Washington State Department of Enterprise Services

ESCO QUALIFICATION - PROJECT NO. 2013-133

22 FEBRUARY 2013

FOR THE LIFE OF YOUR BUILDING

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COMPANY NAME:
McKinstry Essention, LLC

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STATE OF WASHINGTON CONTRACTOR'S LICENSE:
MCKINEI942JQ

1. Experience

1. *The ESCO's experience in auditing and identifying energy efficiency projects. Provide a list of all energy performance contracting projects completed in the past two years (if the ESCO has completed more than 15 projects within Washington State in the past 2 years, the ESCO may list just the Washington State projects, in either case the list should be no longer than the most recent 30 projects), including contract value, client contact and client phone number.*

COMPANY EXPERIENCE

- 12 years as an ESCO
- 50 years as DBOM
- Public & Private Clients
  - >125 municipal/government
  - >450 commercial and industrial
  - >180 college and universities
- Currently auditing, implementing, or commissioning over 1,500 buildings/facilities.

PROJECT EXPERIENCE

- Projects ranging from $50,000-$20,000,000
- Systems ranging from packaged rooftop units to large central steam plants
- Sensible renewable energy options

Energy Efficiency Experience

McKinstry's experience includes a multitude of energy and utility conservation projects that reduce annual utility costs and upgrade aging, inefficient, and/or failing infrastructures. We provide integrated, turnkey solutions. Our approach not only expedites the identification of facility improvement measures and their associated annual energy/utility savings, but also provides our clients with detailed professional design engineering services and guaranteed construction costs for implementing the recommended infrastructure improvements.

McKinstry has developed many innovative solutions that meet our clients' financial and technical criteria. We systematically evaluate facilities and strategically focus on initiatives that have a high probability of implementation and an impactful degree of energy and utility savings. Our customers have consistently given us feedback that the projects we've implemented have exceeded their expectations in terms of innovation, quality, and realized savings.

Our auditing staff is made up of extremely knowledgeable energy engineers, commissioning engineers, and design engineers that have hundreds of combined years of direct auditing and field experience with existing facilities. Many of our design engineers and program managers are also professional engineers, adding expertise and value to the project development phase. We have the necessary proficiency to identify and assess all potential energy savings opportunities and infrastructure needs, and the integrity to ensure we will do everything in our power to deliver a thorough audit with well-thought-out recommendations for facility improvement.

2010-2012 PROJECT EXPERIENCE

McKinstry has completed a significant number of ESPC projects within the past two years. The table below is a sample of our most recent 30 projects demonstrating the broad range of facility types, project sizes, and project types we have implemented. One note of importance is that we are truly scalable as indicated in the contract value column. We scale up to handle the very large projects and just as readily scale down to provide full services to even the smallest of projects.

PROJECT NAME	CONTRACT VALUE	CLIENT CONTACT	PHONE NUMBER
Columbia School District	$547,681	Alysa Wiryrick (DES) Rod Pankey	509.533.8200 509.722.3311
Whitman County	$494,471	Alysa Wiryrick (DES) Bob Reynolds	509.533.8200 509.397.6263

1. Experience

PROJECT NAME	CONTRACT VALUE	CLIENT CONTACT	PHONE NUMBER
West Valley School District Ph 2.1	$1,439,912	Todd Flynn (DES) Tim Critchlow	360.902.7251 509.972.6030
WSU - Student Rec. Center Energy Upgrades Ph B	$472,139	Terry Ryan	509.335.9352
Keller School District	$255,797	Dave Iverson	509.634.4325
Sunnyside SD	$871,432	Kirsten Wilson (DES)	509.533.8282
Loon Lake School District	$58,116	Steve Waunch	509.233.2212
Cascade School District	$225,228	Steve McKenna	509.548.5885
Kennewick SD	$2,202,156	Chris McCarthy (DES) Keith Colee	509.315.6701 509.222.5867
Naches Valley SD	$1,122,839	Donna Albert (DES)	360.902.7248
City of Des Moines Upgrades	$304,520	Scott Romano	206.870.6539
Everett CC Phase 1	$530,272	Thom Watson	425.388.9516
King County MRJC phase 2/3	$1,752,744	Stephen Swinburn	206.296.0624
Mukilteo SD Phase 2	$2,832,692	Debra Fulton	425.356.1330
Highline SD Phase 2	$1240454	Frank Eshpeter	206.433.2252
Stanwood Camano Island SD - Phase 1	$1539536	Gary Platt	360.629.1215
North Thurston PS Phase 1	$1,146,669	Dean Martinolich	360.412.4500
Washington State DOT Materials Lab	$509,699	Bala Ramaya	360.902.7218
Peninsula College Phase 1	$587,230	Rick Croot	3604176553
Skagit Co Phase 1	$738,112	Kaci Radcliffe	360.419.7607
Thurston CO Phase 1	$722,308	Ed Burnet	360.786.5487
Tukwila SD Phase 2	$302,338	Linda Sebring	206.901.8003
Washington Department of Ecology	$2,531,023	Carol Fleskes	360.407.7012
University Place SD Phase 3	$2,740,869	Ruth Russell	253.566.5600
City of Everett	$477,259	Carlton Gipson	425.257.8916

1. Experience

2. Provide a matrix of the range of energy and utility management services provided by the ESCO, including the ESCO's capability to provide the following services: energy auditing, financing, design, general contracting, construction management/administration, testing and balancing, commissioning, warranty services, measurement and verification of savings, energy savings guarantees and facilitating utility participation to maximize utility rebates and incentives.

McKinstry does not typically use subcontractors during the design and development phase of each project. McKinstry's in-house experts will provide the construction documents for the build effort. For construction, we believe in and will focus on utilizing qualified, local firms to build/renovate the facility. This is important as it keeps the work in the local contractor community. McKinstry will actively manage the construction process with all of the selected contractors. Our desire to work collaboratively with our clients to select all sub-tier firms (consultants, contractors, vendors, etc.) has driven us to rarely commit to specific subcontractors until we have further discussion with our clients.

SERVICE	CORE COMPETENCY	SUB-CONTRACTED	CAPABILITIES
COMMISSIONING/*RETRO*-COMMISSIONING	X		New construction, modernization projects, existing buildings and facilities. McKinstry has a dedicated commissioning team independent of the project team that has worked with many different facility's lighting, security, HVAC controls, fire, electrical, and mechanical systems with varying degrees of complexity.
CONSTRUCTION MANAGEMENT/ ADMINISTRATION	X		Preconstruction planning and coordination; subcontractor and equipment procurement; safety management; quality management; schedule management; budget management; onsite supervision and coordination; and project closeout.
DESIGN	X	X (as needed)	We offer engineering, innovative value engineering solutions, financial modeling, drawing permitting and stamping, energy retrofits, sustainable design, operational modeling, integrated delivery, Building Information Modeling, CAD, CAD 3D and super plot drafting and detailing, Total Cost of Ownership analysis, and guidance for critical decisions, code compliance, system selection, LEED® certification and overall design process. We possess the in-house capability to design all aspects of energy and utility conservation systems including central plants (chilled water, hot water, steam), ventilation systems, lighting & lighting control, DDC/building control systems, plumbing, process piping, laboratory specialized HVAC, fire protection, and integrated fire detection metering, sustainability measures, and renewable energy.

1. Experience

SERVICE	CORE COMPETENCY	SUB-CONTRACTED	CAPABILITIES
ENERGY AUDITING	X		Our energy engineers have the technical expertise to develop energy models and analyze the various design scenarios. Our audits do not focus solely on how our clients can achieve energy savings; we look at total solutions, and we will use an innovative approach to evaluate all potential options for improvement, including renewable options for heating, cooling, and generation such as biomass, geothermal, solar, wind, etc. Our engineering-based approach to auditing, coupled with extensive site investigations and interviews will generate a project that meets all of your financial, facility, and operational objectives.
ENERGY SAVINGS GUARANTEES	X		McKinstry has provided detailed engineering studies on projects that range in size from $50,000 – $20,000,000 that included local utility rebates and resulted in significant annual energy and utility savings. The energy savings are derived from electrical, gas, water, and waste initiatives that are pursued. The energy savings are converted to a dollar figure (by using the units saved multiplied by the utility rate) and guaranteed up to 100%.
EQUIPMENT ACCEPTANCE TESTING	X		McKinstry can perform site acceptance testing using predictive maintenance technologies as an integral part of assuring equipment condition. McKinstry has invested in predictive maintenance technologies such as SPM bearing analysis, vibration analysis, motor circuit analysis, and ultrasonic detection to assess equipment condition and hold manufacturers accountable to the specifications and condition of the equipment they ship. Acceptance testing is performed in conjunction with the commissioning agent and does not replace commissioning, but enhances its effectiveness significantly.
FINANCING	X	X	McKinstry works with clients to find optimum financing solutions. We can direct finance projects if needed, however, we typically rely on financing solutions available in the marketplace. Financial services include Financial Modeling; Capital Optimization; Financing Options; and Securing Grants. Brokerage Services include Tax Exempt Lease Purchases; Private Placements; Tax Credit Bonds; Capital Leases; Shared Savings Agreements; Power Purchase Agreements; and Public/Private Partnerships. Tax Advantaged Strategies include Energy Efficiency Commercial; Buildings Tax Deduction (EPAct); Investment Tax Credits; Production Tax Credits; Modified Accelerated Cost; and Recovery System. High Performance Design Build Services include New Markets Tax Credits and Historic Tax Credits.

1. Experience

SERVICE	CORE COMPETENCY	SUB-CONTRACTED	CAPABILITIES
GENERAL CONTRACTING	X	X	McKinstry can provide the following services with our internal staff: provision of material, labor, equipment, and services, hiring of subcontractors, procurement of building permits, site security, managing personnel on site, site surveying and engineering, disposing of or recycling construction waste, monitoring schedules and budget, and maintaining records. We do not maintain a general contracting workforce and will subcontract these elements to qualified local firms.
MAINTENANCE	X		McKinstry does not require a maintenance contract as a condition of the performance contract; however, we do have a complete service group that stands ready to assist clients as needed with their maintenance needs. Our operational strategy is guided by our clients' needs and direction. Many of our clients have the in-house resources to maintain and operate their facilities. For each project, we develop an engineered maintenance plan that lists the various service tasks and frequency for all of the applicable system components. This plan will be developed with your maintenance staff early in the design process to improve future service levels. This comprehensive approach helps you to optimize system performance and life. In cases where clients do not have the resources or do not wish to operate their systems, McKinstry can provide these services.
MEASUREMENT & VERIFICATION	X		McKinstry adheres to the International Performance Measurement and Verification Protocol (IPMVP) in performing M&V procedures. Our logging equipment includes electrical logging meters, light level meters, combustion efficiency testing equipment, HOBO micro data loggers, indoor air quality logging, ultrasonic meters, air flow measurement devices, water flow measurement devices, utility manager accounting software, Metrix utility accounting software, and a remote monitoring station staffed 24x7
PROJECT STABILIZATION	X		McKinstry supports customers in a transition from their current facility project to operation of the facility. Our solution encompasses three phases: Project Closeout (capture of system knowledge, components, and features; acceptance and training), Initial Occupancy (standardized methods and procedures to manage and maintain the equipment), and Stabilized Occupancy (highly trained personnel utilizing the standardized processes).

1. Experience

SERVICE	CORE COMPETENCY	SUB-CONTRACTED	CAPABILITIES
REMOTE MONITORING	X		Twenty-four hour remote monitoring is one of our specialties; we monitor buildings throughout the United States. Via a modem, network connection, and building DDC controls we are able to check system operations, temperatures, and foresee potential problems. Many adjustments to system operation such as temperature set points, schedules, and air volumes can be performed remotely—eliminating many emergency service calls.
SYSTEM OPERATIONS POST INSTALLATION	X		McKinstry's strong background in engineering, construction, and commissioning enables us to deliver reliable systems that perform as designed throughout the life of the initiative. Developing long-term relationships with our customers is of critical importance to us. To that end, McKinstry provides you with a single point of accountability to contact should issues arise with any of your systems. McKinstry's operational strategy is guided by the needs and direction from the client. Many clients have the in-house resources to maintain and operate the installed systems. In cases where clients do not have the resources or do not wish to operate their systems, McKinstry can provide these services.
TESTING & BALANCING	X	X	McKinstry has the capability, experience, and manpower to provide complete test and balance services on all projects. We also subcontract this work when appropriate. When we self perform, McKinstry performs all Testing and Balancing (TAB) work in accordance to the National Environmental Balancing Bureau (NEBB). McKinstry is an NEBB certified firm (certification No. 2728). NEBB Qualified Supervisors perform or supervise all TAB work. Final TAB performance data is recorded onto appropriate forms where it is compared to the designed performance criteria given. In the event a system is not meeting the design intent, McKinstry's project manager, commissioning manager, and design engineer are immediately notified. A resolution is worked through in a timely manner.
TRAINING	X		Onsite training session for all appropriate aspects of the project with an engineer. If appropriate, onsite training by the vendor. As part of the training program, McKinstry provides instruction on a proper maintenance plan and strategy.
UTILITY REBATES & INCENTIVES	X		McKinstry has 20+ years of rebate capture experience and have secured over $15 million of rebates for our customers in the last five years. We are familiar with a variety of utility company's programs and people.

1. Experience

SERVICE	CORE COMPETENCY	SUB-CONTRACTED	CAPABILITIES
WARRANTY SERVICES	X		Development and management of the warranty issue work order process; 24x7x365 Operations Center to handle work requests; Management of the vendor dispatch process; Tracking and follow up on completion of work; Routine vendor performance reporting; Follow up with customer and project team on work satisfaction; Ongoing equipment status details; Detailed warranty issue work information including the time issue was logged, progress on the issue, and confirmation the issue is resolved; and Warranty preventative maintenance management and scheduling.
WEB BASED PROJECT MANAGEMENT	X		Workflow Process Development/Management; Control System Support & Service; Central Repository for All Facility Documentation; 24x7x365 Customer Service & Issue Management; Event Scheduling & Management; Key Performance Indicators Development & Management; Facility Asset Management; Facility Business Reporting; Computerized Maintenance Management System; Vendor/Service Provider Management; Facility Issues Prioritization, Dispatch & Tracking

1. Experience

3. The ESCO's experience with measurement and verification (M&V) processes. The ESCO should describe its familiarity with M&V protocols and when each is most appropriately applied.

KEY POINTS:

- McKinstry will guarantee up to 100% of energy savings
- McKinstry adheres to the International Performance Measurement and Verification Protocol (IPMVP)
- All savings, including excess savings, go to the client
- McKinstry will reimburse the client for any guaranteed savings shortfalls
- McKinstry will develop a detailed M&V plan that focuses on preserving true savings

Measurement & Verification of Energy Savings

McKinstry relies on sound engineering practices and industry accepted tools and methodologies in developing baselines and calculating savings associated with specific initiatives. We rely on the International Performance Measurement and Verification Protocol (IPMVP) as the starting point of all M&V discussions. We strive for our baseline and savings calculations to be an accurate representation of the facility's operations, presented in an easy to understand format, and with associated parameters that can be measured and verified.

Our personnel, including energy engineers and energy auditors, will gather the information needed to establish an accurate energy performance baseline. Many of these individuals are licensed professional engineers and/or Certified Energy Managers and have the knowledge and skill set needed to evaluate systems, gather data, and accurately model and calculate energy performance.

McKinstry owns more than $280,000 of logging equipment to deploy on projects to gather field measurements and trend data. These tools include: electrical logging meters, light level meters, combustion efficiency testing equipment, HOBO micro data loggers, indoor air quality logging, ultrasonic meters, air flow measurement devices, water flow measurement devices, EEM Suite utility manager accounting software, Metrix utility accounting software, and a remote monitoring station staffed 24x7.

M&V is a continuous process that McKinstry manages through the duration of the project. After the facility improvement measures have been implemented in construction and setup, and verified through our comprehensive commissioning process, the actual verification of the savings can commence.

We rely on our energy engineers and commissioning agents to perform all the field work necessary to verify performance and gather relevant data. This inclusive dataset is then handed over to our team of M&V analysts that provide a customer-centric review of the information and publish the M&V reports. This handover from the field staff to the M&V analysts allows any designer bias to be eliminated and, in our experience, generates greater benefits for the customer. In addition, as required by the project scale, we deploy the resources of our Remote Operations Center (ROC) and Knowledge Response Center (KRC) to capture additional operation information from the building automation systems. The ROC and KRC teams also have the ability to "tune" the performance of the building based on live data, including but not limited to, trends and alarms notifications.

STANDARDS FOR QUALITY

McKinstry adheres to the International Performance Measurement and Verification Protocol (IPMVP) in performing M&V procedures. This internationally recognized standard provides several different avenues for verifying a particular measure:

- Measure and Monitor
- Measure and Stipulate
- Multivariate Utility Bill Regression
- Standard Utility Bill Comparison

All M&V is designed to cover three critical aspects for each project; namely that it is reliable, robust and cost effective. We believe the best value to the customer is in providing in depth operation verification of each measure. This type of M&V allows us to eliminate the impact of any external factors and demonstrate the

savings achieved directly. This method also allows the customer's facility staff to review and confirm the actual operation of their systems and ensures that the savings persist. If the measures have a significant impact on the total consumption as measured by a utility meter (electricity, gas, water, sewer) we employ utility bill comparison methods to verify savings and statistical analysis, such as regression and root mean squared error calculations, to validate performance.

M&V Option	Savings Calc. Method	Critical Attributes/Where Used
Option A *Based on measured equipment performance, measured or stipulated operational factors, and annual verification of "potential to perform."*	Engineering calculations with some measured data	▪ ECMs where performance remains constant, usage can be readily characterized, and uncertainty is not a major issue ▪ Actual energy or cost savings are not verified ▪ Used where savings is predicted using engineering or statistical methods ▪ Uses historical data for operational factors (occupancy schedule etc.) ▪ May use spot or short-term but no long-term measured data to estimate performance factors ▪ Includes primarily verification activities such as physical assessment of equipment changes ▪ Cost is 1-5% of project construction cost
Option B *Based on periodic or continuous measurements taken throughout the term of the contract at the device or system level.*	Engineering calculations using measured data	▪ ECMs where actual savings (energy and cost) during contract need to be determined, based on end-use ▪ Involves long-term measurements for both performance and operational factors ▪ M&V can be performed at the equipment or system level and goes on for the term of the project ▪ Same procedures as Option A plus measurement of pre- and post-installation energy use ▪ Cost is 3-10% of project construction cost)
Option C *Based on whole building or facility-level utility meter or sub-metered data adjusted for weather and/or other factors.*	Analysis of utility meter data	▪ Properly defined baseline conditions ▪ Projects where actual savings (energy and cost) during contract need to be determined, based on end-use ▪ Utility whole-facility meter analysis and/or computer simulation calibrated with utility billing data. Savings determined by "whole facility" ▪ Same procedures as Option A plus measurement of pre- and post-installation energy use ▪ Requires savings to be significant (>20% of baseline consumption) ▪ Cost is 1-10% of project construction cost
Option D *Based on computer simulation of building or process; simulation is calibrated with measured data.*	Comparison of different calibrated models	▪ Use of a calibrated simulation tool to estimate "before" and "after" use ▪ Simulation of whole building or just end use ▪ Building simulation model (e.g. DOE-2; eQuest), or a spreadsheet, or VSD estimating program, etc. ▪ Calibration is done by linking simulation inputs to actual operating data and comparing the results with end-use or whole building data. ▪ Calibration used for new buildings/complex existing building systems. ▪ The cost is 3-10% of project construction cost.

1. Experience

4. The ESCO's experience designing, costing and managing the construction of heating plants (including steam), chilled water plants, heating ventilation and air conditioning systems, heat recovery, energy management and control systems, lighting and lighting control systems, water efficiency, and other utility system improvements including renewable.

KEY POINTS:

- Our engineers do not work behind the scenes; they work on-site and directly with the team to ensure designs take into account unique considerations, constructability, and ongoing maintenance issues.
- We have decades of historical estimating information we refer to when budgeting projects. We provide construction grade, not engineering grade, estimates.
- We are vendor neutral; however, we do have a number of staff members that are well versed in various control systems due to the years of experience in working with them.

ENGINEERING & DESIGN

McKinstry's engineering and design knowledge is powered by our depth of highly skilled engineering staff and by our unique position in the ESCO industry as a 50-year-old full service "Design *and* Build *and* Operate" company. Although we may not install all energy projects with McKinstry trades people, our engineering knowledge capital has increased substantially due to our design/build/operate cycle of services.

Our engineers have access to trades people and construction professionals that allows for a blend of strong engineering with real world construction expertise. Furthermore, having designs reviewed by service professionals at McKinstry allows understanding and respect for what it takes to maintain equipment and systems after the implementation.

McKinstry has registered Professional Engineers, designers, and CAD staff. Our dedicated engineering group of engineers is well versed in design and code requirements in Washington State. In addition, we have been involved for the past several years with sustainable design concepts and organizations such as the U.S. Green Building Council.

HEATING & CHILLED WATER PLANT EXPERIENCE

We have designed in excess of 30,000 tons of chilled water plants in the last decade, and a significant number of heating plants (steam and hot water). McKinstry has delivered 20+ central plants in the past five years. A sample of clients we've provided these plants to includes:

- AboveNet Data Center
- AT&T Wireless HQ
- Boeing Corporation
- Colo.com
- Columbia Data Center
- Fisher Plaza
- James Tower
- King County Courthouse & Correctional Facility
- Oregon Health & Science University
- Seattle Art Museum
- Seattle University, Lemieux Library
- Unico Financial Center, IBM Building & Puget Sound Plaza
- University of Idaho
- University of Washington School of Medicine
- Valley Medical Center (multiple phases)
- Washington Mutual Center
- Washington State Capital Campus
- Washington State University
- Yakima School District

1. Experience

HVAC EXPERIENCE

We have designed, optimized, and built all types of ventilation systems, including variable air volume, constant volume, dual duct VAV, building and system pressurization issues, fan replacement strategies, fan array technology, coil cleaning, air-to-air heat recovery, demand ventilation, air balancing issues, commissioning and retro-commissioning of air systems, and other areas of expertise.

We have also performed the detailed hardware engineering, wiring diagrams, and software programming for hundreds of energy management control systems. Our indoor air quality experience includes CO_2 analysis for conditioned spaces and CO measurement and analysis for various HVAC systems.

Our cooling experience includes DOE 2.2 modeling analysis, high efficiency equipment upgrades, environmentally friendly refrigerant replacement, absorption chiller and cogeneration analysis, variable flow upgrades, pumping strategies, chilled water system modeling, evaporative cooling, ground source cooling, and other areas of expertise.

HEAT RECOVERY

Our experience includes DOE 2.2 modeling analysis and custom calculations focusing on heat recovery, combined heat and power analysis. We have provided steam and hydronic systems upgrades, boiler upgrades and replacements, and coil cleaning for a variety of facilities, including swimming pool centers, data centers, and laundry facilities.

EXPERIENCE WITH ENERGY MANAGEMENT CONTROL SYSTEMS

Most energy projects typically include an energy management system upgrade component. Our staff is very knowledgeable on the writing of specifications, sequence of operations, and point lists to ensure that functionality and configuration of the specific control system is optimized and energy savings are maximized.

We have had an excellent working relationship with Siemens, Johnson Controls, Invensys (CCI), Alerton (ATS), and other major vendors for many years. We have worked with each vendor on hundreds of projects with great success. Involvement in the construction activities through the years has given us an excellent understanding of their systems and operations. We also have been involved at a building operations level while working with their systems in buildings we now service and maintain. In addition, McKinstry has an in-house remote monitoring system with a total of nine control system interfaces.

We not only have an excellent working relationship and experience with these outside manufacturers, we also have an entire team in-house that is strictly devoted to finding and providing energy management solutions for our customers. Our leadership in the development and procurement of integrated technologies provides overarching solutions to energy management systems, fire alarm, security, CCTV, data, monitoring, etc. resulting in lower procurement costs while creating a much more efficient and reliable system architecture. We can bring this expertise to the Owner to properly analyze the very best value-based solution to the controls for each project.

1. Experience

McKinstry projects have eliminated 354,478 metric tons of CO_2 emissions in the past nine years, which equates to planting 21.2 million trees or removing over 67,778 cars from local highways

McKinstry
For The Life Of Your Building

LIGHTING EXPERIENCE

Lighting is a core competency of McKinstry's; we offer innovative lighting solutions beyond the typical lamp and ballast retrofit. Our range of services and technical abilities include standards review, LEED® and sustainability design guidance and oversight, purchasing and inventory control, operations standardization, and lighting design for major building renovation and new construction projects.

Lighting Design
Schematic design, design development, and construction documentation; concept development, luminaire selection, initial layout, layout refinement, lighting controls design, code compliance analysis, and bid documentation.

Advisory Services
LEED certification, rebate acquisition, code compliance, and standards review.

Visualization Methods
Photometric calculations, photo-realistic renderings and physical mock-ups at construction-grade cost estimates.

WATER EFFICIENCY EXPERIENCE

McKinstry has developed and implemented many water based efficiency measures (irrigation, flow reducers, reduced flow urinals, etc.), and even solid waste conservation measures such as solid waste pulpers and trash compaction systems. We provide field auditing and analysis of building water use, including toilets, urinals, lavatories, showers, kitchen equipment, single-pass condensers, cooling towers, chilled water systems, and boilers. We also provide irrigation audit facilitation.

RENEWABLE SYSTEM DESIGN

McKinstry is dedicated to and focused on renewable energy systems. We consider renewable energy components for every project and every client we serve. We have implemented projects both as standalone solutions and as part of blended energy efficiency projects with non-renewable components. We have developed our own Renewable Energy Profiling software to aid in this complicated interaction and analysis.

