related goals.

Mr. D. Michael Ledbetter, P.E. is a graduate (1987) of Texas Tech University where he earned the degree of Bachelor of Science in Mechanical Engineering (BSME). Mr. Ledbetter is widely regarded as an expert in HVAC Systems, and is a co-founder of *Energy-Energy-Environment-Economics*, an HVAC Systems Commissioning and Optimissioning℠ Company.

Mr. Tripp Armstrong is a graduate (1988) of Arizona State University with a degree in Electrical Engineering (BSEE). Mr. Armstrong is an expert in direct digital control (DDC) systems, including the programming and application aspects of control systems. Mr. Armstrong has intimate familiarity with the design, installation, troubleshooting and commissioning of DDC controls systems, having designed and programmed countless systems.

Mr. Brad Hindes is a graduate (1988) with a Bachelors of Science in Mechanical Engineering (BSME) and has over 20 years of experience in the HVAC industry. The emphasis of his engineering degree is in Heating, Ventilating, and Air Conditioning (HVAC) systems. Mr. Hindes' HVAC systems experience, coupled with his intricate knowledge and experience with air conditioning equipment and control systems, makes him a valued and integral part of our staff of professionals.