We have extensive staff experience with renewable energy systems, including: photovoltaic, solar heating, wind energy, heat & power biomass, heat only biomass, and ground coupled heat pump systems, to name a few. We also have experiences developing unique solutions for tire recycling, waste oil re-use, alternative fuel plants—biodiesel & ethanol, and landfill gas systems.

Our experience includes feasibility, energy, and cost analyses of onsite renewable energy, including solar-electric, solar-thermal, geothermal, and biomass, development of renewable projects in cooperation with utility, state, and federal incentives. We are also experienced in the use of owner-directed systems (independent from product industry).

1. Experience

5. The ESCO's experience securing utility incentives for its customers. Discuss successful strategies implemented for maximizing utility incentives.

KEY POINTS:

- >20 years of rebate capture experience
- >$20 million dollars of rebates for our customers
- McKinstry understands rebate success relies on the nuances of each utility company's program and people and energy analysis.
- McKinstry works to get written confirmation of the incentive amount before the energy services proposal in presented.

MAXIMIZING UTILITY INCENTIVES

Seeking and securing utility incentives for our clients is a critical part of the financing ability an ESCO brings to a performance contract. Typically, the conservation programs provide certain guidelines that must be met throughout the development of the project in order to qualify for a rebate or incentive program. Incentives and rebates are paid directly to the owner with McKinstry operating as an advocate for the owner. A representative from the utility's conservation program is an important member of the project team to ensure that all necessary milestones are met from the utility's perspective.

Our experience with the local rebate programs will prove to be invaluable to the owner. McKinstry has strong relationships with Seattle City Light, Seattle Public Utilities, Avista, Snohomish PUD, Puget Sound Energy, Cascade Natural Gas, Northwest Natural Gas, LOTT, and Grant County PUD, to name a few. These strong relationships ensures that a level of success that will continue throughout the performance contracting process for our clients.

APPROACH

The approach to securing funding from local utilities typically proceeds in the following manner:

- McKinstry contacts the applicable utility during the preliminary scoping phase in order to outline the potential project. Utility requests that a proposal or specific forms to be completed, describing the project and intended audit and calculation methodology.
- Once the methodology is approved by the utility, the audit and calculation proceed as planned. McKinstry presents the final study to all parties.
- The utility reviews the information provided and issues a letter of authorization or intent stating the amount or type of funding secured for the project. This letter may also contain a description of construction deliverables required, as well as a measure & verification (M&V) plan that is required at the end of construction.
- McKinstry communicates with our clients and utility partners throughout construction and M&V to make sure all requirements for obtaining the rebate are achieved and the client receives their incentive payment.

This partnering approach eliminates end-of-project conflicts regarding funding levels, and will help to expedite the final incentive payments to the owner.

1. Experience

6. A description of the experience key staff have, who are responsible for administration of any potential work awarded thru this project. This is to include any sub-consultants routinely used for execution of performance contracting work. This is not to be the resumes or curriculum vitaes (CVs) of personnel. Resumes or CVs may be attached as an appendix. Please indicate if the experience was obtained at other than this ESCO. Please identify the responsible licensed P.E.

The McKinstry Team managing projects across the State of Washington has proven they have the skills, knowledge, and attitude required to complete projects on time and within budget. The table below presents key staff who will be responsible for delivery of ESPC projects, from preliminary audit through measure & verification. Detailed resumes are included in Appendix B.

Name	Role on Project	Energy Audits	Financing	Design	General Contracting	Construction Mgmt./Admin	Testing & Balancing	Commissioning	Warranty Services	M&V	Energy Savings Guarantees	Utility Rebate Capture	HVAC Systems	Lighting & Lighting Control	Building Envelope	Renewables	Professional Credentials	Level of Expertise	Base Location
Brandon Adams	Project Director leads Program Management team for audit and development processes	X	X	X	X		X	X		X	X	X	X	X	X	X	Certified Energy Manager, AEE; Nationally Certified Sustainable Building Advisor	10 years	Portland
Cory Wiltshire	Construction Manager performs supervisory oversight on construction projects	X			X	X		X	X	X	X	X	X	X	X	X		4 years	Portland
Damon Rutherford	Commissioning Engineer performs design and construction commissioning services	X				X	X	X	X	X	X		X	X	X		Building Commissioning Association accreditation and current BCxA Board Member	6 years	Portland
David Baysinger	Account Executive responsible for client relationship through all project phases		X	X	X	X	X	X	X		X		X	X	X			30 years	Portland
Dennis Oberto	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X			X	X	X	X	X	X	X	X	X	X	LEED AP BD+C; Green Building Certification; PPL – FinAnswer Commissioner; USDOE – IBP; BPA - Level I, II & III Analyst & Inspector; OUS - Master Conserver	30 years	Portland
Felix Kersting	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X			X	X	X	X	X	X	X	X	X	X	P.E.	14 years	Portland
Gabe Johnson	Account Executive responsible for client relationship through all project phases		X		X					X	X	X	X	X	X	X	MBA, Certified Energy Manager, PE	12 years	Portland
Jason Carver	Performance Assurance Specialist provides measurement and verification and related services	X				X	X		X	X	X	X	X	X	X	X	ASHRAE; IPMVP CMVP	8 years	Portland
Joe Fuetsch	Program Manager leads audit and development processes	X	X	X	X	X			X	X	X	X	X	X	X	X	Association of Professional Energy Managers	9 years	Portland
Jon Eicher	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X			X	X		X	X	X	X	X	X	X	P.E.	7 years	Portland

1. Experience

Name	Role on Project	Energy Audits	Financing	Design	General Contracting	Construction Mgmt./Admin	Testing & Balancing	Commissioning	Warranty Services	M&V	Energy Savings Guarantees	Utility Rebate Capture	HVAC Systems	Lighting & Lighting Control	Building Envelope	Renewables	Professional Credentials	Level of Expertise	Base Location
Kevin Goad	Account Executive responsible for client relationship through all project phases		X			X			X		X		X	X			LEED Green Associate	12 years	Portland
Kirk Carl	Commissioning Engineer performs design and construction commissioning services	X				X	X	X	X	X	X		X	X	X	X	EPA Universal Refrigeration CFC Certified; OSHA Forklift Operator Trainer Certified; Green Plumbers Certificate; Certified Quality Assurance Inspector for USN	19 years	Portland
Matt Axtell	Project Engineer Construction provides site supervision on construction projects	X		X	X	X		X	X	X	X	X	X	X	X			4 years	Portland
Mike Shadley	Senior Construction Manager manages construction services		X		X	X	X	X	X	X	X	X	X	X	X	X	Construction Management Association of America	22 years	Portland
Tom Konicke	Portland Energy Operations Manager	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P.E., LEED AP, Building Commissioning Professional	20 years	Portland
Trey Scavone	Account Executive responsible for client relationship through all project phases		X		X	X	X	X	X	X	X	X	X	X	X	X		19 years	Portland
Andrew Williamson	Account Executive responsible for client relationship through all project phases		X								X	X					LEED AP	Three years	Seattle
Ben Woodhouse	Lighting Project Coordinator leads lighting portions of the development phase (UDA, savings, guarantee, rebate, and schematic design)	X		X		X	X	X		X				X					Seattle
Brian Hanson	Senior Project Director leads Program Management team for audit and development processes	X	X	X	X	X				X	X	X	X	X	X	X	P.E.	21 years	Seattle
Dave McClain	Construction Manager manages construction services				X	X			X									19 years	Seattle
Dave Robinaugh	Construction Manager manages construction services				X	X			X								LEED AP, OSHA 30, MCAWW CMPM 1	Four years	Seattle
Gerry Galvin	Program Manager leads audit and development processes	X	X							X	X	X					P.E.	18 years	Seattle
Heather Helgen	Construction Manager manages construction services				X	X			X								CMM, LEED AP	13 years	Seattle

1. Experience

Name	Role on Project	Energy Audits	Financing	Design	General Contracting	Construction Mgmt./Admin	Testing & Balancing	Commissioning	Warranty Services	M&V	Energy Savings Guarantees	Utility Rebate Capture	HVAC Systems	Lighting & Lighting Control	Building Envelope	Renewables	Professional Credentials	Level of Expertise	Base Location
Jessica Sanders	Mechanical Engineer develops detailed mechanical drawings and specifications based upon existing field conditions and meeting code requirements as they apply	X		X		X							X		X	X			Seattle
Jonathan Schwenke	Lighting Project Manager leads lighting team and portions of the development phase (UDA, savings, guarantee, rebate, and schematic design)	X		X		X		X	X	X	X	X		X			IES Certification ED 100 & 150	Five years	Seattle
Justin Fallstrom	Construction Services Manager manages construction services				X	X			X									13 years	Seattle
Katie Rossman	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X						X	X	X	X		X	X	P.E., LEED AP	Six years	Seattle
Kristina Sing *Responsible Licensed P.E.*	Engineering Manager manages design engineers and develops detailed mechanical, electrical and plumbing drawings and specifications	X		X		X							X	X	X	X	P.E., LEED AP, Certified Sustainable Building Advisor	18 years	Seattle
Mark Foster	Account Executive responsible for client relationship through all project phases	X	X								X	X	X	X	X	X		10 years	Seattle
Mark Nieman	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X						X	X	X	X		X	X	P.E.	17 years	Seattle
Matt Montagner	Program Manager leads audit and development processes	X		X						X	X	X	X		X	X	P.E. In Training	13 years	Seattle
Mike Dean	Business Development Director Pacific NW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Steam Engineers License	25 years	Seattle
Norm Foster	Construction Manager manages construction services				X	X			X								P.E.	39 years	Seattle
Robert Hail	Project Director leads Program Management team for audit and development processes.	X	X							X	X	X	X	X	X	X	P.E., CEM, LEED AP	14 years	Seattle
Ron Fues	Technical Engineering Manager manages engineering team and designs facility improvements, builds energy models, calculates guaranteed energy savings	X	X	X						X	X	X	X	X	X	X	Healthcare Facility Design Professional, P.E., LEED AP	15 years	Seattle

1. Experience

Name	Role on Project	Energy Audits	Financing	Design	General Contracting	Construction Mgmt./Admin	Testing & Balancing	Commissioning	Warranty Services	M&V	Energy Savings Guarantees	Utility Rebate Capture	HVAC Systems	Lighting & Lighting Control	Building Envelope	Renewables	Professional Credentials	Level of Expertise	Base Location
Seth Davis	Mechanical Engineer develops detailed mechanical drawings and specifications based upon existing field conditions and meeting code requirements as they apply	X		X		X				X			X		X	X	P.E.	13 years	Seattle
Mike James	Project Director leads Program Management team for audit and development processes.	X	X	X						X	X	X	X	X	X	X	P.E., LEED® AP, CEM		Spokane
Stewart De La Hunt	Construction Manager manages construction services				X	X			X				X	X	X	X			Spokane
Erik Bondo	Construction Manager manages construction services				X	X			X				X	X	X	X			Spokane
Derek Larson	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X						X	X	X	X	X	X	X	P.E.		Spokane
Rob Sawyer	Program Manager leads audit and development processes	X	X	X						X	X	X	X	X	X	X	P.E. LEED® AP, CEM		Spokane
Jared Haight	Project Engineer responsible for completing quality HVAC designs using the latest technologies to optimize system performance and energy savings			X			X				X	X	X	X	X	X	P.E. LEED® AP		Spokane
Matt Ophardt	Energy Engineer designs facility improvements, builds energy models, calculates guaranteed energy savings	X		X						X	X	X	X	X	X	X			Spokane
Mike Phenicie	Commissioning Engineer performs design and construction commissioning services						X	X	X	X			X						Spokane
David Moore *Responsible Licensed P.E.*	Engineering Manager manages design engineers and develops detailed mechanical, electrical and plumbing drawings and specifications	X		X									X	X	X		P.E. LEED® AP		Spokane
Mike Lubbering	Performance Assurance Specialist provides measurement and verification and related services							X		X	X	X	X	X	X	X			Spokane
Casey McGourin	Program Manager leads audit and development processes	X	X	X						X	X	X	X	X	X		P.E.		Spokane
Bob Eggart	Operations Manager, INW	X	X		X	X			X	X	X	X	X	X	X				Spokane

1. Experience

Name	Role on Project	Energy Audits	Financing	Design	General Contracting	Construction Mgmt./Admin	Testing & Balancing	Commissioning	Warranty Services	M&V	Energy Savings Guarantees	Utility Rebate Capture	HVAC Systems	Lighting & Lighting Control	Building Envelope	Renewables	Professional Credentials	Level of Expertise	Base Location
Janet Janes	Project Engineer Construction, provides site supervision on construction projects				X	X			X				X	X					Spokane
Dale Silha	Business Development Manager INW	X	X					X	X	X	X	X	X	X	X	X	CEM		Spokane
David Ray	Account Executive Spokane / K-12 Focus, Responsible for client relationship through all project phases	X	X									X	X	X	X				Spokane
Jayson Schmidt	Sales Engineer Spokane / County & Municipalities. Responsible for client relationship through all project phases	X	X									X	X	X	X				Spokane
Mark Jonson	Business Unit Manager INW	X	X			X			X		X	X	X	X					Spokane
Subcontractors — None currently proposed.																			

INDUSTRY PARTNERS

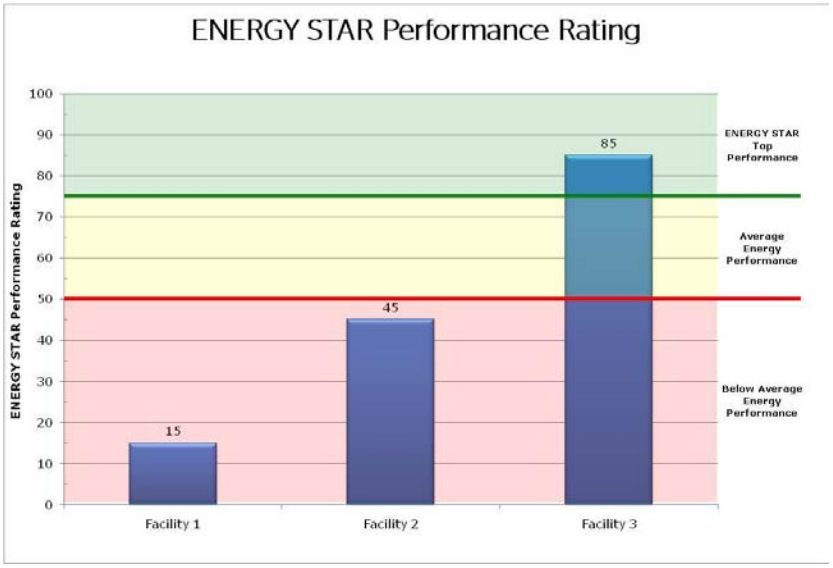
Additionally we have strong relationships with various consulting firms, which are built on a high level of integrity and competitive pricing; we are always interested in working with the owner's select design team if it is appropriate. Their prior knowledge of the facility is most often very valuable and results in lower design fees as a result of not recreating documents.

1. Experience

7. A description of the ESCO's familiarity with EPA's Energy Star Portfolio Manager and other benchmarking tools.

ENERGY STAR Consulting

McKinstry is aware that a recent law requires Washington State agencies, colleges, and universities to use ENERGY STAR® Portfolio Manager to benchmark the energy performance of buildings that they own or lease, and it requires General Administration to report the results to the public. McKinstry has provided energy engineering expertise to help clients achieve ENERGY STAR Certifications for many years.



FACILITY BENCHMARKING

McKinstry's sustainability consulting team begins the ENERGY STAR certification process begins by benchmarking the desired facilities using ENERGY STAR's Portfolio Manager. Benchmarking through Portfolio Manager allows top-performing buildings to earn the ENERGY STAR Leaders recognition, a national symbol for protecting the environment through energy efficiency. The rating system's (1–100) scale allows users to quickly understand how a building is performing — a rating of 50 indicates average energy performance, while a rating of 75 or better indicates top performance. Facilities that show a significant reduction in normalized energy use or achieve a 75 rating average, can earn the ENERGY STAR Leaders recognition.

Based on basic utility use information collected during a preliminary survey, the chart below displays an example of how facilities would be scored on the ENERGY STAR Facility Performance Rating System.

ACTIONS TO BE PERFORMED FOR CERTIFICATION

If facilities are eligible to pursue an ENERGY STAR certification, there are some additional parameters that will need to be analyzed beyond utility use data. These include:

- Review the current Energy Star building metrics. Including review of EPA Portfolio Manager to verify the accuracy of existing operating data, as well as building square footages, operating hours, occupancy count, and the number of computers.
- Interview building operators regarding building operation and performance.
- Review mechanical system plans and schedules to understand system operation and streamline the site visit.
- Perform an audit of the site to investigate indoor environmental quality by testing light levels, temperature, relative humidity and CO_2 concentrations. Verify function of air handling unit dampers and airflow to building occupants.
- If the building meets quality standards for an Energy Star Label based on utility use and onsite testing, a Certified Professional Engineer will review, stamp, and submit the data collection and paperwork.
- Follow up with the EPA and determine the status and results of the label application.

1. Experience

OTHER BENCHMARKING TOOLS

Another common benchmarking tool McKinstry is very familiar with is LEED. We provide key leadership and expertise to help our clients achieve LEED Certification for both new and existing facilities when desired. From project conception through completion, our consultants guide you through the LEED process using our extensive experience in both the administrative and engineering aspects of these rating systems. Our depth of knowledge in design, construction, operations, and maintenance of facilities sets our consulting team apart from other LEED consultants. Using a collaborative approach with building owners, designers, operators, and builders, we develop cost-effective, tailored solutions and consistently deliver LEED ratings beyond our clients' expectations.

On average, energy upgrades typically have a substantial rate of return and are low risk. Building Owners and Property Managers are beginning to consider internal earnings growth - a result of improved energy performance -- as a viable value-creation strategy. Boosting a facility's financial performance by lowering operating costs and improving infrastructure allows property managers and facility managers to make their buildings more competitive, profitable and valuable to the communities they serve.

NOTABLE LEED CERTIFICATION PROJECTS:

McKinstry's Spokane Headquarters — McKinstry recently completed converting a turn-of-the-century railroad shop and warehouse into over 56,000 sq. ft. of green office and mixed-use space that incorporates energy-efficient design and renewable energy systems. The renovated Great Northern Building includes ground-source heat pumps, radiant panels, and a rainwater harvesting system. McKinstry achieved LEED Gold Certification as well as a historic preservation award on this project. McKinstry's Sustainability Consulting Group worked with the design and architecture teams to ensure that all plans were consistent with the project's environmental goals, and guided the construction team on green construction practices. This brick-walled facility on the shores of the Spokane River is a shining example of how sustainable renovation can integrate efficiency measures into historic buildings that preserve our connection to the past.

Avista Utility Headquarters, LEED-CI Gold — Avista Utilities selected McKinstry to manage a series of tenant improvement projects and LEED certifications throughout its Spokane headquarters campus. The renovations started on the fifth floor and have been working down through the building. To date, floors 3, 4, and 5 have achieved LEED-CI Gold certification.

McKinstry's Seattle Headquarters — Over the past decade, McKinstry has converted an aging warehouse complex in the Georgetown neighborhood of Seattle into a higher efficiency facility that serves as the company's national headquarters. Hundreds of tenant improvements, including new roofing and under-floor air systems, have been made to the property. Sections of the renovations McKinstry are being pursued LEED Silver or LEED Gold certifications.

1. Experience

8 A discussion of problems experienced on projects and the remedy for those problems.

INTRODUCTION

McKinstry works hard at identifying potential problems on projects and putting in place strategies to minimize or eliminate these problems prior to occurring. We do this by having a documented process that each project undergoes that looks all aspects of a project from start to finish. With that said, we do experience problems throughout the course of our projects at times. Our commitment is to find solutions to any problems that arise and ultimately deliver projects that meet the needs of our clients.

After projects have been completed, we also hold discussions to review what went well on our projects, as well as what problems arose and how those problems were overcome. Taking an introspective approach to how we identify, manage, and overcome problems has served as well, as the lessons we have learned are then communicated throughout our organization. We will never be perfect, but we always strive to make our delivery as efficient as possible, minimize problems and challenges, deliver great results to our clients, and cement a positive outlook of the ESPC program in the minds of our customers.

The matrix on the following page provides some specific examples of problems that can occur in a performance contract and how we manage against these areas of potential challenge.

1. Experience

PHASE OF PROJECT	POTENTIAL PROBLEM	DESCRIPTION OF PROBLEM	ASSUMPTION OF RISK	LEVEL OF RISK TO CLIENT	METHODS OF MINIMIZING AND MANAGING PROBLEM	EXAMPLE OF THE PROBLEM
Preliminary Assessment and Project Planning	Wrong information provided to ESCO	Wrong information can be provided to the ESCO. This includes: Utility Bills that are incomplete, wrong account numbers, undisclosed or inaccurate information	Shared Risk of ESCO and Client, with emphasis placed on ESCO to verify the proper information	Low (Since client is not committed to proceed with an ESPC)	ESCO to perform all utility bill gathering, verify information provided by client, physical verification of systems, meters, and energy savings opportunities	Not all of the utility accounts at a site are given or provided to the ESCO.
	ESCO supplies over aggressive energy conservation opportunities to client	The ESCO can sometimes over state the energy conservation opportunities to the client, putting the client at risk of pursuing a performance contract when no true or very little energy savings can be attained	ESCO to assume the risk of properly reporting opportunities to the client	Low (Since client is not committed to proceed with an ESPC)	Use of checks and balances (determining if the client truly can save X% of their utility bills by industry standards) and full disclosure of how the energy conservation opportunities were uncovered will minimize the clients' risk	The ESCO states that measures with extremely long paybacks will meet their payback criteria to drive the number or size of projects to be built.
	Project Criteria or Project Financial Criteria not set	If the payback or ROI criteria is not set properly, then a clearly understand of what projects are cost effective cannot be realized. Also, project timeline or specific client needs should are not set.	ESCO and Client	Medium	Clearly define the project criteria. That should include, yet not limited to payback timeline, length of loan, loan rates to use, utility rates to use, base year, project timeline expectations, projects that must be completed, etc.	ESCO develops a list of measures that meet payback criteria set by the ESCO in line with a ten-year loan; however do not consider clients desire to borrow funds for only seven years.
Investment Grade Audit & Pre-Design	Use of Labor Savings in payback calculations	Labor savings have been used in the past to inflate the overall cost savings associated with recommended measures	ESCO to assume the risk of properly reporting opportunities to the client	Low (Labor Savings <u>should</u> be excluded as part of the financial criteria)	Client should not allow labor savings or soft operational cost savings in payback analysis. If allowed, full disclosure of the "funding streams" used is imperative. Evaluation of labor savings must be thorough and documented for future reference	Measures installed by the ESCO are fully or partially funded by reduced labor associated with the installed piece of equipment, however this labor savings is never realized or guaranteed, yet the client still has the full loan obligation to service.
	Aggressive Reporting of Energy Savings	Use of overly aggressive energy savings can drive a client into a performance contract and be obligated to pay for measures that do not meet their financial criteria	ESCO to assume the risk of properly reporting opportunities to the client, they are ultimately responsible for all energy savings calculations	Low (Proper engineering practices will eliminate the use of aggressive energy savings numbers	Use of accepted engineering practices and principles to determine the level of energy savings. Third party verification (local utility and/or State GA) will minimize this risk. Finally, the use of real logged data will provide validation of the savings.	Measures installed by the ESCO are fully or partially funded by overly aggressive energy savings.
	Not using a "holistic" approach in determining the recommended Energy Conservation Measures	Individual systems or piece of equipment can be assessed for energy savings without consideration of implementing the recommendations and the effect it will have on other systems	ESCO to assume the risk of full disclosure of their findings, including adverse effects on other systems	Medium (Client should ask if all systems were taken into consideration when the engineering was performed)	System modeling and determining the interaction of one system on the others will minimize the risk to the client. Physical verification of the systems and the related interactions with other systems should be documented in the Investment Grade Audit	Heating penalties assessed are not considered in lighting upgrades
	Not looking at the effects of the upgrades to other systems and the issue of incompatibility of systems being installed	Recommending energy conservation measures to implement without understanding that the systems may not be compatible, or that the peripheral parts of a system are not considered in the recommendation	ESCO to assume the risk of full disclosure of their findings, including adverse effects on other systems	Medium (Client should ask if all systems were taken into consideration when the engineering was performed)	Determine if systems will be compatible prior to implementation by thorough research and verification. Documentation should be included in the Investment Grade Audit	Control systems are installed and do not communicate with existing equipment, thus necessitating either existing equipment upgrades or other costly solutions, or piping to unit ventilators and the unit ventilators are not considered when a boiler is replaced.

1. Experience

	Recommendations are not clearly defined prior to entering into a performance contract	The recommended energy conservation measures are too loosely scoped during this assessment, making the clients perception of the measure out to be entirely different for the ESCO's	ESCO and some Client risk	Medium (the ESCO should disclose that the investment grade audit does not include full design)	Clearly defining the measure and listing the assumptions used to make the final pass to being included in the implementation phase. After design is started, the ESCO should keep the client informed of any design issues	Energy Management Control Systems that only have stop/start functions instead of robust functionality
	Recommended energy conservation measures meet the clients' financial criteria, however the client decides not to implement the measures through an ESPC	The recommended energy conservation measures actually meet the clients' payback criteria, but for whatever reason, the client decides not to implement the measures.	Client and ESCO	Medium (the ESCO has met the requirements laid out in the Investment Grade Audit)	Every method possible should be explored to minimize the impact to the client to pay for the investment grade audit, including delayed implementation schedule, partial implementation of energy conservation measures and finally discussions around payment of the investment grade audit.	A client was relying on the securing additional capital (bond, legislature, etc.) to help supplement the funding of ESPC projects. This funding does not materialize, and it was never stated in the financial criteria that the project was at risk with no capital funding.
	Utility rebate, or other funding sources are estimated prior to installation	Utility rebates and other sources of funding are estimated during the ESPC process and finalized prior to the implementation of measures. The estimates are very accurate and valid prior to this, but some risk is involved since fund sources can change their programs during the ESPC project.	Client and ESCO	Low (prior warning is given by utility companies about changes to utility rebates)	Commitment of rebates and funding sources can be requested prior to the end of the ESPC project or during the investment grade audit. This way documentation is made requesting the funding.	An ESPC project receives a grant that covers 20% of an HVAC replacement, the local utility announces that they are not continuing their incentive program past a certain date, if the project has not received the proper documentation securing funding, then the 20% may be in jeopardy.
	Client commits to the projects that were developed during the Investment Grade Audit	The projects have been developed to a level that will now go into design and implementation, these projects should be the ones that the client wants to implement	Client and ESCO	Low (most design is thoroughly scoped prior to the ESPC is entered into)	The client still has the opportunity to exclude projects, however the amount of time and material used by the ESCO should be considered to be paid for is an Energy Conservation Measure is not pursued after the ESPC has been entered into	An ECM is included in the ESPC but circumstances change for the client (such as closure of a facility, use of facility changes). The ECM is then removed, which in turn changes the payback and savings stream for the remainder of the projects.
	Level of design changes after a contract to implement (ESPC) is agreed upon	The level of design is increased because of the complexity involved, or additional scope is added by the client	ESCO and Client	Low (most design is thoroughly scoped prior to the ESPC is entered into	ESCO is responsible for proper planning and detailed design scoping, as well as fee estimating. Added scope is managed through a change order process.	A chiller system design becomes more complicated then the ESCO anticipates. And the client has not added any additional scope or scope modifications. ESCO manages the additional engineering costs at no impact to client.

1. Experience

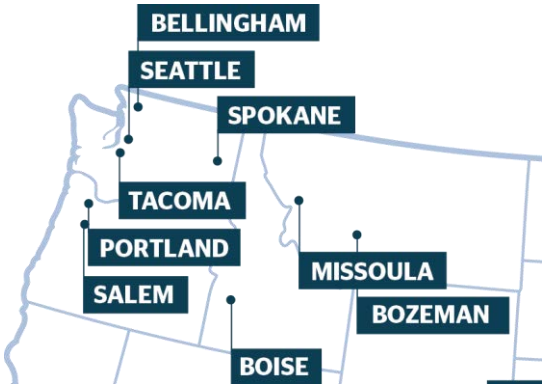
Implementation, Commissioning, and Project Close-out	ESCO exceeds the Guaranteed Maximum Price (GMP)	The project has cost increases due to various reasons (inclusion of new items, wrong design, latent conditions)	ESCO	Low (since the ESCO is guaranteeing the maximum project costs)	Contractually, the ESCO is held to their GMP pricing, latent conditions can be covered out of project contingency.	A new boiler system is installed; cost of materials or sub contractors comes in higher than what was originally guaranteed. ESCO covers added cost.
	Subcontractor and vendor selection process.	RCW 39.35 allows for the "negotiated" selection of subcontractors and vendors; however this is unique to public sector procurement.	ESCO and Client	Low (RCW is clear in its wording and intent.)	Clear communication to the subcontractors and vendors with regard to the RCW, procurement practices, and flexibility is well advised. In addition, ESCO should manage the procurement process with the highest level of integrity and openness, and the client should be involved in all aspects of the procurement process.	EMCS subcontractor provides a low budget (or bid) for work to be performed; however client decides not to use this vendor due to past experience. Vendor attempts to protest procurement method, and is re-explained the RCW.
	Subcontractor and vendor selection is influenced based on low bid only.	ESCO is asked to solicit/entertain pricing from subcontractors or vendors that have worked on the client site.	ESCO and Client	Low	ESCO should entertain any & all recommendations from the client or its representatives. Each vendor will need to be scrutinized for their past performance, safety record, financial ability/integrity, insurance limits and industry reputation. If ESCO deems that a vendor(s) does not meet the stated requirements, they should promptly inform the client and do not proceed with that vendor(s).	ESCO, without proper diligence, implements a project with a subcontractor that was recommended by the client. The subcontractor is financially unstable and defaults on their contract.
	Latent condition found in implementation that would have been impossible to determine in the investment grade audit or design phase	Sometimes latent conditions exist that would not or could not of been uncovered during the Investment Grade Audit. Items such as asbestos or mold could come under this category.	ESCO and Client	Low	A proper contingency plan should be determined prior to the ESPC that will attempt to cover most latent conditions and the actions that will take place if they are found. Project contingency is another way to minimize the risk.	Asbestos Abatement reports claim that all asbestos is removed from a site, but upon implementation asbestos is found.
	ESCO does not provide open-booking accounting	ESCO shared all cost estimates at the beginning of the project, however is reluctant to share end of project cost details.	ESCO and Client	Low (ESCO must provide open-book disclosure)	All cost information, as available based on the nature of the subcontracting methods, should be open and available at nearly any point in a project. To be clear, specifics regarding what elements and at what level of detailed will be reconciled at the end of the project should be stated at the beginning of the project.	ESCO completes a project, yet refuses to share any equipment invoices or subcontractor invoices to substantiate their own ESCO invoice. Client refuses to pay final invoices.
	New equipment fails during implementation	Newly installed equipment fails to operate and/or fails in the start-up phase.	ESCO	Low (ESCO is responsible for the equipment until the end of the warranty period	The necessary subcontractors, vendors, and/or ESCO technical personnel will respond to assess and repair the problem(s). Replacement equipment may be considered if deemed necessary.	A new AHU is installed and it fails to operate properly during start-up. Overall schedule is impacted and energy savings commencement is delayed.
	Measures not performing as intended or designed	Installed measures are not performing as intended during the Investment Grade Audit or Design and Implementation phase	ESCO	Low (ESCO is responsible to fix the measures and produce the energy savings)	Have trends in place during the commissioning that will alert the ESCO that measures are not performing as intended, have the ESCO fix any poorly operating ECM's and have ESCO make up the difference between the guaranteed energy savings and actual energy savings at the end of the first year's M&V period.	Demand Control Ventilation ECM is not set up to operate based on CO levels in the area served. ESCO will need to fix the measure and make the client "whole" about the energy savings.

1. Experience

Measurement and Verification, and Ongoing Savings Guarantee	Utility Rates Decrease	Utility Rates decrease over the Measurement and Verification period, thus lowering the dollar savings associated with the energy saved by ECM's.	Client	Low (Utility rate decrease do happen, however the amount of decrease is usually small, and decrease the overall utility budget.)	The ESCO and Client should agree to a guaranteed savings percent to use of less than 100% (usually between 80% to 95% is used to guarantee ECM's energy savings). This allows for decreases in utility rates and buffers the client from not meeting the loan payment obligation with energy savings.	An electric boiler is replaced with a gas boiler, based on a cost per therm and kWh for the replacement. After the measure is installed, gas rates decrease by 10%. If a 90% guarantee was used on the energy savings calculations, then the client is protected from any risk.
	Utility Rates Increase	Utility Rates increase over the Measurement and Verification period, thus costing more to run the ECM installed.	Client	Low	If the measure was not installed to begin with, the increased cost of running the old measure would be higher than with the conservation measure in place.	An electric boiler is replaced with a gas boiler, based on a cost per therm and kWh for the replacement. After the measure is installed, gas rates increase by 20%. Since the measure was installed (versus keeping the existing system), the measure will provide 20% more dollar savings to the client depending on the utility budget baseline allowed.
	Hours of Operation Change	Hours of operation of a facility can increase of decrease over time, thus impacting the units of energy consumed. If the hours increase then more energy is being consumed, if it is decreased, then less is being consumed. If less is being consumed then this translates back to a lower amount of savings, which might not cover the loan payment.	Client	Medium (only if hours of operations decrease)	Making the client aware that hours of operation are used as a basis for the energy savings, but giving the client the flexibility to operate their facilities how they choose to will keep all the team members knowledgeable of the changes. Also using a guaranteed savings percent of less than 100% (usually between 80% to 95% is used to guarantee ECM's energy savings) will allow a buffer for changes in the hours of operation. The guarantee should still be viable, once the baseline changes are agreed to.	Light retrofit is installed in a gymnasium and community use on nights and weekend was considered in the original estimated energy savings, per the logged data. The hours of operation increase, and will result in less savings. However, since they are not using the old lighting system the potential impact is far less costly to the client.
	Use of Facility Changes	Facilities use can change over any period of time, classrooms change, areas of the building are remodeled, additions are placed on the existing structure, etc.	Client	Low (Other factors greater than the energy savings are in consideration when a changes of use is occurring.)	Documentation of pre and post installation factors that would affect the facilities use. Also, accounting for any additions to the facility is important. The ESCO should also help predict the impact to the energy savings stream when this change of use occurs. The guarantee should still be viable, once the baseline changes are agreed to.	The client builds an addition to the existing structure. There will be increased energy consumption based on the fact that there is more space to condition, plug loads increase, type of use increases, etc.
	Targeted Savings Not Being Realized	The amount of energy reduction stated in the Energy Services Proposal is not being realized because of improperly working equipment, improper design, etc.	ESCO	Low since the ESCO is guaranteeing the units of energy saved	The ESCO would verify why the ECM is not realizing the savings, take corrective action and make up any difference between the estimated and actual energy savings.	An installed ECM is only achieving 85% of what was predicted. Upon verification by the ESCO it is found that a component of the system is not operating and is replaced. Energy savings will then begin to be realized and at the end of the M&V period the ESCO makes up the difference between the estimate and actual savings.

1. Experience

9. What is the makeup of a typical project team with regards to local (WA, ID, OR) vs. outside the region staffing.



The makeup of a typical project team in Washington consists of employees that reside in our various offices throughout the region, specifically Seattle, Spokane, and Portland. We believe that our customers are best served by people that live and work in the save areas, and as a result, the vast majority of our project teams consist of individuals that live in the region.

For western Washington projects, our project teams consist of individuals from our Seattle headquarters. It is safe to say that all of our Seattle based staff reside in the greater Puget Sound area. We roughly use the Cascade mountain range as the defining boundary for western Washington projects.

For eastern Washington projects, we staff our teams from our Spokane office. We also have a project office on WSU's campus to serve that specific client. Most of our Spokane and WSU staff resides in Washington; however, several individuals do live across the border in Idaho.

For southwest Washington projects, we staff our teams from our Portland office. Due to the proximity of our Portland office to the Washington/Oregon border, we have roughly a split mix of Washington and Oregon residents on our project teams.

Our large and dispersed workforce allow us to effectively cover the geography of Washington, apply resources where needed, and scale up/down based on market demands. We have occasionally supplemented our local project teams with additional McKinstry resources outside of the region. These instances have primarily occurred around some of the grant submittal deadlines over the past years. However, we have not and will not bring in wholesale, independent McKinstry teams from outside the region to deliver work in Washington.

While we don't track this specific metric within McKinstry, it's safe to assume that over 95% of our labor on projects in Washington State comes from staff that lives in the region, with the predominance of those individuals living in Washington.

2. Management Approach

ORGANIZATIONAL STRUCTURE

Our commitment to every project is to assign dedicated team of qualified professionals, with the required skills to develop and implement a successful project. We structure our team to ensure a single-point of accountability and contact for our clients through a Project Director. The Project Director quarterbacks the team in assuring the overall success of the project and customer satisfaction. The Project Director is supported in three areas by:

1. Analysis and solutions development, auditing, and engineering which is led by a Program Manager.
2. On time solutions implementation through construction management is led by the Construction Manager.
3. Assuring savings and on-going performance assurance is led by the Performance Assurance Specialist.

The Standard Form 330 found in APPENDIX C includes our Washington Team Organization Chart. The resumes in the APPENDIX B describe the specific role assigned to the various team members for the owner, and their associated duties and responsibilities.

ENERGY SERVICES STAFF ROLES & RESPONSIBILITIES

Note: Depending on project size, some roles may be combined or may not apply

ROLE	GENERAL POSITION DESCRIPTION
ACCOUNT EXECUTIVE	Responsible for client acquisition and management. Responds to RFQ & RFP's. Conveys ESCO program guidelines, describes how the ESCO program may apply to specific client needs.
PROJECT DIRECTOR	Single Point of Accountability for assigned projects across project development and construction. Owns the project from inception to 100% completion. Determines staffing needs and assigns staff as required. Assists with energy conservation measure qualification. Responsible for managing project budgets.
PROGRAM MANAGER	Manages the development phase. Responsible to the project director to produce projects that meet the criteria for implementation. Also responsible to provide day to day strategy guidance for all team members during the development phase. Responsible for managing sub consultants as they relate to the specific project.
ENERGY ENGINEER	Technical lead for the non-lighting portions of the development phase. Responsible for all aspects of UDA, savings, guarantee, rebate, and schematic design in the development phase. Heavily involved as a technical resource during the design phase.
LIGHTING ENGINEER	Technical lead for lighting portions of the development phase. Responsible for all aspects of UDA, savings, guarantee, rebate, and schematic design, as it relates to lighting systems in the development phase. Heavily involved as a technical resource during the design phase.
ENERGY ANALYST	Supports Energy Engineers by working under their direction. Performs utility data analysis and assists with field data gathering and data analysis.
PERFORMANCE ASSURANCE	Develops performance assurance and M&V requirements for each measure and produces M&V and PA reports.
DESIGN ENGINEER	Develops detailed mechanical, electrical, and plumbing drawings and specifications. Designs systems based upon existing field conditions, overlaying Code requirements as they apply.

2. Management Approach

GENERAL CONSTRUCTION ESTIMATOR	Responsible for producing accurate cost estimates based upon historical database and project experience Responsible for obtaining vendor and sub-contractor proposals as appropriate.
GENERAL CONSTRUCTION MANAGER	Hires all subcontractors, manages project budget and critical path schedule. Responsible for all project related contractual document.
GENERAL SITE SUPERINTENDENT	Responsible for On-site supervision and coordination of all trades and subcontractors' field activities.
PROJECT COORDINATOR	Provides document management support. Assists with subcontractor coordination and project coordination.
SUBCONTRACTORS	TBD

2. Management Approach

11. The ESCO's policies and procedures for managing and delivering its committed work products in a timely fashion within contractual obligations, including project development, construction, and post implementation verification.

KEY POINTS:

- McKinstry has several hundred dedicated energy services employees.
- Our staff diversity allows us to fulfill all of our work commitments.
- We regularly review project needs and staff resources and allocate accordingly.
- We have formal meetings at key project milestones to eliminate inefficiencies, avoid future challenges, and deliver better projects.

PROJECT DEVELOPMENT

McKinstry maintains rigorous policies and procedures to ensure our projects are delivered on time and at the highest level of quality. Since developing and implementing energy services projects involve a project team with multiple disciplines, it is important to communicate and collaborate at both the project level, and at the larger business level.

On a macro business level, it is also important to analyze our global body of work and our existing resources, which we do on a regular basis. We review all current and potential projects, the schedule of all projects, and the allocation of staff resources to all projects. This analysis allows McKinstry to identify potential staffing challenges in busy times and the ability to shift resources where and when needed. Due to our size, we have significant staff diversity across multiple states that can help accommodate temporary increases in resource needs in other regions. If these increases in resource needs will be necessary long term, McKinstry will hire the appropriate personnel to deliver the committed work.

PROJECT START

The purpose of this meeting is to clearly identify the project team and their roles and responsibilities. The general nature of the project is described, along with preliminary scheduling information. Since it's early in the overall cycle, project specifics are generally not known, but establishing the team and overall project deliverables is beneficial. This meeting also identifies the deliverables for a preliminary audit and the responsibilities of the individual team members.

AUDIT KICK-OFF

McKinstry holds an audit kick-off meeting with all internal stakeholders, including the implementation team. A typical attendee list will include the program manager/project director, energy engineer/auditor, design engineers, construction/project managers, and commissioning personnel.

The focus of this meeting is to lay out the plan for conducting the audit, how we plan on creating the energy baseline, what data logging and metering is needed, design issues to take into consideration, and various other topics. Also, we focus heavily on understanding the scheduling needs of the project, including the owner approval process and expected date for beginning the work. Many times, the measures we anticipate implementing have a defined window for construction and it is necessary to work backwards to develop the tasks needed in order to guarantee critical dates are not missed.

RISK REVIEW MEETING

Prior to delivering an Energy Services Proposal, McKinstry conducts a risk review meeting where all aspects of the project are scrutinized by McKinstry personnel who are not a part of the direct project team. Essentially, we look for issues that may have been overlooked in the development process related to design, energy guarantees, construction plan, and other project variables. The focus of this meeting is to ensure all aspects of the project have been thoroughly analyzed, which will reduce future issues. These meetings have proved very beneficial in 'heading challenges off at the pass' before projects are implemented. A key component is the review of the construction schedule to ensure the project can be delivered per terms of the anticipated construction contract.

2. Management Approach

DESIGN START MEETING

After the Energy Services Proposal has been accepted by the State and Owner, McKinstry holds a design start meeting. This meeting details the engineering and design needed to produce construction documents for the project. Some of the preliminary design will likely have been completed during the audit. This meeting includes both our development resources, who played a role in scoping the project, as well as our construction team, who have a stake in high quality construction documents produced on time. One key element of the design meeting is to verify the equipment criteria and performance standards that drive the energy savings so that the final design delivers the guaranteed energy savings. These meetings also focus on any critical path scheduling items, such as the production of equipment submittals needed for long lead equipment.

CONSTRUCTION

The key to McKinstry's approach to delivering our construction commitments in a timely fashion is the ability to define the desired outcomes of our clients and develop a detailed construction schedule surrounded with defined processes that assures these outcomes will be met. While our experienced and capable staff is the key ingredient to achieve this, the following outlines the expected process.

Our schedule is built early in early in the overall process, typically during the audit phase as we're scoping the project and understanding the work requirements and needs of the Owner. In many cases, a complete construction schedule is provided as part of our ESP. Early planning around expected outcomes is critical, as it sets the stage for the successful development and implementation of the project. After a project moves into construction, further detail may be added to the schedule as necessary to execute the project. Overall, having a schedule and managing to that schedule is the single most important element in meeting the timeliness of our commitments. Below our several of the important processes and steps we also take that help McKinstry meet the schedule requirements of the project.

CLEARLY DEFINING THE PROJECT OUTCOMES

Similar to our initial involvement in the project, you can expect the delivery of a complete description of scope, budget, schedule and other salient information on our mechanical systems. This will provide a clear communication benchmark with all other team members to establish the desired outcome.

Our in-house commissioning team will be directly involved in reviewing and understanding this deliverable. This will allow for the development of a comprehensive Quality Assurance program for the project. This includes understanding of the drawing development process, scope definition process, maintenance and long-term operational issue assessment and a myriad of other details.

MILESTONE REVIEWS

While we intend to have information available to all team members in an effort to both monitor and interact with our process on a continual basis, we also propose to deliver milestone documentation. This will allow for the regular and thorough quality control overview to take place. At these milestones, which are established by the team, we would expect external reviews of our work product relative to the predetermined expectations and other industry benchmarks. At the same time our in-house commissioning team will serve in the role of "*owner's advocate*" to challenge and validate the scope, quality and assumptions behind every aspect of the deliverable. These milestone reviews allow for efficient and effective quality control to be instituted on an otherwise continuous process.

COORDINATION AND INTERFACE WITH OTHER TEAM MEMBERS AND DISCIPLINES

Our staff and process is designed to deliver the highest quality of communication and content to our design and construction team members. This includes scope means and methods, spatial coordination and other digital communication. We institute design discipline and trade coordination processes at regular intervals in our operation to ensure that a coordinated and comprehensive product is produced for the project in its entirety. Our experience in managing complex relationships between mechanical systems, construction,

structural, electrical, architectural and other disciplines has shown us that we can anticipate and solve problems in the "paper" stage of the project. This effort results in lowering cost and increasing final product for our customers.

PROJECT COMMISSIONING AND CLOSE-OUT

As the project nears completion, McKinstry completes a closeout meeting that includes construction, commissioning, measurement and verification, design, and other relevant staff. The focus of this meeting is to ensure any outstanding issues are completed and the project is transitioned to the owner in a timely and efficient manner. The M&V scope of work is also reviewed and a detailed schedule defined in order to deliver the M&V reports.

POST IMPLEMENATION VERIFICATION

McKinstry is involved in the service, maintenance, and operation of systems and facilities. The best operations practices and knowledge gained from this hands-on operations experience allows us a feedback loop to further refine our management process and educate our project managers. We simply cannot and do not think of jobs as being complete after they are installed. The systems must operate as designed, be integrated into the overall operation of the facility, with client personnel trained and ready to assume operation. This mindset of leaving the client with a fully functioning system, and fully prepared to assume operation, is ingrained in our delivery and culture.

Our commitment to delivering timely post implementation verification services has been a focus over the past several years. We have dedicated performance assurance specialists and energy engineers on our staff who track, manage, and implement the measure & verification tasks on each project. During the audit process, the performance assurance plan is created, reviewed, and approved with the stakeholders. Additionally, the frequency and duration of the reporting is defined. We then enter this information into a master database of all our projects which is regularly updated and reviewed by various individuals throughout our organization in order to drive enhanced visibility into this component of our projects.

2. Management Approach

12. The ESCO's approach to marketing the DES Energy Program to potential client agencies in conjunction with DES personnel.

McKinstry has been an active partner in promoting the utilization of the DES Energy Program across the public sector. Since becoming approved and pre-qualified as an Energy Services Contractor for public agencies within the state of Washington, McKinstry has successfully executed hundreds of millions of dollars through the DES' Energy Services Program. We believe in the value the DES Energy Services Program delivers to the public sector.

Our approach in actively promoting the program has been to involve the DES' Energy Services team early on during the business development process as a means to assist in the education of clients with the Energy Services program. This active Energy Services marketing approach and effort has proven successful in promotion of the program even when McKinstry has subsequently not been selected by the owner as their energy services contracting partner.

Our business development teams are practiced at being able to direct public sector clients to DES' Energy Services program as a streamlined and proven procurement method to assist with addressing building infrastructure needs. McKinstry actively promotes the DES Energy Services Program from an integrated turnkey contracting approach with guaranteed performance requirements as well as the financial benefits of the program, especially when available capital dollars are limited, the facility needs are great and alternate funding & financing is the only path to address their immediate needs. Below is a partial listing of clients that McKinstry has marketed and guided to the DES program:

Kennewick SD, Richland SD, Pasco SD, West Valley SD, Newport SD, Kahlotus SD, La Crosse SD, Grandview SD, Whitman County, Samaritan Healthcare, Yakima Valley Community College, Winlock SD, Onalaska SD, Rainier SD, Morton SD, Mt Adams SD, City of Des Moines, Tukwila Metropolitan Park District, Mukilteo SD, Anacortes SD, Chimcum SD, Jefferson Healthcare, and Skagit Valley Hospital.

13. What is the minimum size project your firm would consider viable.

McKinstry does not have a lower limit or minimum project size that determines the viability of a project. We are a very scalable company with personnel dispersed throughout the state amongst our various offices. We also have work and projects spread throughout the state at any given time. This allows McKinstry to support many of the remote and rural regions in Washington that wish to implement ESPC projects, even when these projects are relatively small in comparison to other ESPC projects throughout the state. We have delivered projects less than $50,000 on several occasions. While the financial benefits resulting from these projects are minimal (on a project basis) for McKinstry, we look at our client relationships as a long term partnership that will drive future business through their organizations and peer networks.

2. Management Approach

14. The ESCO's approach to effectively communicate project information with the DES Energy Program prior to sharing with client agency.

COMMUNICATION

McKinstry's policy is to share all critical information with the DES prior to submitting to the client. This allows us to include any relevant feedback from the DES project manager prior to sending to the client. It also ensures that McKinstry and the DES are all well-versed on all aspects of the project and can aptly answer any questions from the client as needed. Our approach is simple: 1) understand what info needs to be reviewed prior to client submittals 2) build a schedule that reflects the appropriate review periods, and 3) get feedback from DES to make sure we're meeting expectations.

Early in the development of a project, McKinstry will communicate with the DES project manager on the specific communication protocols and expectations for the project. Many of these are known by our various team members, as we have familiarity and experience from past projects and project managers.

We feel a well-planned and communicated schedule both during the audit and throughout construction is essential to this process. By building a schedule on each project, we can imbed the appropriate review periods in from the DES. Having a schedule with these steps included eliminates the desire to circumnavigate the process due to schedule pressures.

We meet with the DES project managers on a consistent basis to discuss projects and business topics. The broad topic of communication is typically discussed around methods and best practices we can administer to make sure McKinstry and DES can continually make the ESPC program a desired procurement tool for our clients.

15. The ESCO's approach to project development from marketing to delivering the ESP.

GENERAL APPROACH

McKinstry's approach to project development from marketing to delivering the ESP is planned, efficient, documented, and ultimately seeks to find solutions for Owners' facility challenges and needs. We find that our most successful projects do not happen by accident – they require purposeful communication between the Owner, DES, and McKinstry to understand needs, discuss options, and develop solutions. Below, please find more information on our approach specific to the phases of a typical project.

OCCUPIED BUILDINGS

It is critical to be flexible, efficient, and as invisible as possible when scheduling and performing the audit to minimize disruption. McKinstry has developed the processes and protocols necessary to facilitate these audits seamlessly.

MARKETING

Our approach to marketing and sales is to educate potential clients on the ESPC process and program. We feel empowering our potential clients with knowledge that ultimately enables them to make the best decisions for their organizations serves our communities and the citizens of Washington the best. We understand that clients do generally not like an aggressive sales pitch, so we focus our efforts on providing information that allows them to address their facility issues and energy use effectively. Through this effort, we hope to gain the confidence and trust of the Owner that hopefully positions McKinstry to get selected as the ESCO. In many cases, McKinstry reaches out to DES during this phase of work if they are not already engaged with the client. Having a state organization help validate the program often answers many questions from the client and helps to eliminate any trepidation on the part of the client in moving forward to select an ESCO.

COLLABORATIVE VETTING PROCESS

McKinstry will work with the client to define the parameters and objectives of the program. This effort speaks to having the purposeful communication needed during the initial stages of the project in order to plan

success. The following topics are discussed between DES, the Owner, and McKinstry.

- Financial criteria including payback/ROI goals, all available funding sources, fiscal deadlines and project financing options and preferences
- Customer interests and objectives including FIM technology preferences, environmental specifications, and other project-specific goals
- Existing systems review including lighting, mechanical, HVAC, controls, water, fire protection, security, information technology, waste stream, and hazardous materials
- Audit criteria including project timelines, existing facility information, available savings sources, utility data, escalation rates and planned capital improvements
- Construction criteria including project timeframes, bidding requirements, subcontractor preferences, vendor/product review, and use of contingency
- Other miscellaneous items for consideration.
- The time and effort spent establishing overall project goals will help define the direction of the TEA and the follow-up project selection process.

DETAILED AUDIT PHASE

The purpose of the detailed audit phase is to fully investigate every measure on the Preliminary FIM List that has been retained after our collaborative decision-making process. The detailed audit phase includes the following tasks:

- Datalogging/Measurements — Detailed Energy Calculations
- Pricing and costing efforts
- Draft Technical Audit Report Development
- Final FIM Selection for the Performance Contract
- Presentation of Detailed Audit Results

DATALOGGING/MEAUREMENTS — DETAILED ENERGY CALCULATIONS

During this phase McKinstry will log equipment to verify operating parameters, run hours, etc. in order to refine our detailed energy calculations and develop the guaranteed savings amount for each FIM.

SUBCONTRACTOR PRICING

To establish our guaranteed maximum price for each improvement measure, it is a McKinstry best practice to solicit subcontractor pricing in a competitive bid environment. McKinstry will develop detailed scopes of work and request for proposal (RFP) packages, conduct site walks, and receive subcontractor bid packages. We will review these with project stakeholders and collaboratively choose subcontractors.

DRAFT ENERGY AUDIT REPORT DEVELOPMENT

McKinstry will prepare a draft energy audit report. The report provides an engineering and economic basis for negotiating a potential Energy Savings Performance Contract. The report includes all data necessary to understand the proposed improvement measures, including detailed write-ups on each measure with energy savings calculations, scopes of work, cost estimates, proposed measurement and verification, and commissioning plans, etc.

FINAL FIM SELECTION FOR THE PERFORMANCE CONTRACT

As part of the final audit phase, McKinstry works collaboratively with our clients throughout the final FIM selection process. We use a structured and disciplined approach to develop and define high-potential FIMs for

the program and then work to evaluate the FIMs and assess priority rankings for each. In addition, McKinstry will perform a life cycle cost analysis of each FIM utilizing our total cost of ownership (TCO) analysis to include a final extended lifecycle cost/benefit analysis. This serves as an additional screening tool. Based on the final quantitative (and, if any, qualitative) screening and ranking, McKinstry will recommend priority FIMs that in aggregate can be accomplished given forecasted available time, funding, and resource availability.

PRESENTATION OF DETAILED AUDIT RESULTS

McKinstry will then coordinate the final energy audit results presentation meeting and present our findings. These findings will become the basis for the development of an ESPC project. As with the Kick-off Meeting and the Preliminary FIM Presentation Meeting, key decision makers should be present. It is appropriate at this point to present this information to key stakeholders so that any questions and concerns can be answered well before the project is approved.

During this presentation, McKinstry will present a FIM Summary Table of all projects analyzed during the audit with a list of recommended projects based on the overall project goals. The FIM Summary Table will typically include the following information for each FIM:

- Brief description
- Buildings associated with each FIM
- Construction cost
- Annual utility savings
- Estimated utility rebate
- Grant or capital contributions (if any)
- Net customer cost
- Net customer simple payback

The FIM summary table can be customized to include other categories such as annual CO_2 savings, annual maintenance savings, TEA fee, and any contingency dollars included in the project.

After reviewing all projects investigated within the energy audit, we come to an agreement upon which FIMs to include in the final project development and proposal phase as described below.

PROJECT DEVELOPMENT / PROPOSAL PHASE

The third phase in the audit is to develop the project(s) that form the basis for the energy performance contract. Proposed project development begins in the Detailed Audit Phase; and this final phase is concentrated on refining details to bring the project to the reality of construction. Tasks included in this phase are:

- Scope Refinement
- Financing Analysis
- Final Technical Energy Audit Report
- Contract Development

SCOPE REFINEMENT

During this final phase, McKinstry continues to work very closely with our clients to make sure that the final scope of work matches their goals and that the final scope of work is correct and acceptable.

FINANCING ANALYSIS

The project funding strategy begins very early in the audit process to assess the ability for our clients to receive grant funding, low-interest financing, etc. so the financing analysis associated with this last phase of the audit is essentially concentrated on the final financing package. McKinstry Capital will solicit financing bids on behalf of our clients and include any local banks as well as financing companies that have experience providing tax-exempt lease purchase financing for energy performance contracts. McKinstry will analyze the bids and provide recommendations; of course, the final decision of which financing vehicle to use resides with our clients.

2. Management Approach

FINAL TECHNICAL ENERGY AUDIT REPORT

Upon review of the Draft Technical Energy Audit Report by you and any additional stakeholders you designate, McKinstry updates the report with any changes, comments, etc. The Final Report is produced as the audit's deliverable. At this time, McKinstry also provides a detailed review of the measurement and verification plan, project costs, etc.

2. Management Approach

16. The method for contracting the installation of the measures, maintaining cost competitive pricing, and whether the ESCO uses open book pricing.

KEY POINTS:

- Pricing and mark-ups are straightforward and 100% open book.
- We will leverage our significant *local* buying power to obtain the lowest possible prices for all projects.
- We are vendor neutral and not aligned with any specific equipment manufacturer.
- Clients often leverage our self-performance contracting capabilities at their discretion in order to receive the lowest cost, rapid turnaround, and overall best value.

CONTRACTING METHOD

Our contracting method is based on dividing projects into relevant scope packages and using an RFP process to select our subcontractors, leading to a contract. We develop our contracting plan in collaboration with the Owner and DES, with this philosophy first in our minds and guide our decisions as we proceed. McKinstry will share the results of contractor proposals and get input from the Owner on any contract preferences they may have.

Our policy is to bid all major scopes of work to multiple contractors, unless there are scopes of work that limited by partnerships between vendors and the Owner (i.e. controls). We employ this policy even in cases where McKinstry has the ability to deliver components of the project. In these cases, our construction team is viewed as an outside contractor and is required to provide a complete and full proposal to our energy team, no different than another 3rd party contractor. We then evaluate proposals and award the work as appropriate. We need outside contractor partners to be successful, so we are very careful to be completely transparent during this process.

COST COMPETITIVENESS

Below are the key aspects of our approach to ensuring cost competitiveness while maintaining a turnkey quality project. However, we also appreciate that these projects are only successful when a partnership is established with the client. Therefore, we welcome the opportunity to work closely with the Owner to ensure competitiveness through this project, and work to develop a specific process that will meet the Owner's requirements. Below are the key aspects of our approach that we have used with energy projects to ensure cost competitiveness.

- Our business is facility infrastructure upgrades. We are expert budgeters and cost estimators, which ensure that the budgets established at the beginning of the project will not dramatically fluctuate through the development process.
- An open book pricing approach and a guaranteed maximum pricing (GMAX) agreement will ensure that any cost advantages gained through the construction process will be fully (100% of construction savings) realized by the owner.
- McKinstry has the in-house engineering and professional service expertise to provide solutions that will meet the first cost and long-term life cycle operating needs of the owner.
- We competitively bid major equipment. Based on the volume of mechanical and electrical equipment McKinstry purchases annually, the equipment pricing we receive directly will be the most competitive, and will provide the owner with a negotiated advantage regarding extended warranties.
- We competitively bid subcontractors.
- Our construction teams are set up to minimize multiple tiers of contractors, thereby saving mark-up costs, and have a McKinstry representative as the single point of accountability for the day-to-day on-site management of construction.
- In a case where McKinstry is requested to self-perform, we offer several means of price validation from which the owner can select.
- All available utility rebates will be secured.

- We focus on bringing all available funding sources together to create the most viable funding package for each project. This includes grants, loans (i.e.: QZAB zero interest) and third party financing to secure the best possible rates.
- We provide an aggressive solution development and implementation timeline. As energy rates continue to impact your operation, any energy savings solutions should be brought online in short order.
- Finally, we are committed to staying within the final proposal prices we provide for all scopes of work. Our goal is to be your single-point of accountability, therefore *No Scope Modifications - No Change Orders.*

OPEN BOOK PRICING

Our fee and mark-up structure is presented in an open book-pricing format for all projects. This pricing format will allow the Owner to review our direct costs, overhead, mark-up, discounts, and labor rates. We have used this format with all of our customers in order to confirm competitive pricing.

17. The ESCO's procedures for timely closeout of construction projects delivery of O&M manuals, commissioning reports and other pertinent paperwork to the DES Energy Program and the client agency.

McKinstry does not like to have projects linger and we strive to close out our projects in an efficient and timely manner. To do so requires a well planned schedule with sufficient detail that identifies all of the tasks with appropriate durations, as well as the resources to execute said plan. Our construction manager leads this effort on each project, while communicating the close-out requirements to the other project team members.

Part of successfully managing the closeout process is having a thorough understanding of the client's expectations for specific deliverables, e.g. O&M Manuals. McKinstry works with each of our clients early during the construction process so we have clear direction on the required closeout information that will be submitted.

On all of our projects, the McKinstry project team utilizes the Energy Services Construction Completion Checklist developed by DES as a tool to ensure timely closeout and delivery of O&M manuals, commissioning reports, and pertinent paperwork to the DES and client agency. We review and complete this list item by item as we work through the closeout process.

In addition to using the Energy Services Construction Completion Checklist, McKinstry also holds a formal project closeout meeting on all projects. At this meeting, the paperwork closeout process is reviewed to capture any remaining items. Additionally, other topics are discussed in the meeting relevant to the project including other closeout documentation such as as-built drawings, O&M manuals, etc. We also discuss how McKinstry will communicate going forward as we move into the verification phase of the project.

2. Management Approach

18. The ESCO's procedures for timely submittal of required documentation to Departments of Revenue, Employment Security, and Labor and Industries.

LABOR DOCUMENTATION

McKinstry is very focused on making sure we submit proper document in a timely matter for the topics referenced in the question and have set up our processes to accomplish this result. We have found it most efficient for McKinstry's Contract Administrators handle the documentation procedures as required by the Department of Revenue, Employment Security, and Labor & Industries. Upon notification of a project and contract, McKinstry submits a Statement of Intent to Pay Prevailing Wages through the Department of Labor & Industries. Once an approved "Intent" is received back from the department, it is forwarded to the Project Manager (or Point of Contact), as well as the Public Agency.

McKinstry's Payroll department handles the reporting of Employment Security taxes. Reporting periods are defined on a state-by-state basis. Generally, reporting is done quarterly. Payroll reports are run at the end of the designated period, uploaded to the state's Employment Security tax website and a check is issued from accounts payable for the tax amount due. The check is then mailed to the state office.

Upon notification of completion of the project, McKinstry runs substantiation and contacts all subcontractors on the project to gather all necessary information to file the Affidavit of Wages Paid with the Department of Labor & Industries. Once the approved Affidavit is returned, it is copied to the PM/POC as well as the Public Agency. We further provide all necessary information to file appropriate documents to subcontractors. We also make sure to contact and monitor all subcontractors regarding filing of their Intents to Pay Prevailing Wages and Affidavits of Wages Paid with the Department of Labor & Industries. Once complete, the Affidavits of Wages Paid are collected and sent to the PM/POC and Public Agency.

2. Management Approach

19. The ESCO's approach to mitigate risks associated with guaranteed cost, savings, and performance.

KEY POINTS:

- Up to 100% of energy savings guaranteed
- All savings, including excess savings, go to client
- Client is reimbursed for any guaranteed savings shortfalls
- A detailed M&V plan focuses on preserving true savings.
- Regular sharing of a project's financial performance
- Mark-ups are clearly defined and in line with our profit motive
- At minimum, we report on a monthly basis internally and externally
- We guarantee all project costs

RISK MITIGATION

McKinstry believes in continuously assessing the risk on projects and acting upon this information in order to deliver successful results. Throughout our sales and development process, we have many discussions around risk elements and strategies. We also understand that McKinstry needs to firmly accept the risk associated with the guaranteed cost, savings, and performance and not dilute our risk by placing more risk on the Owner. Our comprehensive risk mitigation and planning program allows us to achieve this goal, and ultimately benefits all stakeholders on a project. Our risk mitigation and planning program culminates in a formal risk review meeting that takes place near the end of the audit process, prior to delivering the ESP to the DES and Owner. We do this for ALL projects. This meeting includes the entire team that developed the project, the individuals who will be executing the project, and appropriate management individuals who ultimately need to approve the project prior to sending to the DES and client. The lead development individual, typically the project director or senior program manager is required to fill-out a Risk Assessment document which becomes the basis for the risk review meeting. The following information is captured in our Risk Assessment tool:

Project Scope: This portion of the meeting is a detailed review of the project and the scope of work. In our risk review meeting we review the detailed scope of work for each FIM trade by trade, any scope assumptions or clarifications, and any exclusions. We focus on viewing the proposed scope of work through the lens of the owner to make sure there's clarity, as well as to challenge any of the assumptions/clarifications/exclusions to ensure they are respectful of the ESPC process and our obligation as an ESCO.

Project Team: At this time, we review our internal project team, 3rd parties that have assisted in development of the audit (if applicable), and potential contractors/vendors who may deliver a portion of the project. Our focus is on understanding how well we've matched our project team to the needs of the project to date, and how we are setting up the project team to deliver success in the future. We discuss the experience and expertise of our project team relative to the proposed solutions for the client, the individuals that have been engaged with the project, our plan for defining the bid packages for construction, how much work is subcontracted to local labor, past performance issues with any potential vendors/contractors, whether the client has any contractor preferences, whether there is a need to pre-qualify contractors, and other various discussions around the project team.

Client: We spend time discussing the client, how active and collaborative they have been in the development process, what we have interpreted as their needs, whether there's any room for McKinstry to have misinterpreted communication with the client, and what the potential ramifications could be around these topics. Ensuring that we've had good, open dialogue with the client throughout the sales and development process helps deliver a successful project.

Project Conditions: We review the project conditions, including the access to the work space, hazardous materials, adverse weather conditions, safety considerations, critical environments, requirements for temp cooling/heating, system shutdowns, staging areas for the work, building occupant management, and a host of other site/project conditions that can or do impact the project. As part of this component of the risk review meeting, we review the proposed project schedule in detail to ensure we can meet our construction commitments to the owner.

Contract: The contract is reviewed at this time. For DES ESPC projects, the risk associated with the contract is minimal, due to the master agreement contract in place as well as our familiarity with the contracts and

contracting process.

Design: We typically complete some level of design and engineering during the audit phase so we can accurately scope and price the job, define energy savings, and understand system performance. As we're often tying into existing systems, it is absolutely critical that we understand how the existing systems work and how our proposed solutions are going to interact with the system and overall performance of the facility. Typical topics we discuss are relevant building code issues, has the building use changed or is it expected to change, does the electrical system have the capacity to handle proposed renovations for new equipment, have structural ramifications of proposed solutions been considered, are we changing the operation of the system that will be noticeable by building occupants, what engineering assumptions have been made, what level of design was available for pricing, and other project specific engineering & design elements.

Technology: Every project incorporates the use of technology in some manner. Many gains in energy efficiency come through improved technology and equipment performance. As a result, there is often a desire to utilize new technology to deliver solutions to clients. Also, buildings are becoming more complicated with controls systems, smart building technologies, and IT solutions that drive efficiency gains. McKinstry focuses on making sure we have the necessary expertise to understand and implement the proposed solutions. We also discuss the client's capacity to understand and operate any proposed technology

Energy Guarantee: We focus intently on the energy guarantee during the risk review meeting. We discuss how the baseline was measures, how the savings were calculated, what percentage of the total savings we're comfortable guaranteeing, and how we'll measure & verify the savings at completion of the project. We also discuss what's at risk should we not meet the savings guarantee and potential remedies. Since utility rebates are typically tied to the energy savings in some shape or form, we also address the utility rebate at this time, what commitments we have from the utility provider, and how we'll help secure the rebate on behalf of the owner at the completion of the project.

GUARANTEED COST, SAVINGS, AND PERFORMANCE

Taking a thorough approach to risk planning and mitigation takes discipline, as it forces us to do extra work and ask difficult questions. We have at times needed to take several steps back in our development process as an outcome of these meetings, because the information we had developed was not to our standards and left too many unanswered questions. Our teams understand the scrutiny that will be leveled at each project, so all throughout the development process, there's a sharp focus on asking hard questions and capturing all of the needed detail so projects can be approved internally as efficiently as possible. The Risk Assessment tool and risk review meetings are not the start of our risk review process, but really the culmination of an incredible amount of work and effort that gets applied to each and every one of our projects. By going through this process, when we submit an ESP, McKinstry is confident that we can achieve or exceed the guaranteed savings, meet or beat the guaranteed cost, and deliver on all of the performance guarantees for the project.

As further detail, we would suggest reviewing the matrix supplied in Question #8. This highlights many of the problems that are typically encountered on ESCO problems, which is another way of asking about the risk and how to best mitigate. In this matrix we discuss how to minimize and mitigate the risk associated with each of the specific problems that can be encountered on projects.

2. Management Approach

20. The ESCO's approach to sharing EPACT tax credits with client agencies.

ENERGY POLICY ACT (EPACT) APPROACH

Section 179-D of the IRS code allows a taxable property owner, tenant, or designer to claim a tax deduction up to $1.80psf of improved space for installing energy efficiency improvements to a newly constructed or existing commercial building. For public building owners, the intent of the deduction is to reward the designer for efficient design. Since tax-exempt entities cannot benefit from a tax deduction, the IRS issued guidance to allow the designer of the infrastructure to claim the tax deduction.

While many designers simply take the deduction with no reciprocity to the public property owner, McKinstry believes sharing the economic benefit is the right thing to do. As such, our Energy Services Team will consult with the client to determine how to share economic benefit and what form it will take with an emphasis on enhanced performance assurance. Examples of such include Knowledge Response Center, continuous commissioning, enhanced Measurement and Verification, Resource Conservation Manager, Remote Operations Center, or Transition to Stabilized Operations services. Providing this in-kind contribution that is free to the public property owner will enable McKinstry to engender trust and build a closer relationship with our public customers.

21. The ESCO's experience and approach to meeting the public works requirements for apprenticeship training programs as directed by Chapter 39.04.320 RCW.

APPRENTICESHIP TRAINING

McKinstry is continually looking for opportunities to support the trades industry. We actively participate in trades' apprenticeship programs and are very interested in supporting local efforts to encourage the education and growth of qualified trades' people. Due to our firsthand knowledge, understanding, and experience that comes from our apprenticeship training within our union trades' people at McKinstry, we are uniquely positioned to understand and implement the needs of RCW 39.04.320.

While there are provisions in the RCW that would appear to allow exemptions on projects, it is not McKinstry's intent to 'work the system' in order to qualify so we are not beholden to the RCW requirements. We understand and promote the philosophy of creating solid jobs throughout our business and feel the apprenticeship program is a good method to accomplish this goal.

For all applicable projects, McKinstry will clearly articulate the apprenticeship level needs amongst the various trades during the contractor selection RFP process. Language in RFPs will clearly outline the required percentages of apprenticeship as well as the reporting procedures required to validate apprenticeship labor. As the project is implemented, McKinstry will track apprenticeship involvement throughout the project. We currently use L&I's prevailing wage reporting process as a means to track involvement for outside contractors. For any work that McKinstry performs in-house, we will naturally have the required information to demonstrate apprenticeship involvement from our end. This information will be collected and reported as necessary throughout the project.

2. Management Approach

22. How Minority and Women Owned Business (MWBE) enterprises will be utilized on the project.

MWBE UTILIZATION

As a union contractor for over 50 years and currently employing over 900 Union employees, McKinstry is continually looking for opportunities to support the building trades. McKinstry actively participates in trades' apprenticeship programs and is actively engaged in supporting efforts to advance the education and professional growth of qualified Union employees.

McKinstry's outreach on similar municipality programs has provided multi-million dollars of work to numerous small and emerging, women or minority enterprises as our senior leadership team has been involved with the "empowerment" movement for many years. We have participated in the Contractors Resource Center (mentor-protégé program), Washington State Apprenticeships Program, the City of Seattle's Contractor Advisory Committee (minority and women apprenticeship program), and King County internships in partnership with the Manufacturing Industry Council.

We are also involved in educational institutions to encourage and support candidates in fields such as Engineering, Construction Management, and Project Management. This includes participation in programs such as Ace Mentors and North Shore School District's Secondary Academy for Success.

McKinstry has taken the following innovative measures to work with M/W/ESB vendors and subcontractors:

SUBCONTRACTING

McKinstry builds and maintains relationships with a variety of MWBE contractors and have built a vendor base that we can draw from that includes qualified MWBE firms. A typical procedure is to use this vendor base to seek out accredited firms to participate in the bidding process based on their capabilities and experience for the applicable area of the project. We actively review FedBizOpps, state-specific minority contractors' member lists, attending MWBE trade fairs, attending MWBE training workshops, and contacting the local unions for contractors listed as MWBE.

We will identify work or bid packages that are attractive, i.e. right-size, and common or standard materials that do not require any specialty equipment or tools for installation. Additionally, we will identify scopes of work that have clean scope breaks, i.e., a particular system (Domestic Solar Hot Water System), work within a designated area, i.e., mechanical room, scope per floor, etc. Clean scopes of work are easier to bid, create less confusion, are easier to manage and therefore more attractive to M/W/ESB contractors.

JOINT VENTURES

McKinstry has in place the business model to facilitate joint venture partnerships that complement specific project requirements.

MWBE FIRM DEVELOPMENT

McKinstry's mentoring programs include such issues as business consultancy, loaned employee programs, staff to staff networking, shadow activity, and business development advice and support.

WORK ACQUISITION TRAINING

McKinstry advises in such areas as pricing strategies, sales, and marketing planning. Finally, we identify top MWBE contractors in key areas where McKinstry has expertise and mentoring them to help them gain business opportunities and identify top MWBE contractors in key areas where McKinstry doesn't have expertise and leverage each other's capabilities to jointly secure work. We can also create opportunities if one does not exist: As an example, a MWBE contractor could not be found for a specialty trade and McKinstry is working with the general contractor and other sub-contractors to mentor and train a MWBE sub to open up this opportunity.

2. Management Approach

23. The ESCO's policies and procedures for recycling materials such as lamps, ballasts, fixtures, ceiling tiles, and other recyclable material.

RECYCLING PROGRAM

McKinstry's vision is 'Together, Building a Thriving Plant'. This vision is realized through our core beliefs, best practices, and processes we enact, one of which is our recycling program. We are committed to sustainable design and construction. We believe in developing and executing a comprehensive waste management plan, and seek to minimize the waste stream from projects whenever feasible. Our waste management plan not only considers the existing materials that need to be removed from the jobsite, but also the construction methods and materials that will be used for any new work being installed.

On a typical lighting retrofit project, our recycling program begins during the audit phase as we identify the quantity of scope of the proposed retrofit measures and what that means regarding the material that will be removed from the facility. We make sure our subcontractors are familiar with our expectations around the recycling of lighting materials so they build this into their work plan. This is accomplished by McKinstry providing written documentation as part of the RFQ contractor selection process that clearly articulates our recycling expectations.

We recycle the metal from removed lighting fixtures, typically to a local metal recycling organization. For lamps and ballasts, we use certified contractors who specialize in the recycling of these items. Most of the ballasts we remove generally do not contain PCBs and can be recycled. For ballasts that contain PCBs, we follow approved disposal methods and follow-up with all documentation per the requests of the Owner. We also recycle any cardboard from material packaging. Overall, all recycling is conducted in accordance with regulations published by the Environmental Protection Agency (EPA) and the State of Washington.

The following paragraphs describe the various components we take into consideration throughout a project:

Identification of Materials for Removal
The majority of all ESPC projects focus on the renovation or replacement of existing energy-consuming systems such as lights, boilers, chillers, ventilation systems, and other equipment. Due to the nature of the projects, much of the existing materials need to be removed as part of the project. Prior to beginning any project, McKinstry identifies all of the material to be removed, the disposal method, and the handling procedure. While most of the materials are typically metal or glass, it is common to encounter other materials that need to be removed in order to support either the replacement of the primary equipment or the installation of the new system(s).

Design Engineering
We believe the most successful waste management strategy is to minimize products, materials, and construction techniques that generate waste. To this point, throughout the design process, one of the key variables considered is the impact of design selections and options on the waste stream. The waste factor is weighed against other design criteria in order to provide the best overall solution to our client.

Equipment Packing Strategies
McKinstry will implement meetings with each equipment supplier to optimize shipping packaging to minimize the waste stream shipped to the jobsite. These meetings will emphasize the utilization of recycled products for packaging, minimized packaging requirements and reusable packaging that can be returned to the vendors for reuse on future packaging. Preliminary discussions with vendors suggest that significant reduction to the waste stream is possible through this effort.

We believe in developing and executing a comprehensive waste management plan, and seek to minimize waste stream from projects whenever feasible. Our waste management plan not only considers the materials that need to be removed from the jobsite, but also the construction methods and materials that will be used for any new work being installed. The following paragraphs describe the various components we take into consideration throughout the duration of the project.

2. Management Approach

24. How potential hazardous materials encountered in the installation of energy efficiency measures will be managed; and whether the ESCO has been cited by the Washington Department of Ecology, Federal Environmental Protection Agency, or any other regulatory agency for inappropriate handling, transportation or disposal of hazardous materials. If cited what was the ESCOs remedy. Being cited does not automatically constitute disqualification as an ESCO.

HAZARDOUS MATERIALS

McKinstry recognizes the critical nature of the various hazardous materials encountered while performing energy work. While new construction does not pose a threat for hazardous materials, there is the chance that hazardous materials may be encountered during the demolition, removal, and recycling of the existing structures found in the renovation process of an ESPC project. Due to this potential risk, McKinstry is covered through a $5,000,000 pollution liability insurance policy.

During the course of a project, McKinstry takes the lead role in addressing and managing any hazardous materials. All McKinstry projects are required to have a Good Faith Survey for hazardous materials before performing work. If any hazardous materials are identified, McKinstry will work with the Owner to create a management plan before there is any exposure of the hazardous material to building occupants or the construction crew. McKinstry will manage the lawful abatement process through a pre-approved subcontractor. If hazardous materials are found during construction, all construction activities will cease or move to other work areas until the abatement process is complete. McKinstry has never been cited by any governmental or regulatory agency for inappropriate handling, transportation, or disposal of hazardous materials.

3. Energy Calculations

25. Describe the methodology used to calculate baseline energy use and savings of different types of EEMs. This should include a description of various software tools that are utilized in the calculation process. Include the methodology used for campus settings that are master metered.

KEY POINTS:

- Whether or not the facility has separate metering, McKinstry develops measure-specific energy baselines using data logging equipment.
- Client input is important in developing measures and ensuring comfort with the savings guarantee.
- McKinstry engages with your utility companies in early in the project to accurately estimate utility rebates

METHODOLOGY FOR CALCULATING & MEASURING SPECIFIC BASELINES

In general, the more detailed the performance data (relative to the specific measure — e.g., kW, run time, flow rates, temperatures, and equipment efficiencies), the more accurate a baseline we can develop. Therefore, to the extent that the project constraints will allow, McKinstry will focus significant effort in collecting this data using data logging equipment. In addition, we will gather information from equipment logs, balancing reports, equipment specifications, and interviews with staff on the operation of the existing system. We will work with you to ensure that any subjective information we gather is accurate and that we are all in agreement on any assumptions made.

STEP 1: GATHER & ANALYZE DATA

At the beginning of the project, utility data is analyzed to provide an overall review at the buildings' energy use. Typically, two to three years' worth of utility data are entered into Utility Manager (UM) software. The UM software is used as a reliable storage database for basic reports and for secure Internet access to bill data. More in-depth reports are created by exporting specific pieces of data from the UM database into McKinstry's utility data analysis spreadsheet tool that incorporates heating degree day regression analysis, end use breakdown, occupancy, optimal benchmark targets, and current rate application. The utility analysis remains an important check of the energy savings, but as the project progresses, the focus shifts toward measure-specific baselines (i.e. based on real system operating parameters) with the utility bill baseline serving as a check and balance.

For campus settings that are master metered with no sub meters, McKinstry believes that the simplest method to allocate energy use is to assign a percentage of the meter to each building in the UM software—the percentage split is based on square footage, building operating hours, and building use. This generally provides the accuracy necessary for a rough scope of the energy savings potential, and the measure-specific metering (described in the following paragraph) is put in place after the rough scoping stage. For certain Facility Improvement Measures (FIM), such as a full HVAC upgrade, building meter data might be required to establish the FIM baseline—in this case McKinstry would either provide temporary logging (if possible) or we would work with the client to get a sub meter installed.

STEP 2: ESTABLISH BASELINE

Energy cost savings are calculated utilizing the baseline analysis model with new input variables and logic to reflect the post-retrofit operation of the systems. The post-retrofit input variables are based on new equipment's performance specifications and the performance criteria that are specified for the new control system. The difference between the baseline energy consumption and the post retrofit energy consumption then becomes the target energy savings. Guaranteed savings levels are then set based on the amount of control we will have over the critical performance factors associated with the particular measure. All the baseline and savings calculations are available for review as part of the Energy Services Proposal. A performance assurance plan is then developed outlining the methodology that will be used to measure and verify the savings for review and approval by the client.

CALCULATION TOOLS

Once accurate inputs are established, McKinstry's energy engineers use a combination of commercially available calculation programs and custom calculation tools developed by our engineers to determine actual

savings. A variety of tools allows us to choose best way to combine accuracy, simplicity, and time efficiency in calculating savings. If needed, McKinstry's energy engineers are capable of developing custom calculations for measures that do not fit the standard calculations. We also have a large library of custom calculations used on past projects that we can refer to as needed. A more detailed description of our standard calculation tools follows.

Computer Simulated Energy Models:
Whole-building computer simulated energy models provide the most comprehensive approach towards establishing the baseline energy performance of a building, and for predicting the magnitude in which the proposed energy saving measures will impact the baseline energy performance. Energy models utilize both user-defined and user-independent variables to construct a dynamic thermal simulation of the building. Energy models are commonly used in situations where there is extensive interaction between the various proposed measures. To ensure the accuracy of the baseline model, actual logged data is commonly fed into the baseline model. McKinstry also performs an adjustment the baseline energy model based on a utility bill end use analysis when necessary.

Watergy
This program was developed by the National Renewable Energy Laboratory. It is the industry standard for water conservation savings calculations.

Motor Master+
This is the most fully featured software available for modeling savings from motor upgrades. It includes details such as power factor, part load efficiency, etc., and has a large database of information based on manufacturer model numbers for existing motors.

Custom Worksheets
We develop custom worksheets in Microsoft Excel for situations where the energy savings calculation does not warrant simulation software. Notable spreadsheet tools that McKinstry has developed in-house include:

Lighting Tool
The lighting tool has extensive libraries of fixtures, lamps, and ballasts that contain information related to energy consumption, component life, and maintenance costs. Continually updated, the libraries make use of information from McKinstry's past lighting projects related to actual construction material and labor costs.

Standard Bin Calculation
McKinstry 's standard bin calculation accounts for internal heat gains, building insulation values, infiltration, solar loads, night setback with or without HVAC fan and outside air damper shut down, peak monthly kW, economizer operation, reheat systems such as VAV, fuel type, heating and cooling efficiency, fan energy, and end use breakdown of heating load components. It is set up so that all inputs can be varied between the base and the proposed system.

The standard bin calculation is used in cases where a full computer simulated energy model is not necessary. McKinstry's bin calculations have been created to be very flexible so they can quickly and accurately model a wide variety of energy conservation measures. We can modify this as necessary to analyze a non-standard system, which is not possible with commercially available programs.

Pool HVAC Calculation
Most energy modeling software packages are not adept at adequately modeling pool HVAC systems. Our pool HVAC calculation tool accounts for water temperatures, activity level, outdoor air specific humidity ratio, etc. It can model dehumidification using outside air, outside air with heat recovery, mechanical dehumidification, and mechanical dehumidification with heat recovery.

3. Energy Calculations

26. Describe potential scenarios where a modified baseline may be proposed.

KEY POINTS:

- McKinstry's measure-specific energy baseline inputs reduce the impact of weather and facility use on M&V.
- When necessary, McKinstry uses easy to follow methods to adjust for weather and facility use changes.
- Our Total Cost of Ownership™ model can be used to analyze many different scenarios during the development to provide decision-critical information.

POTENTIAL SCENARIOS

CHANGE OF SITE CONDITIONS

Should site conditions that are not in our control change, we will work with Owners to realize the proposed savings. Conditions beyond our control include such items as a change of use or occupancy, a change in operating hours, facility modifications, and/or varying preventative maintenance practices. An adjustment to baseline energy use may be necessary to correct for these situations, but we will first explore other alternatives. One very important advantage of the measure-specific verification approach we use is that it minimizes the impact that other site condition changes may otherwise have on a particular measure.

CODE COMPLIANCE

McKinstry's first priority in developing initiatives will be to ensure code compliance is maintained for the safety, health, and comfort of facility occupants. In situations where the system operation is not in compliance with current standards, McKinstry will bring the situation to the attention of the project team and may recommend a baseline adjustment. This modification to the baseline will represent what the energy consumption would have been, had the existing situation been code compliant.

BASELINE ADJUSTMENT METHODOLOGY

If the baseline is measure-specific, then confirming proper performance during M&V is somewhat independent of changes to weather and facility use changes. McKinstry usually does not recommend guaranteeing savings based on bill reductions for several reasons. A utility bill reduction does not prove that the system is functioning as promised. If optimal system performance is the goal, only a measure-specific M&V approach can provide enough detail to indicate performance issues. Factors such as weather and facility use are not influenced by the project and are beyond the Contractor's ability to control. Finally, the resolution of bill comparisons is much lower than the resolution of measure-specific performance indicators.

With an existing facility, it is often very useful to do a pre- vs. post- utility bill comparison for reference. When McKinstry does a bill comparison for reference purposes, we use a simple approach that focuses on making adjustments only for major factors. McKinstry provides a non-adjusted comparison as well as an adjusted comparison. For the adjusted comparison, we use a simple linear regression formula to adjust for weather, and we normalize to square footage to account for any changes in facility area. Adjustments for changes in operating hours, plug loads, etc., are done on an end-use-by-end-use basis and these adjustments are only made if they will have a significant impact on the bills.

However, our early focus on developing an accurate model that takes into consideration all relevant information regarding the proposed building minimizes adjustments to the baseline.

During the development, if the client knows of potential facility use changes or has several scenarios they wish to explore, McKinstry can evaluate these changes in the energy baseline (energy model) for review. For example, if it is known that the square footage served by a boiler will increase by a predictable amount, we will adjust for the boiler's baseline gas consumption.

3. Energy Calculations

27. Describe the ESCO's utilization of M&V processes in the establishment of baseline energy use and the post installation energy use.

METHODOLOGY FOR ESTABLISHING BASELINE ENERGY USE

McKinstry uses the M&V process to help establish the baseline energy use. By this, we mean that we need to understand the variables and methods that will be used in the M&V process so we can capture this information during the energy audit and make our baseline relevant to the proposed M&V approach. Summing it up another way, our philosophy is simply 'begin with the end in mind'. Once we have an understanding of the M&V approach, we can then successfully map out how we are going to capture the data to establish the baseline energy use.

In order to establish baseline energy use, a more specific M&V approach for proposed ECMs at a site is determined by the availability of site utility data, utility billing histories, sub-metering data, and the amount of savings to be guaranteed. Our energy engineers and energy auditors will gather the information needed to establish an accurate energy performance baseline. Many of these individuals are licensed professional engineers and/or Certified Energy Managers and have the knowledge and skill set needed to evaluate systems, gather data, and accurately model and calculate energy performance.

Please refer to our answer to Question 3, for additional information regarding McKinstry's approach to M&V processes and standards.

METHODOLOGY FOR CALCULATING POST-INSTALLATION SAVINGS

McKinstry's M&V plans are designed to verify performance through proposed energy calculations. Our M&V plans are established with input and review from our clients and DES. The M&V plan will dictate what information and data needs to be captured after the system becomes operations. Once this data has been captured, McKinstry's energy engineers use a combination of industry standard calculation programs and custom calculation tools developed by our engineers to determine actual savings. A variety of tools allows us to select the best way to combine accuracy, simplicity, and time efficiency in calculating savings. If needed, McKinstry's energy engineers are capable of developing custom calculations for measures that do not fit the standard calculations. We also have a large library of custom calculations used on past projects that we can refer to as needed.

4. Savings & Performance Guarantees

28. The ESCO's project cost guarantee policies and procedures; including remedies when project costs exceed ESCO estimates.

COST GUARANTEE

McKinstry provides a guaranteed maximum project cost (GMAX) as part of the performance contracting agreement. The cost guarantee is submitted as part of our ESP, so the client is protected prior to entering into a performance contract with McKinstry. This guarantee provision places the burden of project cost risk on McKinstry. We understand that clients are purchasing projects that have a specified minimum return on investment, and therefore the cost to the client must not increase through the project implementation. If the project scope remains the same, but the project cost increases, then McKinstry will bear the burden of those cost increases and shelter the client. If the project cost increases outside of McKinstry's control, then we will manage those increases with our clients. Should a client requests additional work to be completed outside the agreed-upon scope of services, we would add the cost of the added services to the guaranteed maximum price.

In addition to a guaranteed maximum project cost, McKinstry will provide the client with all construction labor and material cost savings based on the cost reconciliation process established for the projects. McKinstry will work with the State GA and the client to establish a construction cost substantiation process that will provide the client with confidence in the actual construction costs for the project. This typically will be handled by providing copies of actual subcontractor and equipment invoices as back up for progress billings and for the final closeout of the project.

REMEDIES WHEN PROJECT COSTS EXCEED ESTIMATES

McKinstry will establish an overall cost of project upon completion via reconciliation. At this time, if the total project costs are more than the GMAX for the agreed-upon scope of work and services, McKinstry will assume responsibility for the additional costs at no expense to the client. It is our commitment to an Owner when we enter into an ESPC. If contractor/vendor pricing is over our declared budget, we work diligently in collaboration with the vendor(s) to isolate and successfully remedy the area(s) of inflation, while not jeopardizing energy savings, quality and/or performance. To date, McKinstry has been successful in returning construction savings to the client on many of our projects.

4. Savings & Performance Guarantees

29. The ESCO's energy savings guarantee policies and procedures, including remedies when actual savings are lower than the ESCO's estimates and guarantees, and the length of the savings guarantees.

OUR PHILOSOPHY

McKinstry guarantees savings for any portion of a project which we can exercise direct control of the installed systems. Where McKinstry does not have direct control (e.g., burn hours associated with lighting), we will work with Owners to devise a method of Measurement &Verification (M&V) that will provide the highest degree of assurance that the energy cost savings are realized. While our standard practices are described below, it is important to note that we are flexible in modifying our guarantee to meet the client's specific needs. As the overall success of a project relies on the long-term performance of the measure, it is important that both McKinstry and you are comfortable with the verification process.

ENERGY SAVINGS GUARANTEES POLICIES & PROCEDURES

M&V is the critical development and management tool that defines the energy baseline, verifies the post-installation conditions and energy use, and provides the assurance that the savings are being generated as guaranteed. We work with the client to develop a measure-specific performance assurance (PA) program that validates that optimal performance of your new system(s) is maintained throughout the life of the energy services contract. "Measure-specific" means that, wherever possible, we will install measuring and logging equipment directly on the equipment responsible for the energy savings. This approach minimizes the impact that other site changes may otherwise have on a particular measure. McKinstry presents an easy-to-follow table, clearly listing which values will be measured and quantified for each FIM at every stage of the guarantee—from baseline development, to commissioning, to ongoing performance assurance. The information can be reported to the client on a monthly, quarterly, or annual basis. An important core value of the PA report is the ongoing information it provides to further optimize the client's building operations. Regardless of when guaranteed savings are achieved, we work to provide meaningful information and recommendations for further energy savings based on any trends apparent in the data collected.

McKinstry adheres to the International Performance Measurement and Verification Protocol (IPMVP) in performing M&V procedures. This internationally recognized standard provides several different avenues for verifying a particular measure: Measure and Monitor, Measure and Stipulate, Multivariate Utility Bill Regression, and Standard Utility Bill Comparison. Each of these procedures provides a varying degree of accuracy, complexity, and cost. We rarely rely on utility bill comparison as the method of guaranteeing savings because, in many instances, it is difficult to disseminate the actual savings attributable to a particular measure—we do employ bill comparison as the verification method for specific FIMs where the utility meter serves a single end use and the proposed savings represent a significant fraction of the bills.

REMEDIES FOR WHEN ACTUAL SAVINGS ARE LOWER THAN ESCO ESTIMATES

McKinstry takes responsibility for remedying any shortfalls by correcting system performance or making monetary payment. If energy savings are tracking short of the guarantee level, our first response is to identify and correct the reason for the shortfall, to the extent that the comfort, safety, and health of the occupants are not compromised. If efforts are not successful and an annual energy shortfall is realized, McKinstry will pay the owner the difference. McKinstry currently has no savings shortfall situations with its customers that haven't been field correctable—this is due to the methodical way in which we develop good baselines and solid savings estimates based on well thought out FIMs. All savings exceeding the guaranteed level are returned to our clients.

LENGTH OF SAVINGS GUARANTEES

McKinstry will guarantee the energy savings for the project based on the client needs and desires. At a minimum, we guarantee one year of savings. We will work with Owners and the DES to determine a guarantee that best meets the needs of the project. In some cases, we have provided guarantees that cover the length of the financing period, which is typically 10 years or longer.

4. Guarantees

30. The ESCO's equipment performance guarantee policies and procedures, including remedies when performance of equipment is not met.

KEY POINTS

- In or out of warranty, McKinstry will be there to respond to all of your issues. We provide a one–year minimum warranty on all projects.
- McKinstry utilizes a web–based warranty management system that allows clients to log and track warranty issues.
- McKinstry leverages our unmatched buying power in the region to extend or enhance typical equipment warranties.
- We provide a single point of contact for long–term accountability.

EQUIPMENT PERFORMANCE GUARANTEE AND PROCEDURES

McKinstry's guarantee of performance allows us to commit to our clients that the equipment and systems installed will meet or exceed established performance standards. Our first priority will be to make certain that all newly installed equipment and systems will operate to ensure occupant safety, health, and comfort. The second priority will be to meet the project's operational and utility savings.

We will commission projects to ensure all equipment and systems installed meet or exceed performance standards. We guarantee installation and workmanship for one year against defects. Equipment typically carries the manufacturer's warranties, yet based on our relationship with vendors, we will extend warranties at no or low cost.

McKinstry offers more options due to our network of buying power and our relationships with local equipment providers. We are able to reduce the initial cost of equipment, in addition to being able to arrange for extensions to the warranty period of the equipment. This combination of strong buying power and extended warranties gives us a value-added advantage that further enhances our performance guarantee.

REMEDIES WHEN PERFORMANCE OF EQUIPMENT IS NOT MET

If the equipment is maintained based on the manufacturer's guidelines, yet it does not meet performance standards, McKinstry will take the necessary steps to correct or improve equipment performance. If it is determined that the newly installed equipment has failed, we will find a final repair resolution or we will replace it.

An example of this approach and our commitment occurred at the City of Spokane. McKinstry had completed a controls upgrade in one of their police facilities and the system was not working correctly. We attempted to resolve the issue through re-commissioning of the system and on-going troubleshooting. At the end of the day, these steps were not enough – the control system was simply not a good solution for the system and the space. As a result, McKinstry authorized our control vendor on the project to replace the poorly functioning system with a new system at no cost to the City of Spokane, but at a cost of over $35,000 to McKinstry.

4. Guarantees

31. Provide information on the ESCO's warranty enforcement role and the ESCO's responsibility, if any, when there is an equipment failure beyond the warranty period when the client agency has financed the project and assumed ownership of the installed equipment.

WARRANTY APPROACH

McKinstry is very experienced in system performance and warranty concerns. We understand the value of equipment performing as intended. We routinely complete services—at no additional cost to the customer—after the original warranty expires to ensure our clients are satisfied and that the system operates as intended. McKinstry will provide a single point of contact for long-term accountability regarding maintenance and training on all new equipment installed as part of any project. We do not defer ownership of any warranty issues to our contractors and vendors that installed the work.

KEY POINTS

- In or out of warranty, McKinstry responds to all of your issues. We provide a one–year minimum warranty on all projects.
- Controls carry a one-year warranty and set point adjustments are provided without charge for 30 days.
- Balancing work will be certified at final acceptance with minor airflow adjustments made, free of charge for 30 days.
- Warranty period starts at date of substantial completion or occupancy.

WARRANTY SUPPORT

McKinstry takes on the administrative headache often associated with warranty management. McKinstry can implement our Knowledge Response Center (KRC), an innovative 24x7 web-based system suite that allows clients to log and track warranty issues. The KRC utilizes the web-based platform InfoCentre™ to document relevant facility data and work flow processes in order to effectively and efficiently manage your equipment's warranties. This process provides a single repository of archived information relevant to your specific facilities – clients are able to view warranty requests, note when the issue was logged, view progress on the issue, and receive confirmation when the issue is resolved. All this is handled seamlessly with minimal time commitment from the client organization. In addition, this process provides a single repository of archived information relevant to your specific facilities. Our standard warranty services include:

- Development and management of the warranty work order process;
- Management of the vendor dispatch process;
- Tracking and follow up on completion of work;
- Routine vendor performance reporting;
- Follow up with customer and project team on work satisfaction;
- Ongoing equipment status and warranty work reporting details; and
- Warranty preventative maintenance management and scheduling.

EQUIPMENT FAILURE OUT OF WARRANTY

McKinstry values our client relationships. This philosophy is demonstrated in how we take care of equipment and/or system failures outside of the warranty period. While we will not make a blanket statement about fixing any problem at any time at no cost to the Owner, our commitment will be to work with the Owner to solve the problem in a mutually agreeable fashion. A recent example of this approach occurred at Eastern Washington University where some pool piping had become severely corroded due to the chlorinated water that was circulated through the piping. The piping material, while not ideal for pool water, was approved by the client and installed by McKinstry. We could have simply told our client that since the project was out of warranty (it had been constructed approximately five years earlier) and since the design was reviewed and approved by EWU, it was their responsibility. Instead, McKinstry spent $17,000 to remove and replace the piping. This one example demonstrates our commitment to stand by our work, in and out of warranty.

Financing Projects

32. The ESCO's project financing ability. Describe capability for carrying costs until completion of the installation of energy efficiency measures. Describe capability and willingness to fully finance project over a financing term including how the interest rate the ESCO would use is determined. Provide letters of commitment from funding sources or from ESCO's Chief Financial Officer if self-funded. Tax-exempt municipal lease financing does not qualify for ESCO financing ability.

KEY POINTS

- McKinstry is a financially strong and stable company with a history of profitability.
- Our insurance and surety carriers both carry A++, XV AM Best ratings.
- McKinstry will actively pursue any and all grant funding, options for in-kind donations, and utility incentives.
- Financing packages are not viewed or structured to create income for McKinstry.
- McKinstry has key relationships with third party banking and financing institutions, with the ability to finance substantial long-term projects (up to 20 years).
- We work with clients to determine the most fiscally responsible financing program.

FINANCING ABILITY

McKinstry is uniquely positioned to provide maximum financing flexibility to its clients via McKinstry Capital. McKinstry Capital is a privately held financial services company that concentrates its efforts on capital formation and optimization for energy efficiency and renewable energy production infrastructure. McKinstry Capital enjoys the freedom that comes from its independence as a financial services provider not beholden to any single source of capital. Rather, it accesses several sources of third party capital as well as its own proprietary sources.

McKinstry Capital consults with clients to understand unique objectives and constraints, evaluate financial solution alternatives, and develop a customized financing solution to meet the client's goals. McKinstry Capital accomplishes its two-fold objective of reducing the amount of debt required, and securing the lowest cost capital solution, by monetizing grants, rebates, and tax incentives and then utilizing one or a combination of the following structures and vehicles:

Qualified Energy Conservation Bond (QECB)

Tax Exempt Bond

Industrial Development Bond (IDB)

Tax-Exempt Municipal Lease Purchase Agreement

Shared Savings Agreement (SSA)

Power Purchase Agreement (PPA)

Public/Private Partnership Structure

Commercial Loan

We do not structure financing packages for internal profit and gain; we develop a thorough understanding of client needs. With this information, we then solicit financing packages from various entities through an RFP process, and provide the results to our clients for review and direction. McKinstry also focuses on maximizing utility rebate incentives. The dollars available through utilities can play a very important role in overall project funding. Finally, any means of supplemental and creative funding are explored, such as grant programs and in-kind donations.

Our financial approach is to assist in obtaining the lowest rates for project implementation, while maximizing the project scope. All costs associated with projects, including finance, can be funded by the project, so there are no new budget items, but simply the redirection of some of the existing budget dollars you have today. To assist our clients we developed a financial pro-forma work sheet that incorporates all of these financial variables.

We have provided letters of commitment from our banker, Jill Scheuerman, VP & Senior Relationship Manager at KeyBank and Surety Company, HUB International NW, at the end of this section.

Financing Projects

GRANTS, FUNDS OR OTHER GOVERNMENT PROGRAMS

McKinstry has the in-house resources to serve as a single-point of contact for our clients, including the ability to identify, apply for, and successfully administer grants on behalf of our clients. McKinstry has been very successful in assisting public schools and colleges with securing energy-related grants. We have helped our clients secure a total of $95 million in grant funds for clients in nine states. In Washington State, McKinstry has been the leader in securing Jobs Now and Jobs Act grants for our clients over the past several years. These grants have proven to be an invaluable source of funding for our clients and have allowed our clients to implement energy-saving projects worth a total of $202 million.

CONSTRUCTION PERIOD FINANCE

We can provide construction period financing until the construction has been completed and permanent financing has been secured. Under this scenario, the Owner would be charged a short term finance charge in order for McKinstry to carry the cost of the project until complete. The financing charge will depend on market conditions at the time of project. In any situations where this occurs, McKinstry will fully document the cost of the financing prior to commitment from the Owner so they can evaluate their options and make the decision that's best for their organization.

INTERNAL ESCO FINANCING

McKinstry can directly provide long-term funding for client financing needs; however, we can secure those funds only at commercial interest rates. Interest rates offered to customers are dependent on many factors, including security, and loan tenor. To develop the interest rate, McKinstry Capital uses a Treasury Constant Maturity rate appropriate to the term of the financing plus a risk adjusted spread that may vary from 200 basis points to 500 basis points. Therefore, clients may be better served to consider financing from one of our financing partners. McKinstry does not endeavor to gain profit from the financing of these projects; we seek out the most cost-effective finance program for each project and present those options to the client.

EXTERNAL FINANCING

In the event that a project requires long-term financing, we will source capital from local, regional, or national banking partners. In any event, our goal is to support our clients with the most fiscally responsible financing program. Traditionally, these financial arrangements have been advantageous to our clients. They provide low interest rates and can be implemented rapidly. McKinstry will also be happy to work with any local banking entities that want to finance a client's project, and will provide assistance to the local entity regarding supporting legislation if necessary.

There are many financing options available to public clients, including:

- **Qualified Energy Conservation Bonds**: (QECBs) may be issued by state and local governments to finance energy efficiency capital expenditures, mass transit or green community programs, and renewable electricity production projects.
    - These bonds provide for a lower cost of borrowing by offering a subsidy in the amount of 70% of the stated tax credit rate to the bondholder in the form of direct cash payments. This subsidy lowers the effective borrowing rate for the bondholder to levels generally below tax–exempt rates, approximately 2%-3%, dependent on the overall credit of the borrower, term and security.
    - Bonds can be issued for terms up to 24 years; the term limit may change at the discretion of the US Treasury.
- **Washington State Treasurer Financing:** We highly recommend the LOCAL and MLPP programs

offered by the State Treasurer's Office for their low rate and ease of use. We are committed to working with our customers to secure the best funding available for their projects.

- **Tax-Exempt Lease Purchase (TELP)**: also known as a tax-exempt capital lease or municipal lease purchase is an installment purchase contract that most public entities and private tax-exempt entities can use to finance equipment and capital projects at a low fixed interest rate. The effective interest rate depends on the strength of collateral, the borrower's credit worthiness, the duration of financing, and current market rates but is typically approximately 2.5%-4.0%. In true Energy Performance Contracting, savings from energy efficiency equipment installation can be used as lease payments, resulting in a budget-neutral solution.

- **Tax Exempt Bond**: A tax-exempt bond is debt instrument issued by a governmental entity, including states, cities, counties, school and fire districts, airports, and special purpose districts. Similar to a loan, the public entity issuer promises to pay the lender, or bondholder, interest and principle at agreed-upon rates and terms. Under the current tax code, the interest income paid to the bondholder is exempt from federal income tax, making these bonds highly attractive.

    - Tax-exempt bonds can be sold via a public sale or private placement. A public sale is typically held for larger issuances, while private placements are used for smaller or specialized debt issuances.

    - As in the case of TELPs, savings from energy efficiency improvements can be used as a repayment stream, resulting in budget-neutral or budget-accretive financing solutions.

OTHER FINANCING METHODS

THIRD PARTY OWNERSHIP MODELS

A third party ownership structure will allow the a public entity to realize the cost savings benefit of using energy efficient equipment and renewable energy or carbon-based energy production equipment without the responsibilities and liabilities associated with owning them. These structures are known as Shared Savings Agreements (for energy efficiency equipment), and Power Purchase Agreements (for energy production systems).

Shared Savings Agreements allow entities to replace failing infrastructure with high performance systems owned by others. Under these structures, equipment is owned by a third party but the user hosts the equipment on its property and is charged a per unit charge of avoided energy costs. As such, the host benefits from reduced energy consumption without up-front expenditures and the liabilities associated with ownership. These structures require extensive measurement and verification to validate savings and have end of term considerations. McKinstry Capital is knowledgeable of these structures and familiar with financial firms who offer this solution.

Power Purchase Agreements allow entities to purchase renewable or conventional energy generated by a system owned by a third party on a per kWh or per Therm unit basis. PPAs allow entities to benefit from renewable energy without ownership responsibilities; furthermore, PPAs allow tax-exempt entities to indirectly monetize robust financial incentives available for renewable energy systems. McKinstry Capital has experience negotiating PPAs and establishing financial metrics for systems.

KeyBank
Seattle Commercial Banking
1301 Fifth Ave., 24th Floor
Seattle, WA 98101
PH: (206) 684-6203
FX: (206) 689-5959

February 6, 2013

Joseph Hagar, Director of Finance
McKinstry Essention, LLC
5005 Third Avenue South
Seattle, Washington 98124

RE: McKinstry

To Whom It May Concern:

With respect to your consideration of an RFP from McKinstry the following information may prove useful.

We have enjoyed a banking relationship with the company since 2001. Currently, KeyBank makes available to McKinstry operating lines of credit with commitments aggregating in the mid eight-figures of which a mid seven-figure balance is currently outstanding, giving the company a significant current financing capability. Throughout our banking relationship the company has consistently met its payment responsibilities.

In addition to the above referenced credit facilities, we would be happy to entertain any project specific financing needs McKinstry may have. In these circumstances, normal due diligence would apply, including review of the project scope, credit capabilities and history of the project owner and confirmation of the borrower's sound ongoing performance.

Please feel free to contact me if additional information would be helpful.

Sincerely,

Jill Scheuermann

Jill Scheuermann
Vice President & Senior Relationship Manager

HUB International Northwest, LLC

Insurance . Bonds . Employee Benefits

12100 NE 195th Street, Suite 200
P. O. Box 3018
Bothell, WA 98041-3018
Office 425/489-4500
Fax 425/485-8489

February 6, 2013

Mr. Joseph Hagar
McKinstry Essention, LLC
5005 3rd Ave. South
Seattle, WA 98124

Re: Surety Facility
McKinstry Essention, LLC

Dear Joseph:

As surety broker for McKinstry Essention, LLC, we are pleased to provide comments concerning their capabilities and bonding. McKinstry Essention, LLC maintains an outstanding construction organization and project management staff, and enjoys an excellent reputation for the timely delivery of quality workmanship to satisfied customers. They have always conducted business matters in a highly professional manner.

CNA Surety Companies is the surety company for McKinstry Essention, LLC. CNA Surety has committed to bonding single projects in excess of $100,000,000 and an aggregate work program in excess of $350,000,000. These figures should not be construed as a limitation of bonding capabilities, but rather as an indication of the level of support we have provided this organization. CNA Surety Companies is listed on the federal registry and has an A.M. Best rating of A XV.

The decision to provide performance and payment bonds is subject to satisfactory review of final contract terms and conditions, including financing arrangements acceptable to McKinstry Essention, LLC and CNA Surety.

If you have any further questions, please do not hesitate to call me at (425) 489-4519. We would be happy to provide any assistance we can.

Sincerely,

Michael A. Murphy
Executive Vice President
HUB Northwest

Appendix A
Sample Performance Contract

a Preliminary Audit Findings
b Audit Proposal
c Measurement and Verification Plan
d Investment Grade Audit Findings
e Energy Services Proposal
f Measurement and Verification Report

Appendix A

Preliminary Audit Findings

McKinstry has had an on-going relationship with Valley Medical Center for many years. We have successfully developed and implemented multiple phases of work in collaboration with the Owner and DES over this time period. Some of these phases of work have been developed based on direction from the Owner, while others have been developed through a more exploratory process by the team to determine appropriate measures to implement.

For the project included in response to this RFQ, McKinstry had clear direction on the needs and desires of the client. We also had the experience in working with the client to understand the proposed project was feasible to complete through the ESPC process. As a result, the team opted to not complete a preliminary audit and instead, moved directly to develop an audit proposal.

State of Washington
Department of General Administration
Facilities Division
Engineering & Architectural Services
210 11th Avenue, SW • PO Box 41012 • Olympia, WA 98504-1012
(360) 902.7272 • FAX (360) 753.2848

July 8, 2011

McKinstry Essention
PO Box 24567
5005 3rd Avenue South
Seattle, WA 98124-0567

RE: ESCO Contract No. 2010-252 H (2-1)
Heating Water, Dual Duct AHU, Lighting Upgrade & Solar PV Project
Valley Medical Center

We have enclosed the following documents:

1. Energy Service Company Contract with payment and performance bond.
2. Certificate of Insurance form and memo for your insurance agent.
3. Retainage investment form.

Please be advised that the General Conditions for Washington State Facility Construction require that the above listed documents be returned to Engineering & Architectural Services (E&AS) within 15 days of receipt, or E&AS may terminate the award of this ESCO contract. Transmittal of this ESCO contract for signature and request for bond and insurance does not obligate E&AS to proceed with award. This ESCO contract is not binding upon the State of Washington until it has been duly signed by E&AS' contracting officer.

Should you have any questions about this contract package, please call Eddie Miller, Contracts Specialist, at (360) 902-7219.

Sincerely,

Todd Flynn, P.E.
Energy Engineer

TF:em

Enclosures

cc: Todd Thomas, Valley Medical Center

ESCO Contract No.	2010-252 H (2-1)
Project	Heating Water, Dual Duct AHU, Lighting Upgrade & Solar PV Project
Agency	Valley Medical Center
Date	July 8, 2011

STATE OF WASHINGTON

ENERGY SERVICE COMPANY (ESCO) CONSTRUCTION CONTRACT

For the FACILITIES DIVISION, ENGINEERING & ARCHITECTURAL SERVICES

This Energy Service Company (ESCO) Construction Contract, made and entered into this 8th day of July, 2011, shall be the agreed basis of performing the following work by and between the State of Washington, Valley Medical Center acting through the Department of General Administration, Facilities Division, Engineering & Architectural Services, hereinafter referred to as the Owner, and

McKinstry Essention
5005 3rd Avenue South
PO Box 24567
Seattle, WA 98124-0567
Telephone (206) 762-3311
Fax (206) 658-1769

hereinafter referred to as the ESCO or Contractor.

WITNESSETH: Whereas the parties hereto have mutually covenanted and by these presents do covenant and agree with each other as follows:

FIRST: The said ESCO agrees to furnish all permits, material, labor, tools, equipment, apparatus, facilities, etc., necessary to perform and complete in a workmanship like manner the work called for in the attached Scope of Work, Energy Services Proposal dated May 4, 2011 and the latest revision dated June 21, 2011, for:

Energy Services Authorization No. 2011-252 B (2)
Master Energy Services Agreement No. 2009-151 D (4)

Audits and Proposals for this project were prepared by the ESCO according to the terms of the Contract Documents which include, but are not limited to, the Master Energy Services Agreement, Energy Services Authorization(s), the accepted Proposal, *Conditions of the Master Energy Services Agreement, Instructions to Bidders/General Conditions/Supplemental Conditions For State Facility Construction, EPC Modifications to Instructions to Bidders/ General Conditions/Supplemental Conditions For State Facility Construction*, Addenda, Specifications, Drawings, Bond, and this Construction Contract.

SECOND: Time of Completion: The work to be performed under this contract shall commence as soon as the ESCO has been officially notified to proceed and shall be substantially complete within 210 consecutive calendar days after the date of Notice to Proceed.

THIRD: The apprenticeship labor hours required for this project are 15% of the total labor hours. The undersigned agrees to utilize this level of apprentice participation. Voluntary workforce diversity goals for this apprentice participation are identified in the *Instructions to Bidders* and *Supplemental Conditions*.

FOURTH: In consideration of the Performance of the Work, herein contained on the part of the ESCO, the Owner hereby agrees to pay the ESCO for said work completed according to the Contract Documents, for not more than the sum of $1,820,461.00, plus 9.5% state sales tax consisting of the following:

ESCO Contract Cost	$ 1,820,461.00

The ESCO shall bond this contract at 100% of the construction contract cost, plus Washington State sales tax, per Section 13 of the Conditions of the Energy Services Agreement. The construction value is a guaranteed maximum not-to-exceed cost and final payment to the ESCO shall be reconciled to reflect the actual installed cost provided it does not exceed the guaranteed maximum cost.

FIFTH: ESCO payments to subcontractors and materialmen shall not be contingent upon the ESCO receiving payment from the Owner. Unless otherwise agreed upon, payment to the ESCO shall be made only after completion of the energy efficiency measure(s) and the ESCO has issued a Notice of Commencement of Energy Savings and the Owner has accepted such Notice.

IN WITNESS WHEREOF: The said Department of General Administration, Division of Engineering & Architectural Services, has caused this ESCO Construction Contract to be subscribed in its behalf, and the said ESCO has signed this ESCO Construction Contract the day and year first above written.

ESCO:	Owner:
McKinstry Essention	Facilities Division Engineering & Architectural Services
By _____	By _____
Name _____	Name John W. Lynch, P.E.
Title _____	Title Assistant Director
Date _____	Date _____

Washington State Contractor's License No. MCKINEI942JQ

Federal Tax ID No. 91-2055773

UBI Number 602 039 273

MWBE Certification No. _____

E-mail address: asha@mckinstry.com

July 8, 2011

SCOPE OF WORK

ESCO Contract No. 2010-252 H (2-1)

Heating Water, Dual Duct AHU, Lighting Upgrade & Solar PV Project
Valley Medical Center

Furnish and install the energy efficiency measures, including any and all necessary ancillary equipment, as described in the Valley Medical Center Energy Services Proposal dated May 4, 2011 and the latest revision dated June 21, 2011.

Assignment To Successor Washington State Government Entity Due To Transfer Of Authority. In the event that the authority of GA is withdrawn by operation of law or otherwise, and that authority is transferred and vested in a successor Washington State government entity, with written notice to VMC from an authorized agency of the state of Washington, this Agreement may be assigned to such successor Washington State government entity. The assignment of this Agreement under the aforementioned conditions shall not relieve the parties of their duties and/or obligations hereunder.

State of Washington
Department of General Administration
Facilities Division
Engineering & Architectural Services
210 11th Avenue, SW • PO Box 41012 • Olympia, WA 98504-1012
(360) 902.7272 • FAX (360) 753.2848

July 8, 2011

RETAINAGE INVESTMENT

ESCO Contractor	McKinstry Essention
ESCO Contract No.	2010-252 H (2-1)
Description	Heating Water, Dual Duct AHU, Lighting Upgrade & Solar PV Project
Client Agency	Valley Medical Center

Pursuant to R.C.W. 60.28, you are required to exercise your option, IN WRITING, on whether or not monies reserved from the amounts due you on the above contract shall be placed in escrow. You are therefore directed to complete and return this form with the signed copy of the above contract to the Division of Engineering & Architectural Services.

Should you desire to have the retained monies invested, it will then be necessary that you enter into an escrow agreement with a bank, trust or savings and loan company, and the above Client Agency.

This form will be transmitted to the Client Agency for further action in preparing the escrow agreement.

ENERGY SERVICES CONTRACTOR'S OPTION

_____ I do not request retainage on the above contract to be invested.

_____ I hereby request retainage on the above contract be invested.

_____/Date_____
Signature

_____
Title

Table 3.2 - M&V Plan Outline

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Date	5/4/2011

Facility Improvement Measures	Building	Key Performance Indicators	Agreed Upon Criteria for Guarantee: Baseline Values	Agreed Upon Criteria for Guarantee: Proposed Values	Agreed Upon Criteria for Guarantee: Stipulated Factors	Audit Stage (Baselining) Tasks	Post Retrofit Stage (Commissioning) Tasks	Annual Tasks	On-going Owner Responsibilities
01.01-VMC Heating Water Upgrade	Valley Medical Center	1. Converter Size 2. Converter Jacket Loss 3. Efficiency of steam boiler 4. Hours of Operation 5. System pump BHP 6. System pump flow control; load profile 7. Average Heating Water Delta T	1. Preheat System: 19,500 MBH; Reheat System: 4,000 MBH &13,000 MBH 2. Preheat System: 0.25%; Reheat System: 0.5% 3. 80% 4. 24/7 5. Preheat System: qty 2 30-hp; Reheat System: qty 2 10-hp, qty 2 25-hp 6. Preheat System: Constant Volume; Reheat System: qty 1 10-hp pump has VFD, remaining qty 3 pumps are CV. Load Profile of pump with VFD is constant at 8.4 Amps. 7. Preheat System: 10 deg F; Reheat System: 25 deg F	1. Preheat System: 10,338 MBH; Reheat System: 14,905 MBH 2. Preheat System: 0.13%; Reheat System: 0.25% 3. 80% 4. 24/7 5. Preheat System: qty 2 20-hp; Reheat System: qty 3 50-hp 6. Preheat System: VFD; Reheat System: VFD; Refer to calculations for Load Profile 7. Preheat System: 10 deg F; Reheat System: 25 deg F	Instulation quality of existing converters, building loads, outside air temperature.	1. Verify Converter Sizes 2. Visual inspection of insulation on converters and heating water plant. 3. Stipulated at Code Minimum Value. 4. Review of pump operation logs (pumps are manually staged). 5. Verify pump sizes. 6. Verify pump operation. 7. Trend 1 week HWS and HWR temperatures	1. Review Converter submittals. 2. Verify converter and corresponding system is properly insulated. 3. No task. Boiler efficiency is assumed constant. 4. Provide point to point functional testing of the new reheat and preheat system converters, and controls sequence modifications 5. Review Pump submittals. 6. Provide point to point functional testing of the new VFDs on the system pumps. 7. Provide testing and balancing for terminal unit reheat coils.	1. No task required. 2. Verify converter and corresponding system is properly insulated. 3. No task. System demand is assumed constant. 4. No task. Boiler efficiency is assumed constant. 5. Review Pump submittals. 6. Trend/Alarm/log controls sequence to verify operation per design documents. 7. Trend/Alarm/Log pumps to verify VFD modulates to meet system load.	Maintain equipment per manufacturer recommendations.
03.01-VMC Dual Duct Unit Replacement	Valley Medical Center	1. Fan Operation 2. Discharge Air Temperature	1. Fan rides the fan curve 2. 55 Deg F	1. VFD adjust fan speed to meet static pressure setpoint 2. Discharge Air Temperature resets based on system feedback	Elevated baseline to compare design unit without a VFD or Discharge Air Temperature reset to the proposed design unit with a VFD on the Hot and Cold deck fan and Discharge Air Temperature reset. Stipulated factors: Annual Operation hours, building loads, outside air temperature, filter pressure drop.	1. No action required 2. Record DAT setpoint	1. Verify newly installed system performance matches existing fan measurements. Back down new fan airflow to match existing CFM. Provide functional performance testing on VFD operation. 2. Working with building operator to set DAT reset points on trial by error process without comfort complaints. (No feedback from boxes).	1. Trend supply fan kW to show VFD operation (7 days) 4. Trend Discharge Air Temperature (7 days)	Maintain equipment per manufacturer recommendations. Inform McKinstry of any changes to control sequence and setpoints.
09.01-VMC Surface Parking Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
09.02-VMC Lobby Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
09.01-TLB Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
24.01-VMC Solar PV Installation	Valley Medical Center	1. Total Incident Solar Radiation. 2. Net PV System Production. 3. PV System AC Electricity Generation Effectiveness. 4. PV System Performance Ratio. 5. Total Facility Energy/Electricity Use	1. Time-series measurement of insolation, array area. Refer to PV Watt software. (stipulated) 2. None. 3. None. 4. None. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis. (stipulated)	1. Time-series measurement of insolation, array area. Refer to PV Watt software. Same as baseline. 2. Total PV system production and standby use. Refer to calculations. 3. Total incident solar radiation and net PV system production. Refer to calculations 4. PV system AC electricity generation effectiveness and rated PV module efficiency. Refer to calculations. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis. Same as baseline.	Environmental conditions (Solar radiation)	1. Time-series measurement of insolation, array area. Refer to PV Watt software. Same as baseline. 2. Total PV system production and standby use. Refer to calculations. 3. Total incident solar radiation and net PV system production. Refer to calculations 4. PV system AC electricity generation effectiveness and rated PV module efficiency. Refer to calculations. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis.	1. Photos of installation.	1. Photos of installation to ensure maintenance.	Maintain equipment per manufacturer recommendations.

Confidential and Proprietary

February 20, 2013

Mr. Todd Thomas
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Valley Medical Center
400 South 43rd Street
Renton, WA 98055

Mr. Robert Johnson
Project Manager
Department of General Administration
Division of Engineering & Architectural Services
PO Box 41012
Olympia, WA. 98504-1012

Subject: DIRECTED ENGINEERING STUDY PROPOSAL
VALLEY MEDICAL CENTER – AHU AND LIGHTING UPGRADES

Valley Medical Center is interested in improving the infrastructure of their existing facilities by assessing energy savings opportunities with McKinstry. This proposal will provide the guidelines for which McKinstry will provide the following tasks:

1. Conduct a Directed Engineering Study associated with the East and West Penthouse AHU and terminal box upgrades, and various Pneumatic to DDC upgrades.
2. Conduct a Directed Engineering Study associated with lighting upgrades to the main hospital, NW Pavilion and service parking areas.
3. Constructability review, mechanical installation coordination, preliminary project schedule development and construction estimating review.
4. Project specification coordination and review.
5. Develop a comprehensive Energy Services Proposal for the identified systems and initiatives.
6. Alternative – tax exempt financing solutions.

The target facilities to be studied are as follows:

- ✓ MAIN HOSPITAL CAMPUS - 400 SOUTH 43RD STREET, RENTON, WA 98055
  - MAIN HOSPITAL
  - NW PAVILION
  - RADIATION ONCOLOGY BUILDING
  - SURFACE PARKING AREA LIGHTING
  - DAY SURGERY BUILDING
  - TENANT AREAS OF MEDICAL ARTS CENTER LEASED BY VMC
  - TENANT AREAS OF TALBOT PROFESSIONAL BUILDING LEASED BY VMC

The target infrastructure systems to be studied are as follows:

- ✓ HVAC upgrades
  - West Penthouse SAF 1 and SAF 2 serving West Wing patient rooms.
  - East Penthouse SF 1 serving second floor radiology, lab and pathology areas.
  - East Penthouse SF 4 serving Kitchen and Service areas.
- ✓ Controls upgrades
  - West Wing Patient Areas
  - Lab and Radiology Areas
  - Radiation Oncology Building

- ✓ Lighting upgrades
  - Surface Parking Areas
  - Main Hospital Lobbies
  - Radiology Wing
  - Day Surgery Building
  - NW Pavilion
  - Leased areas of MAC and Talbot Building

- ✓ Renewable Initiative Development
  - Solar PV
  - Solar Hot Water
  - Wind Power

ACTIONS TO BE PERFORMED: McKinstry will complete the following actions leading to implementation of performance-based initiatives:

Conduct a Directed Engineering Study. The investment grade effort is intended to lead to the implementation of facility improvement measures. The DES will provide all the details necessary for implementation of viable initiatives detailing all the associated savings, costs, potential utility funding, and return on investment scenarios, as well as loan details (if applicable) and construction schedules.

The DES will be a product of the direction McKinstry receives from Valley Medical Center. It is anticipated that the information contained in the DES will form the basis of a proposal and contracting documents.

The specific deliverables associated with the directed engineering study can be found in *Attachment A*.

REQUESTED INFORMATION: For effective execution of this letter of intent we ask that Valley Medical Center be prepared to provide or make available any of the following information not previously provided:

- ✓ Historical utility bills for the last 36 months.
- ✓ All mechanical, electrical, architectural, and structural drawings.
- ✓ All operational and maintenance manuals, balancing records, & specifications.
- ✓ Operational records related to the cost of maintaining specific equipment.
- ✓ Service records and information from existing service providers.
- ✓ Information with regards to any on-going maintenance contracts
- ✓ Access to individuals that have relevant information pertaining to the day-to-day operation of energy using systems on site.

TIMELINE AND MILESTONES: McKinstry will initiate this scope of work immediately upon acceptance of this letter of intent. Formal progress review meetings will be conducted regularly throughout the study phase. During these review meetings, McKinstry will recommend measures based on preliminary analysis, while Valley Medical Center will provide final direction regarding recommended measures. The goal of these review meetings is to focus engineering efforts, budgeting, and savings assessment on those measures that possess a high probability for implementation. During this time, McKinstry will provide a detailed measurement and verification plan for the energy savings. McKinstry will target completion of the Directed Engineering Study within 30 days of approval of the Proposal.

The following are proposed milestones:

- 04/14/2010 - Directed Engineering Study Authorized by Valley Medical Center
- 06/14/2010 - McKinstry to Deliver Pre-Final Analysis and Recommendations

- 06/30/2010 - VMC & State GA Review Comments and Direction Given on Measures
- 07/07/2010 - McKinstry to Deliver Final Investment Grade Analysis & Energy Services Proposal
- 07/14/2010 - Implementation Agreement Authorized and Work Started
- 12/31/2010 - Anticipated Construction Completion.

CRITERIA FOR IMPLEMENTATION: It is Valley Medical Center's intent that McKinstry will implement all approved projects that meet the following criteria:

- ✓ Aggregate simple payback for mechanical & electrical infrastructure work shall be equal to or less than the useful life of the equipment/system less any utility rebates. Savings will include utility and may include hard-cost operational savings (at the owner's approval).
- ✓ For lighting improvements in leased spaces, project payback must fall within the terms of the lease. For the Talbot Center, payback must be complete before 1/31/2019. For the Medical Arts Center, payback must be complete before 4/30/2023.
- ✓ For installation, a finance term no greater than Fifteen (15) years through a lending program of the owner's choice will be presented and used to determine the viability of the non-capital portion of the performance contract.
- ✓ McKinstry will work with the following utilities to secure conservation grant funding or low interest loans for applicable initiatives:
  - Puget Sound Energy
- ✓ Not more than 90% of the Energy Cost Savings may be used to repay the loan.
- ✓ The owner's cash flow including savings, utility contributions, monitoring, cost of ECM's, loan repayments, State E&A Fees and debt service must be neutral or positive with respect to the baseline cash flow and based on guaranteed savings. A capital contribution of ***TBD*** may be considered as part of the cash flow to make the project budget neutral or positive.

FEE BILLING: All fees assessed under this proposal will be included in the final implementation costs. In the event that McKinstry is unable to recommend projects that meet the criteria above, Valley Medical Center has no further financial obligation to McKinstry. However, if the recommendations meet or exceed the "Criteria for Implementation" (list above), and Valley Medical Center chooses not to enter into an agreement with McKinstry to install the projects, Valley Medical Center will reimburse McKinstry for its time and expenses, not to exceed **$52,090**. See below for a breakdown of costs. All associated information, including deliverables, will become the property of Valley Medical Center upon final receipt of payment.

COST BREAKDOWN:

1) DES cost for HVAC and Lighting Upgrades -	$39,810 (Original DES Cost)
2) Additional DES cost for Renewable Initiative Development	
a. Solar PV	$3,520
b. Solar Hot Water	$4,630
c. Wind Power	$4,130
TOTAL REVISED DES COST:	**$52,090**

Attachment A

Directed Engineering Study Deliverables

The Directed Engineering Study for Valley Medical Center will include, the following elements:

1. A description of the facility and a description of the mechanical and electrical systems which shall receive ESCO Equipment and ESCO Services;
2. The cost effective Facility Improvement Measures (FIMs) to be installed or caused to be installed by the ESCO and a description of the FIMs analyzed but disqualified under the cost effectiveness criteria;
3. A description of the services that the ESCO will perform or cause to be performed on or in the facility, including but not limited to engineering, construction management, the operations and maintenance procedures for use on ESCO Equipment, training for facility personnel, warranty service provided, and equipment maintenance provided;
4. The Maximum Allowable Project Cost, itemized in detail, which may be amended to represent actual costs;
5. Recommendations for replacement of existing equipment, along with recommendations for improvements to existing equipment and operating conditions;
6. The standards of comfort and service appropriate for the facility;
7. The baseline energy consumption for the facility, including the data, methodology and variables used to compute the baseline, and the baseline calendar period which shall not be less than twelve (12) months;
8. The estimated energy savings and energy cost savings that are expected to result from the installation of the ESCO Equipment and from the ESCO Service, and an explanation of the method used to make the estimate;
9. The method by which Energy Savings and Energy Cost Savings will be calculated during the term of the Energy Services Agreement;
10. A description of how project financing (if required) will be completed;
11. A description of how the Energy Cost Savings will be guaranteed by the ESCO;
12. A description of how the ESCO proposes to be compensated;
13. The term of the Energy Services Agreement;
14. The Termination Value for each year during the term of the Energy Services Agreement;
15. The schedule for project completion;
16. The nature and extent of the work and equipment that the ESCO anticipates it will receive from other firms under subcontract.

Valley Medical Center

Heating Water, Dual Duct AHU, Lighting Upgrades and Solar PV Energy Services Proposal

SEATTLE, WASHINGTON
4 MAY 2011 REV-1
(JUNE 21ST, 2011)

FOR THE LIFE OF YOUR BUILDING

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EXHIBIT 1 Directed Energy Study

Executive Summary

1.1 OVERVIEW

McKinstry Essention (herein after as McKinstry) is pleased to present this proposal for the implementation of energy efficiency measures at Valley Medical Center in Renton, Washington.

This proposal follows the outline contained in Section 2 of the Energy Services Agreement. It presents the contractual terms under which McKinstry and Valley Medical Center will work together over the term of the project. This Proposal describes the scope, costs, guarantees, and other aspects of the project.

The services included in this Proposal include design, construction, and system verification. Although Valley Medical Center will operate and maintain the new equipment, McKinstry will provide an initial commissioning of the systems installed and will provide commissioning documentation of system operation and performance, proving the ability to realize the necessary savings.

1.2 PROJECT DESCRIPTION

This project includes a new dual duct AHU for the East Penthouse, a temporary AHU to serve spaces during demolition and construction, a Main Hospital heating water system upgrade, upgrades to the existing Main Hospital lighting systems for the lobby and the parking lot, Talbot Professional Building Lighting and the addition of a Solar PV system for Valley Medical Center.

1.3 SUMMARY OF BENEFITS

FINANCIAL BENEFITS

Section 4 of the proposal provides information related to specific project financials related to this project. The guaranteed maximum project allowable cost is $ 2,474,188. Including sales tax and Engineering & Architectural Services (E&AS) management fees, and before any utility incentives, the final project cost is estimated at $ 2,769,136. The estimated utility rebate from the Utility is approximately$40,195.

The improvements are projected to produce over $ 38,782 of annual energy savings to Valley Medical Center. Savings of $36,253/yr are projected based on a reduced repair costs and future avoided capital expenditures as agreed upon with Valley Medical Center. Total first year savings is estimated at $75,035 annually.

ENVIRONMENTAL SUMMARY

The energy savings produced will directly reduce the amount of power produced by the Utility. To compute the environmental impact, McKinstry uses factors from the work developed in 2008 by the NW Power and Conservation Council (www.nwcouncil.org) in their report entitled "Marginal Carbon Dioxide Production Rates of the Northwest Power System" (http://www.nwcouncil.org/library/2008/2008-08.pdf).

On average, one car produces 15,000 pounds of CO2 annually and one acre of trees absorbs 7,333 pounds of CO2 annually. By implementing this building improvement, CO2 emissions will be reduced by 320,376 pounds annually, which is equivalent to removing 41 cars from the road or planting 58 acres of trees.

LIFE CYCLE COST COMPARISON

A life cycle cost comparison was run comparing the proposed project and te existing systems over the next thirty years. The proposed system is $ 44,193 more cost effective over the time period. The life cycle cost comparison is provided in the DES in Exhibit 1, Section 5.4.

Executive Summary

1.4 MAXIMUM PROJECT COST

McKinstry guarantees that the project cost, related specifically to the project scope defined herein, will not exceed the maximum price of $ 2,474,188. This excludes sales tax, Engineering & Architectural Services (E&AS) management fees, and before any utility incentives.

1.5 CONCLUSION

This project represents an excellent opportunity for Valley Medical Center to greatly improve its facilities while saving energy. The net present value of this project represents a savings of $ 44,193 based on a 30 year analysis of the replaced equipment. This project meets and exceeds the requirements to qualify as it as an energy project as defined by the State of Washington RCW 39.35A, and its interpretations, which governs performance contracting. McKinstry looks forward to working with Valley Medical Center in making this project a success.

Scope of Work

2.1 FACILITY IMPROVEMENT MEASURE (FIM) SUMMARY

For detailed scope of work descriptions please refer to Attachment A – "Detailed Scope of Work."

FIM #	1.01	VMC Heating Water System
FIM #	3.01	VMC Dual Duct Unit Replacement
FIM #	9.01	VMC Surface Parking Lighting Upgrade
FIM#	9.02	VMC Lobby Lighting Upgrade
FIM #	24.01	VMC Solar PV Installation

There are a number of FIMs that were developed as part of this study but are not included in this final proposal. For a list and description of these measures, reference section 5.6 of the ESP.

2.2 ESCO SERVICES

McKinstry will include the following services related to this project:

1. ENERGY AUDIT: The energy audit is complete and is submitted under Exhibit 1 – "Directed Engineering Study."
2. DESIGN SERVICES: McKinstry will provide a detailed engineering design as needed to obtain Owner review and approval of the proposed lighting and solar PV measures. The heating water and dual duct replacement will be designed by others but will be detailed by McKinstry. In addition, McKinstry will also provide construction support services, start-up, testing, as-built drawings (of the lighting and solar PV) of systems installed, and provide relevant operations and maintenance manuals. Redline drawings of the heating water and dual duct replacement measures will be provided to the designer for incorporation into the as-builds.
3. CONSTRUCTION: Provide, or cause to be provided, all material, labor, and equipment, including paying for permits, fees, bonds, and insurance, required for the complete and working installation of McKinstry's equipment.
   A. McKinstry will provide a site superintendent who will be responsible for the onsite supervision and coordination of trades and subcontractors. This individual's responsibilities will also include regular work observations, quality control, site security, enforcement of the site specific safety plan, as well as coordinating any impact upon building tenants with the Owner.
   B. McKinstry may perform portions of the contraction work or may subcontract portions to qualified firms. In either case, McKinstry will share information regarding actual costs of the work with the Owner.
   C. When McKinstry has completed the installation of the Equipment, including start-up, operations verification, and training in accordance with the Proposal, McKinstry will provide to Owner a "Notice of Commencement of Energy Savings".
   D. At the conclusion of the project, McKinstry will submit a "Notice of Substantial Completion" to the Owner.
4. CONSTRUCTION MANAGEMENT: McKinstry will provide a dedicated construction manager who will provide contract administration services for the project. The owner is expected to coordinate day-to-day communications with tenants and any scheduling of tenant relocations in and around occupied areas.
5. OPERATION TRAINING: McKinstry will provide on-going training of building staff during construction and a

minimum of 8 hrs of training on the energy management control system.

6. PERFORMANCE MAINTENANCE: ESCO will provide ongoing monitoring and support services to help ensure that predicted savings are achieved throughout the term of the agreement. Ongoing services shall be under separate agreement. Ongoing services shall be at the discretion of the Hospital to terminate. Specific tasks associated with proposed ongoing performance assurance tasks can be found in Table 3.2.
7. EQUIPMENT MAINTENANCE: McKinstry will provide no equipment maintenance or repairs after the warranty period. Following the completion of the installation and Owner acceptance of the Equipment, the Owner shall provide all necessary service, repairs, and adjustments to the Equipment so that the Equipment will perform in the manner and to the extent set forth in the Proposal. McKinstry shall have no obligation to service or maintain the Equipment after the warranty period.
8. WARRANTY: McKinstry will warrant equipment for one year following Notice of Substantial Completion. Specific information regarding equipment warranty will be passed on to owner.
9. HAZARDOUS WASTE OTHER THAN PCB LIGHTING BALLASTS: Should the project require removal or disposal of hazardous material, McKinstry may have the hazardous material or substances removed and disposed of at the request of the Owner. McKinstry will not assume ownership of the material but may act on behalf of the Owner to properly remove and dispose of the material. The Owner shall pay McKinstry for the cost of such work. The Owner agrees and acknowledges that it has not relied on or employed McKinstry to analyze or identify the presence of any hazardous substance on the Owner's premises. The cost of hazardous material abatement and disposal is not included in this proposal.
10. HAZARDOUS WASTE ASSOCIATED WITH PCB LIGHTING BALLASTS: Where PCB ballasts are discovered as part of lighting retrofit work, McKinstry shall dispose of PCB ballasts through an approved hazardous waste vendor. The cost of hazardous material abatement and disposal associated with PCB ballasts is included in this proposal.

2.3 EXTENT OF SUBCONTRACTING

McKinstry may subcontract the energy audit, design, construction management, start-up, and training portions of this Contract to qualified firms upon review and approval by owner. The Owner has requested McKinstry Mechanical and Electrical to self perform portions of this work. McKinstry will endeavor to satisfy the MWBE goals of Washington State.

2.4 PROJECT SCHEDULE

The following information lists several milestone dates for the project. McKinstry will develop a detailed schedule outlining all of the various design, pre-construction, construction, and closeout tasks associated with the project and that interfaces with other construction work not under this proposal. It is estimated that it will take 210 working days to complete the design and construction of this project.

	Start	Finish
ESP Review and Approval Process	May 11th, 2011	July 15th, 2011
McKinstry Design and Pre-Construction	July 15th, 2011	August 12th, 2011
Final Construction Docs	August 12th, 2011	August 26th, 2011
Construction	August 29nd, 2011	March 22nd, 2012

Detailed Scope of Work

FIM# 1.01-VMC
VMC Heating Water Upgrade
Valley Medical Center

GENERAL

Upgrade the heating water preheat and reheat system at Valley Medical Center. Pricing is based upon design drawings provided on 2/11/2011.

SCOPE OF WORK INCLUDES

A. Mechanical
   1. Provide all labor, tools, rentals and materials to provide the following scope of work for the Valley Medical Center Preheat System:
      a. Replace the existing preheat plant in the South Penthouse to new location within the penthouse.
      b. Provide air separator, expansion tank, heat exchangers and pumps. Refer to drawings for sizing and quantities. Provide steam traps for heat exchangers.
      c. Provide ~100-ft of 8" heating water piping to serve the new heat exchanger plant. Connect to existing distribution piping. Provide insulation and appurtenances to enable a fully operational heating water system.
      d. Provide ~40-ft of 8" 15-lb steam piping to serve the new heat exchanger plant. Connect to existing boiler piping. Provide insulation and appurtenances to enable a fully operational steam plant.
      e. Provide ~40-ft of 4" condensate return piping to serve the new heat exchanger plant. Connect to existing boiler piping. Provide appurtenances to enable a fully operational steam plant.
      f. Provide duplex steam condensate pump.
   2. Provide all labor, tools, rentals and materials to provide the following scope of work for the Valley Medical Center Reheat System:
      a. Replace the existing reheat plant to new location within the boiler room.
      b. Provide air separator, expansion tank, heat exchangers and pumps. Refer to drawings for quantities and sizing. Provide steam traps for heat exchangers.
      c. Provide ~100-ft of 8" heating water piping to serve the new heat exchanger plant. Connect to existing distribution piping. Provide insulation and appurtenances to enable a fully operational heating water system.
      d. Provide ~40-ft of 6" 30-lb steam piping to serve the new heat exchanger plant. Connect to existing boiler piping. Provide insulation and appurtenances to enable a fully operational steam plant.
      e. Provide ~40-ft of 4" condensate return piping to serve the new heat exchanger plant. Connect to existing boiler piping. Provide appurtenances to enable a fully operational steam plant.

Detailed Scope of Work

B. Controls
   1. Coordinate the removal of the control system panels, components (sensors, actuators, valves, etc), wiring and pneumatics.
   2. Coordinate the relocation and removal of the control system Building Level network cable.
   3. Remove the existing control system sequences of operations, point database, alarm programming, trend logs and equipment schedules associated with the existing HW system mechanical equipment.
   4. Refer to the points list dated 4/12/2011 for more information regarding the scope of work.
   5. Provide control of the New South Penthouse Heating Water System
      a. Provide a new Siemens PXC control panel dedicated for this system.
      b. Provide control of the new HW pump VFDs. VFDs and installation provided by electrical.
      c. Provide the Heat Exchanger steam control valves. Provide the Heat Exchanger Hot Water Control Valves.
      d. Provide monitoring of pipe temperature and pressure sensors, steam pressure sensors and HW differential pressure sensors.
   6. Provide control of the New Basement Heating Water System
      a. Control will be from the existing MBC-10 control panel.
      b. Provide control of the new HW pump VFDs. VFDs and installation provided by electrical.
      c. Provide the Heat Exchanger steam control valves. Provide the Heat Exchanger Hot Water Control Valves.
      d. Provide monitoring of pipe temperature and pressure sensors, steam pressure sensors and HW differential pressure sensors.

C. Electrical
   1. Line Voltage Controls Support
      a. Install the Siemens system per points list dated 4/12/2011
      b. Remove the existing Siemens system components and associated equipment only.
      c. Terminate new and existing control points per Siemens direction.
   2. Equipment Electrical Support
      a. Remove existing power to heating water pumps.
      b. Provide new power from existing power panel for new pumps.
      c. Disconnect and reconnect existing fire alarm for preheat and reheat.
      d. Provide and install (2) 20-hp VFD with bypass for preheat.
      e. Provide and install (1) condensate pump
      f. Provide and install (3) 50-hp VFD with bypass for reheat.
      g. Provide factory startup and factory warranty for VFDs

D. Structural
   1. Provide access platform for reheat heat exchangers.

E. Architectural
   1. None.

F. Specialty
   1. Commissioning
      a. Provide point to point functional performance testing of the new reheat system heat exchangers, controls sequence modifications and VFDs.

   b. Provide point to point functional performance testing of the new preheat system heat exchangers, controls sequence modifications and VFDs.
   c. Provide testing and balancing for Terminal unit reheat coils.
2. Engineering
   a. Provide mechanical permit, inspection and plan review of CDi prints when complete.
   b. Provide electrical permit, inspection and plan review of Sparling prints when complete.
   c. Provide Mechanical detailing.
3. Schedule
   a. Work which disrupts hospital operations is to occur during off hours or weekends.

G. Demolition and Removal
1. Remove the existing preheat heat exchanger plant
   a. (1) heat exchanger
   b. (2) pumps, piping and appurtenances.
   c. (1) expansion tank
   d. (1) air separator
   e. Disconnect existing electrical service.
2. Remove the existing reheat heat exchanger plant
   a. (2) heat exchanger
   b. (4) pumps, piping and appurtenances
   c. (2) expansion tanks
   d. (2) air separators
   e. Disconnect existing electrical service.
3. Load, haul and dispose of materials from site. Roof load out is to occur off the North side of the building. Protect roof and lawn which coincides with load-out route.

EXCLUSIONS/CLARIFICATIONS

A. All special inspections are excluded.
B. Holiday work is excluded.
C. All hazardous material or contaminated soil mitigation and disposal are excluded.
D. Valley Medical Center to Provide Good Faith Survey for Asbestos Abatement
E. Repairs to existing systems are excluded.
F. Any work not specified within the drawings and specifications is excluded.
G. Relocation of existing equipment/systems is excluded.
H. Equipment expediting is excluded.
I. It is anticipated that the revised plant location does not require existing equipment relocation or demo.
J. Controls exclusion:
   1. Modifications to the fire alarm or sprinkler systems are excluded.
K. Exclude additional isolation zone valves.
L. Exclude rebalance of heating hot water system.

Detailed Scope of Work

FIM# 3.01-VMC
VMC Dual Duct Unit Replacement
East Penthouse

GENERAL

This measure will replace the existing Dual Duct Unit in the East Penthouse.

Existing Conditions:

A fan in the East Penthouse of Valley Medical Center was installed in 1969 and is approaching end of life. SF-1 serves the Lab and Radiology, and runs 24/7 during the week. This unit is a dual duct unit with a VFD for filter loading. The outside air is preheated, the cold deck is served with chilled water, the hot deck with heating water.

Existing AHU Schedule for SF-1

Tag	CFM	SP ("H2O)	OV (FPM)	MFR and Model	BHP	HP	Volt /ph	RPM	Weight (lbs)	Service	Location
S-1	24,380	6 ½	2550	Am Std A300	30	30	440/ 3	1470	1500	Xray & Lab	East Pent

Existing Heating Coil Schedule for SF-1

Tag	CFM	MBH	EAT	LAT	GPM	EWT	LWT	Fan	Notes
HC-5-1	22,500	725	20	50	36.5	200	160	S-1	Pre Heat Coil
HC-5-2	18,000	925	50	100	97.5	200	180	S-1	Heating Coil

Existing Cooling Coil Schedule for SF-1

Tag	CFM	MBH	EAT		LAT		GPM	EWT	LWT	Face Area	Max H2O PD	Max Air PD	Fan
			DB	WB	DB	WB				SF	(Ft)	("H2O)	
CC-5-3	22,500	1070	85	66	50	50	214	42	50	46.9	10	0.70	SF-1

Proposed Scope:

Replace the dual duct supply fan SF-1 in the East Penthouse of the Valley Medical Center Building.

SCOPE OF WORK INCLUDES

A. Mechanical
   1. Provide Temporary Air Handling Unit to prevent shutdown of services within the Valley Medical Center.
      a. Provide a temporary 100% OA unit with an integral preheat coil and 30,000 CFM fan.
         i. Crane temporary AHU up to roof from the north parking log. The pick shall be performed during normal working hours and AHU shall be set on the south side of the mechanical room.

ii. Extend new lined galvanized sheet metal supply air ductwork to the mechanical room through a new double door opening.
iii. Provide (1) new temporary duct mount heating hot water coil for the hot deck temp connection.
iv. Provide bypass duct around heating coil which shall be the cold deck supply air duct.
v. Extend the temporary hot deck and cold deck ducts into the mechanical room and connect to the existing hot and cold deck supply air mains. The connections shall include a sheet metal rectangular duct with manual volume damper.
vi. Hot tap the existing 6" heating hot water mains in the mechanical room with (2) new 4" branch lines with butterfly isolation valves.
vii. Provide new 2" hot water piping out to the temporary AHU preheat coil. The outdoor piping shall include weather proof metal jacket insulation.
viii. Provide new 3" hot water piping to serve the heating hot water coil.
ix. Upon start-up of the new AHU and shut down of AHU, drain the hot water and chilled water coils.
x. The existing 6" chilled water and hot water mains run overhead and will require modification to accommodate the new AHU height. Both sets of piping have 3" branch piping extended from the bottom of the pipe mains. We will need to remove the branch lines and a section of the mains to accommodate the new AHU. This work will require a shutdown of both chilled and hot water piping serving the adjacent AHU's in the mechanical room. The shutdown will take no more than 8 hours.
xi. During the shutdown, provide new chilled water isolation valves to serve the new chilled water coil.
xii. Relocate (1) existing floor drain. The existing location will be in conflict with the new AHU footprint. This work shall be mostly performed from the floor below which has t-bar ceiling and is easily accessible. This work to be performed on off-hours.
xiii. Install (1) new floor sink for the condensate P-trap and drain. This work shall be performed on off-hours.
xiv. Rotate RF-E-107, install new supports and spring hangers.
xv. Re-route (1) gas vent piping riser from the floor below. The piping shall be re-routed into the OSA plenum and extended up to the roof.

2. Replace existing constant volume dual duct unit (SF-1) with one (1) 30,000 CFM VAV dual duct unit.
   a. Refer to equipment schedule for fan and coil sizes.
   b. Unit Performance:
      i. Provide dual fan/dual economizer. Provide heat recovery capabilities.
      ii. Provide N+1 fans with premium efficiency motors
         - Equip with VFD for filter loading and in case of future remodels allow for VAV dual duct mixing boxes.
         - Motors are to be direct drive.
      iii. Provide a pre-filter (60% eff).
      iv. Provide final filter within hot and cold deck (90% eff).
      v. Unit is to be 100% outside air.
   c. Provide new 30,000 CFM VAV Dual Duct Unit:

i. Crane new AHU up to roof. The AHU shall be shipped loose and assembled in the mechanical room.
ii. Provide air leakage test and water leak test.
iii. Provide new chilled water, hot water and pre-heat coil connections.
iv. Provide new supply air ductwork from the new AHU and connect to the existing duct at slab level.

B. Controls
1. Provide DDC building control system that will communicate through the existing Siemens building controls and totally replace the existing pneumatic controls.
   a. No pneumatic actuators or sensors shall remain in the penthouse.
   b. Provide wiring, relays, actuators, temperature sensors, valves and any other devices necessary for a complete and operational system as required to meet the performance dictated, even if not previously present within existing pneumatic system.
   c. Refer to the attached points list for scope. Allow for 10 additional DDC points.
   d. The dual duct terminal box controls will remain pneumatic. The conversion to DDC VAV mixing box control will happen in a future phase.
2. Remove the existing MBC control panels. Return parts to the owner.
3. Coordinate the removal of control system panels, components (sensors, actuators, valves, etc), wiring and pneumatics
4. Coordinate the relocation and removal of control system Building Level network cable.
5. Remove the existing control system sequences of operations, point database, alarm programming, trend logs and equipment schedules associated with the East Penthouse mechanical equipment.
6. Ostracize the existing MBC control panels from the Apogee control system network.
7. Temporary Unit Control Performance intent:
   a. Provide control for the temporary supply fan VFD. VFD installation provided by electrical.
   b. Provide control of the outside air intake damper and heating coil bypass damper. Control damper installation provided by electrical.
   c. Provide Preheat and heating coil control valves.
   d. Provide freeze protection thermostat.
   e. Provide monitoring of the duct temperature and duct static pressure sensors.
8. Permanent Unit Controls
   a. Performance: Provide additional points and electrical capacity as required for a complete and functioning system.
      i. The unit shall run based upon an operator adjustable schedule. All time of day scheduling shall be coordinated with the McKinstry Energy Engineer.
      ii. Economizer:
         - The controller shall modulate the economizer dampers to maintain a setpoint.
         - The outside air dampers shall maintain a minimum adjustable setpoint when occupied, and close when all zones are unoccupied.
      iii. The building DDC system shall provide optimum start/stop signal and night setback for spaces not operated 24/7, as identified by VMC.
      iv. Provide DAT reset based on outside air temperature.
         - Reset hot deck as low as possible and cold deck as high as possible.
      v. Locate DSP sensor 2/3 down the duct.

b. Provide a new Siemens PXC control panel dedicated for the fan system.
c. Control the supply fan variable frequency drives.
d. Control outside air intake dampers and heating coil bypass damper.
e. Provide CW and HW coil control valves
f. Provide monitoring of freeze protection thermostats.
g. Provide monitoring of the air flow measuring stations at the return air and (2) supply air duct locations.
h. Provide monitoring of the hot deck and cold deck discharge air smoke damper end switch status and supply duct smoke detector alarm status.
i. Provide monitoring of the duct temperature sensors and duct/filter static pressure sensors.
j. Provide start/stop control and status monitoring of fans EF-12, 13 & 128.

9. Temporary Unit Controls
   a. Control Temporary AHU with SF-1 control panel.
   b. Provide control of supply fan VFD. VFD and installation provided by electrical.
   c. Provide control of outside air intake damper and heating coil bypass damper. Provide HW control valve.
   d. Provide freeze protection thermostats and monitoring.
   e. Provide monitoring of duct temperature and duct static pressure sensors.

C. Electrical
1. Temporary Unit Electrical:
   a. Three Phase Power:
      i. Provide VFD
      ii. Provide temporary power from existing power panel in the east penthouse.
   b. Line Voltage:
      i. Install control dampers provided by controls contractor.
      ii. Install controls provided by controls contractor. Controls contractor to provide all system devices and panels.
2. Dual Duct Unit Electrical:
   a. Three Phase Power:
      i. Demo SF-1 power and install new power from the existing power panel in the east penthouse. Assume capacity in existing panel.
      ii. Provide and install (2) 10-hp VFD with bypass for SF-1.
      iii. Provide factory startup and factory warranty for VFD.
   b. Line Voltage:
      i. Demo and relocate power outlets and lighting for new units.
      ii. Disconnect and reconnect existing fire alarm for SF-1.
3. Provide electrical permit, inspection and electrical plan review of Sparling prints.

D. Structural
1. Provide structural support as needed for placement of temporary and dual duct unit.
   a. Temporary AHU shall be set on steel I-Beams or redwood sleepers.

E. Architectural
1. Cut and patch roof and walls to match existing.
2. Provide double door on South side of Penthouse. Finish to match existing.
3. Replace T-Bar ceiling where needed for new floor sink location.

F. Specialty
1. Commissioning
   a. Review Sequence of operations, submittals and plan set.

   b. Functional performance testing of unit operation.
   c. Provide testing of existing fan performance at design CFM.
   d. Verify newly installed system performance matches existing fan measurements. Back down new fan airflow to match existing CFM.
   e. Provide fire and life safety/start up.
   f. Provide testing and balancing of temporary unit.
2. Schedule
   a. Work is to be performed during the winter.
   b. All disruptive work is assumed to be completed during off-hours.
3. Engineering
   a. Review Sequence of operations, submittals and plan set.
   b. Provide Mechanical detailing.

G. Demolition
1. Remove all pneumatic controllers and all pneumatic tubing. No unused equipment is to remain in place.
2. Remove existing MBC control panels. Return parts to the owner.
3. Remove existing control system sequences of operations, point database, alarm programming, trend logs and equipment schedules associated with the East Penthouse mechanical equipment.
4. Demolish and remove SF-1 and associated pipes and ducts.
5. Load, haul and dispose of materials from site.

<u>EXCLUSIONS/CLARIFICATIONS</u>

A. Correction of any unknown existing system deficiencies.
B. Hazardous material abatement is excluded.
C. Valley Medical Center to Provide Good Faith Survey for Asbestos Abatement
D. CDI Engineers is responsible for AHU acceptance of the energy code compliance of the design including the heat recovery requirement.
E. This scope does not include cleaning of existing ductwork outside of the mechanical room.
F. Exclude fire standpipe relocation.

Detailed Scope of Work

FIM# 9.01-TLB
Lighting Upgrade
Valley Medical Center

GENERAL

Scope of work only includes fixtures listed in the attached detailed audit spreadsheet with a proposed code. Narrative reference or descriptions below are for reference only and are not official counts of fixtures being replaced or sensors being installed. Audit sheets override any errors or omissions in narrative discussed below.

This measure includes retrofitting existing fixtures using T12 lamps and electronic ballasts and replacing existing HID fixtures located in the Gymnasium and Pool areas. Occupancy sensors will be installed to control fixtures in the Gymnasium. Gift shop fixtures will be retrofitted with a "retrofit kits" to standardize the lamp ballast combination in all fixtures located in this area.

SCOPE OF WORK INCLUDES

A. Lighting
   1. Retrofit existing 34W T12 lamps and magnetic ballasts with 32W T8 lamps and electronic ballasts.
   2. Replace existing HID fixtures located in the Pool and Gymnasium areas with fixtures using linear fluorescent T5HO lamps and electronic ballasts.
   3. Install retrofit kits in 2x4 fixtures located in the Pharmacy/Gift Shop.
   4. Install Radio Frequency (RF) sensor switches to replace existing toggle switches that will operate wireless wall mounted sensors.

EXCLUSIONS

A. This proposal does not include repairs to existing electrical code violations or upgrades unless otherwise stated in the ESP.
B. This proposal is based on re-using existing circuits and controls unless otherwise stated in the ESP.
C. This proposal does not include the replacement of fixture lenses unless otherwise stated in the ESP.
D. This proposal is based on second shift working hours.
E. Staging areas will be provided at a common location for material delivery. Disposal is vendors' responsibility.
F. This proposal does not include asbestos, lead paint, or mold removal and/or abatement.
G. McKinstry will replace any battery backup units where ballast compatibility issues arise as a result of this upgrade (like for like existing condition). Additions or alterations to the existing emergency and/or egress lighting system, which are required by local codes, are not part of this scope of work.
H. This proposal assumes proper grounding exists on existing fixtures.

Detailed Scope of Work

FIM# 9.01-VMC Surface Parking
Lighting Upgrade
Valley Medical Center

GENERAL

Scope of work only includes fixtures listed in the attached detailed audit spreadsheet with a proposed code. Narrative reference or descriptions below are for reference only and are not official counts of fixtures being replaced or sensors being installed. Audit sheets override any errors or omissions in narrative discussed below.

This measure includes replacing existing HID post top area light fixtures located in the surface parking areas surrounding the hospital with fixtures to match the newly installed area parking fixtures with LED lamps and drivers. HID sign fixtures will also be replaced with LED flood light fixtures. Main canopy fixtures located near the front of the hospital will be replaced with surface mount CFL canopy type fixtures.

SCOPE OF WORK INCLUDES

A. Lighting
   1. Replace existing post-top 400W and 250W metal halide and high pressure sodium fixtures with fixtures using 156W LED fixtures. New tenon arm brackets will be used to mount the new fixtures.
   2. Existing 175W metal halide flood lights will be replaced with 24W LED flood lights which will maintain ground mounting location at each sign.
   3. Replace existing 50-75W metal halide front canopy fixtures with 32W CFL surface mount canopy fixtures

EXCLUSIONS

A. This proposal does not include repairs to existing electrical code violations or upgrades unless otherwise stated in the ESP.
B. This proposal is based on re-using existing circuits and controls unless otherwise stated in the ESP.
C. This proposal does not include the replacement of fixture lenses unless otherwise stated in the ESP.
D. This proposal is based on second shift working hours.
E. Staging areas will be provided at a common location for material delivery. Disposal is vendors' responsibility.
F. This proposal does not include asbestos, lead paint, or mold removal and/or abatement.
G. McKinstry will replace any battery backup units where ballast compatibility issues arise as a result of this upgrade (like for like existing condition). Additions or alterations to the existing emergency and/or egress lighting system, which are required by local codes, are not part of this scope of work.
H. This proposal assumes proper grounding exists on existing fixtures.

Detailed Scope of Work

FIM# 9.02-VMC Lobby
Lighting Upgrade
Valley Medical Center

GENERAL

Scope of work only includes fixtures listed in the attached detailed audit spreadsheet with a proposed code. Narrative reference or descriptions below are for reference only and are not official counts of fixtures being replaced or sensors being installed. Audit sheets override any errors or omissions in narrative discussed below.

This measure includes replacing existing 250W metal halide down light fixtures with a combination of LED down lights and decorative pendant fixtures.

SCOPE OF WORK INCLUDES

A. Lighting
   1. Remove existing 250W metal halide down lights and blank existing receptacles.
   2. Install 12.5 LED downlights where existing blank covers exist above pool, both staircases and 2nd floor waiting area where skylights exist. Install new can housings and run new circuits to power new fixtures.
   3. Install (3) linear fluorescent T8 decorative pendant fixtures with one 39W PAR30 down light above each stairwell. New mounting brackets will be installed to support each fixture. Install new circuits to power new fixtures.

EXCLUSIONS

A. This proposal does not include repairs to existing electrical code violations or upgrades unless otherwise stated in the ESP.
B. This proposal is based on re-using existing circuits and controls unless otherwise stated in the ESP.
C. This proposal does not include the replacement of fixture lenses unless otherwise stated in the ESP.
D. This proposal is based on second shift working hours.
E. Staging areas will be provided at a common location for material delivery. Disposal is vendors' responsibility.
F. This proposal does not include asbestos, lead paint, or mold removal and/or abatement.
G. McKinstry will replace any battery backup units where ballast compatibility issues arise as a result of this upgrade (like for like existing condition). Additions or alterations to the existing emergency and/or egress lighting system, which are required by local codes, are not part of this scope of work.
H. This proposal assumes proper grounding exists on existing fixtures.

Detailed Scope of Work

FIM# 24.01
VMC Solar PV Installation
Yard Mounted

GENERAL

Proposed Scope:

Install approx 1500 W AC grid-connected solar PV power system. The PV panels will be pole-mounted and installed on the VMC lawn next to the Valley Medical Center lighted sign, near the entrance to HWY 167. Location is designed to cost-effectively maximize public exposure. Scope includes "SMA" brand Web-based monitoring equipment and software that will make it possible to monitor and display system performance data online. All of the system designs have tracking capabilities to maximize production.

DESIGN INTENT

A. Mechanical
   1. None.
B. Controls
   1. Install (1) SMA Web Box Ethernet based monitoring system, and all associated hardware and wiring.
C. Electrical
   1. Install one (1) pole-mounted solar PV system. Preliminary basis of design:
      a. Approximately 1500 W grid-connected solar PV array.
      b. Panel basis of design: Solar World 250 W PV panels.
      c. Install SMA 'Sunny Boy' SB1100US photovoltaic inverters.
   2. Connect and wire all solar panels to the VMC information sign electrical panel
   3. Electrical design and permit
D. Structural
   1. Structural review to verify that pole structure can accommodate weight of the new PV system frame, equipment. The exact location of the PV system may be adjusted slightly as recommended by structural reviewer.
   2. Attachment of support pole mounting system frame to roof structure shall be included.
E. Architectural
   1. None.
F. Specialty
   1. None.
G. Demolition and Removal
   1. None.
H. Scheduling
   1. Non invasive installation work shall be conducted during normal business hours. Work considered disruptive to facility operations shall be conducted outside of normal work hours as coordinated with owner.

Detailed Scope of Work

EXCLUSIONS/CLARIFICATIONS

A. Exclude "Fat Spaniel" type web-monitoring. Base system calls for "SMA" web monitoring hardware.
B. Excludes repairs to existing electrical system.
C. Customer to provide internet connection (Ethernet) drop for web-based monitoring to PV equipment.
D. Scope does not include the installation of an educational kiosk; only web-based connection to existing hospital kiosks.
E. Excludes hazardous material abatement.

Energy Cost Savings Guarantee

3.1 GUARANTEE OVERVIEW

1. Philosophy: McKinstry is prepared to guarantee any portion of a project over which it has direct control. Where McKinstry does not have direct control (such as burn hours associated with lighting), we are prepared to work with the customer to devise a method of Measurement and Verification (M&V), which will provide the highest degree of assurance that the energy cost savings exist.
2. This Project: For this project, McKinstry is prepared to guarantee the performance of the installed initiatives to reduce energy consumption. For the target energy reductions for the initiatives that will be implemented please refer to Table 3.1. Based upon the stipulated conditions as enumerated by the Valley Medical Center personnel and the utility rates as described below, the utility cost savings are also shown in Table 3.1.
3. On-going Services: The cost of the first year of Performance Assurance is included in the project scope. The cost of On-going Performance Assurance in years 2-10 is at the discretion of Valley Medical Center. McKinstry is prepared to continue the guarantee as long as Valley Medical Center continues the on-going services as described herein. When Valley Medical Center chooses to cancel the ongoing services, the guarantee will also be terminated at the same point in time.

For this project, Valley Medical Center has elected not to have McKinstry provide on-going performance assurance services past year one.

3.2 FIM SPECIFIC PERFORMANCE ASSURANCE METHODOLOGY

1. Guarantees: Tables 3.1 and 3.2 provide the specific energy consumption savings for each field improvement measure and the guarantee that McKinstry will provide associated with that measure. Savings calculations are based upon both baseline operating characteristics and proposed operation criteria:

   A. Baseline: "Baseline" refers to the existing operating characteristics that were used to calculate energy cost savings. The baseline operating characteristics, including system performance and operational expenditures, which were used for this project are provided in Tables 3.1 and 3.2. In general, all parties acknowledge the baseline associated with any specific measure has been derived from the following sources:

      1) Actual operating information gathered through field observation, measurement, micro-data loggers, and owner's operating log books.
      2) Owner provided information concerning stipulated factors such as burn hours, occupancy, or operational expenditures.
      3) In some instances, a modified baseline may have been developed to address areas whereby pre-retrofit conditions do not reflect a system that is operating per current code or what the client may deem as normal operation.

   B. Proposed: The proposed operating criteria, including system performance and operational expenditures, which were used for savings calculations are provided in Tables 3.1 and 3.2. Systems must be operated per the proposed criteria to ensure energy cost savings are realized. McKinstry will provide the initial start-up, commissioning, and programming of the system to ensure that the systems operate per the proposed operating criteria. Valley Medical Center acknowledges their

responsibility to ensuring that these criteria are maintained and associated energy savings are realized. Energy Savings Guarantees are predicated on Valley Medical Center maintaining their responsibilities as provided below in "On-Going Owner Responsibilities."

2. Performance Assurance (PA): Table 3.2 provides the specific on-going reporting tasks that McKinstry will perform to verify that the systems are performing as specified. The intent of the verification is to measure and verify leading indicators on which the energy savings are based. Once these leading indicators are measured and are verified to be in accordance with the proposed criteria, the savings due to the performance of the equipment or measure shall be deemed as met. McKinstry has proposed measurement of these indicators. The site specific Performance Assurance Program encompasses the following elements:

   A. Closeout Commissioning Report: McKinstry will provide a closeout commissioning report during the one month period starting three months after the Notice of Commencement of Energy Savings. The scope of this report consists of the tasks outlined under the "Post-Retrofit" stage of Table 3.2.

   B. First Year On-going Reporting: For this project, McKinstry proposes reporting of the first year PA tasks as provided in Table 3.2 on a one-time basis. The scope of this report consists of the tasks outlined under the "First Year" stage of Table 3.2. The first report shall be provided no later than one year after last date of Notice of Commencement of Energy Savings. However, if additional phases of work are involved, a single PA Report may be provided at regular interval(s) that reports across all relevant phases of work.

   C. Years 2 – 10 On-going Reporting: At this point, this proposal does not contain any guarantee past Year 1.

3.3 UTILITY RATES

1. Utility Rate: For the purpose of calculating savings, the utility rates used will be the utility rates as paid by Valley Medical Center to the utility company during the pertinent period, adjusted for any rate schedule changes made by the utility company, except that the utility rate used for calculation will never go below the Floor Rate, or above the Ceiling Rate, as described below. In the event that a building has multiple meters on different rate schedules, the per-unit cost of the utility will be the average of all the rate schedules in effect at that facility.

2. Base Utility Rate: Refer to Table 3.3 for the Base Utility Rates (including sales tax).

3. Floor Utility Rate: For the purpose of calculation of savings, the utility rate shall never drop below the base utility rates described above. This shall be known as the Floor Utility Rate.

4. Ceiling Utility Rate: For the purpose of calculation of savings, the utility rate shall never exceed 1.5 times the base utility rate described above. This shall be known as the Ceiling Utility Rate.

5. Rate Schedule Changes: When the utility company makes a change to the rate schedule, the new rate will be used for calculating savings realized during a given period. If a rate schedule change occurs partway through a period, an aggregate rate comprised of a weighted average between the old and the new rate will be used. The weighting will be based upon the portion of the period that each rate applied.

3.4 STANDARDS OF COMFORT SERVICE

The following section provides the standards of comfort, which Valley Medical Center must maintain to ensure the comfort of the students, faculty, and staff, and upon which all energy calculations were based.

HVAC COMFORT

Heating, ventilating and air conditioning (HVAC) systems provided by McKinstry will provide comfort and indoor air quality in accordance with the Standards of Comfort below. This standard will pertain only to buildings and areas of buildings in which the McKinstry is installing HVAC equipment that has direct control over space comfort conditions. HVAC comfort conditions cannot be guaranteed when operable windows or doors are open.

Indoor Conditions

Occupied:
Winter Heating Minimum Setpoint – 70 degrees F
Winter Heating Maximum Setpoint – 74 degrees F
Summer Cooling Minimum Setpoint - 72 degrees F (where mechanical cooling systems are employed)
Summer Cooling Maximum Setpoint - 78 degrees F (where mechanical cooling systems are employed)

Unoccupied:
Minimum - 55 degrees F
Maximum - 85 degrees F (where mechanical cooling systems are employed)

Relative Humidity (If humidity control provided):
Minimum - 40%
Maximum - 60%

Minimum outside air per occupant:

In accordance with ASHRAE standards and Washington State Ventilation and Indoor Air Quality Code.

LIGHTING

Illumination Levels Verification:

Illumination levels shall be as recommended by the Illuminating Engineer's Society of North America (IESNA).

For primary and secondary schools, illumination will also meet 1997 WAC 246-366-120 lighting requirements (for Washington state school districts only).

Illumination Levels Design:

The lighting and illumination levels for lighting systems provided by the McKinstry will meet or exceed current recommended practices by the Illuminating Engineering Society of North America for illumination levels for the various tasks that are conducted throughout Valley Medical Center.

3.5 ON-GOING OWNER RESPONSIBILITIES

Valley Medical Center shall provide the following services as part of this energy services project. In the event that these services are not provided, energy savings and associated guarantees will be modified to reflect the associated impact.

1. Maintain all equipment per manufacturer's recommendations and proposed maintenance schedule.
2. Maintain all sequence of operations and performance criteria related to installed systems as proposed and designed.
3. Provide other FIM specific on-going responsibilities as provided in Table 3.2.
4. Provide McKinstry with copies of actual monthly utility billing information on a quarterly basis for the duration of the ongoing service period. This includes electric, natural gas, and fuel oil. For this project, the ongoing service period shall be one year. The associated facilities where utility information shall be provided include all meters providing direct or indirect service to all buildings included in this project.
5. Provide McKinstry all internal sub-meter data, including electric and condensate meters, providing direct or indirect service to all buildings included in this project.
6. Provide McKinstry access to Energy Management and Control Systems for the purpose of collecting and logging data over time as required for performance verification.
7. Valley Medical Center shall notify McKinstry in writing with regards to any changes or alterations to buildings that will affect energy usage. This notification must be provided within two weeks of the change. This includes occupancy or use changes, computer load or other load changes, scheduling changes, and sequence of operations changes.

3.6 NON-PERFORMANCE

In the event the equipment performance is not met, McKinstry accepts responsibility for additional electricity used by the equipment as a result of the reduced performance. McKinstry may, at its option, execute any of the following options:

1. Repair or replace equipment as required to meet required performance.
2. Make payments for the extra energy consumption to Valley Medical Center. In the event that the McKinstry chooses the payment option, McKinstry reserves the right to select either an annual payment for the duration of the finance term or a one-time lump-sum payment of the same amount. In either case, the payment will be calculated based upon the quantity of additional electricity used and the Base Utility Rate as described above.

3.7 CHANGE OF USE

In the event that Valley Medical Center chooses to make changes to the facility that require set point adjustments, longer operating hours, or continuous equipment operation, Valley Medical Center agrees that:

1. Savings deemed as met described above will continue to be deemed as met.
2. Additional cost of extended equipment operation is a cost of the change, not due to a failure of the McKinstry or their equipment.

Energy Cost Savings Guarantee

3. McKinstry shall not be responsible for any increase in energy, maintenance, or any other costs incurred as a result of the extended equipment operation.
4. McKinstry at its option may make a baseline energy use adjustment to account for a change-of-use at any facility.

Table 3.1 - Energy Savings Summary

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Date	5/4/2011

			Electricity				Natural Gas		Total **
Facility Improvement Measures	Building	Guarantee Multiplier *	kW	kW ($)	kWh	kWh ($)	Therm	Therm ($)	($)
01.01-VMC Heating Water Upgrade	Valley Medical Center	90%	3.6	$18	166,769	$10,840	8,235	$8,317	$19,175
03.01-VMC Dual Duct Unit Replacement	Valley Medical Center	90%	0.0	$0	52,188	$3,392	4,676	$4,722	$8,114
09.01-VMC Surface Parking Lighting Upgrade	Valley Medical Center	95%	146.3	$732	64,929	$4,220	0	$0	$4,952
09.02-VMC Lobby Lighting Upgrade	Valley Medical Center	95%	84.6	$423	57,513	$3,738	-89	-$90	$4,071
09.01-TLB Lighting Upgrade	Valley Medical Center	95%	106.4	$532	30,007	$1,950	-119	-$120	$2,362
24.01-VMC Solar PV Installation	Valley Medical Center	90%	0.0	$0	1,649	$107	0	$0	$107
		Totals * **	**340.8**	**$1,704**	**373,055**	**$24,249**	**12,702**	**$12,829**	**$38,782**

* The savings shown in this table are less than the calculated savings unless a guarantee multiplier of 100% is shown.

** The guarantee is based on Key Performance Indicators shown in Table 3.2. Refer to Section 3 of the ESP for the method of converting Key Performance Indicators to dollars during the M&V period.

*** The guarantee is based on the aggregate savings for all FIMs, not on individual FIM savings.

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Table 3.2 - M&V Plan Outline

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Date	5/4/2011

Facility Improvement Measures	Building	Key Performance Indicators	Agreed Upon Criteria for Guarantee: Baseline Values	Agreed Upon Criteria for Guarantee: Proposed Values	Agreed Upon Criteria for Guarantee: Stipulated Factors	Audit Stage (Baselining) Tasks	Post Retrofit Stage (Commissioning) Tasks	Annual Tasks	On-going Owner Responsibilities
01.01-VMC Heating Water Upgrade	Valley Medical Center	1. Converter Size 2. Converter Jacket Loss 3. Efficiency of steam boiler 4. Hours of Operation 5. System pump BHP 6. System pump flow control; load profile 7. Average Heating Water Delta T	1. Preheat System: 19,500 MBH; Reheat System: 4,000 MBH &13,000 MBH 2. Preheat System: 0.25%; Reheat System: 0.5% 3. 80% 4. 24/7 5. Preheat System: qty 2 30-hp; Reheat System: qty 2 10-hp, qty 2 25-hp 6. Preheat System: Constant Volume; Reheat System: qty 1 10-hp pump has VFD, remaining qty 3 pumps are CV. Load Profile of pump with VFD is constant at 8.4 Amps. 7. Preheat System: 10 deg F; Reheat System: 25 deg F	1. Preheat System: 10,338 MBH; Reheat System: 14,905 MBH 2. Preheat System: 0.13%; Reheat System: 0.25% 3. 80% 4. 24/7 5. Preheat System: qty 2 20-hp; Reheat System: qty 3 50-hp 6. Preheat System: VFD; Reheat System: VFD; Refer to calculations for Load Profile 7. Preheat System: 10 deg F; Reheat System: 25 deg F	Instulation quality of existing converters, building loads, outside air temperature.	1. Verify Converter Sizes 2. Visual inspection of insulation on converters and heating water plant. 3. Stipulated at Code Minimum Value. 4. Review of pump operation logs (pumps are manually staged). 5. Verify pump sizes. 6. Verify pump operation. 7. Trend 1 week HWS and HWR temperatures	1. Review Converter submittals. 2. Verify converter and corresponding system is properly insulated. 3. No task. Boiler efficiency is assumed constant. 4. Provide point to point functional testing of the new reheat and preheat system converters, and controls sequence modifications 5. Review Pump submittals. 6. Provide point to point functional testing of the new VFDs on the system pumps. 7. Provide testing and balancing for terminal unit reheat coils.	1. No task required. 2. Verify converter and corresponding system is properly insulated. 3. No task. System demand is assumed constant. 4. No task. Boiler efficiency is assumed constant. 5. Review Pump submittals. 6. Trend/Alarm/log controls sequence to verify operation per design documents. 7. Trend/Alarm/Log pumps to verify VFD modulates to meet system load.	Maintain equipment per manufacturer recommendations.
03.01-VMC Dual Duct Unit Replacement	Valley Medical Center	1. Fan Operation 2. Discharge Air Temperature	1. Fan rides the fan curve 2. 55 Deg F	1. VFD adjust fan speed to meet static pressure setpoint 2. Discharge Air Temperature resets based on system feedback	Elevated baseline to compare design unit without a VFD or Discharge Air Temperature reset to the proposed design unit with a VFD on the Hot and Cold deck fan and Discharge Air Temperature reset. Stipulated factors: Annual Operation hours, building loads, outside air temperature, filter pressure drop.	1. No action required 2. Record DAT setpoint	1. Verify newly installed system performance matches existing fan measurements. Back down new fan airflow to match existing CFM. Provide functional performance testing on VFD operation. 2. Working with building operator to set DAT reset points on trial by error process without comfort complaints. (No feedback from boxes).	1. Trend supply fan kW to show VFD operation (7 days) 4. Trend Discharge Air Temperature (7 days)	Maintain equipment per manufacturer recommendations. Inform McKinstry of any changes to control sequence and setpoints.
09.01-VMC Surface Parking Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
09.02-VMC Lobby Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
09.01-TLB Lighting Upgrade	Valley Medical Center	1. Fixture types and quantities 2. Fixture input power (Watts) 3. Typical light levels (FC) 4. Fixture annual burn hours	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	1. See detailed lighting audit. 2. See detailed lighting audit. 3. Varies by location 4. See detailed lighting audit	Run Hours based on office/ building schedule. Fixture Wattage based on as-built	1. Detailed lighting audit. 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. Stipulated based on customer interview.	1. Lighting contractor's as-built documentation 2. Stipulated at ANSI values. 3. Light level survey in a sample of rooms. Specific scope of survey to be determined by McKinstry Co. 4. No task. Annual operational hours are assumed constant.	None Proposed at this Time.	Maintain fixtures and ballasts per McKinstry and manufacturer recommendations.
24.01-VMC Solar PV Installation	Valley Medical Center	1. Total Incident Solar Radiation. 2. Net PV System Production. 3. PV System AC Electricity Generation Effectiveness. 4. PV System Performance Ratio. 5. Total Facility Energy/Electricity Use	1. Time-series measurement of insolation, array area. Refer to PV Watt software. (stipulated) 2. None. 3. None. 4. None. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis. (stipulated)	1. Time-series measurement of insolation, array area. Refer to PV Watt software. Same as baseline. 2. Total PV system production and standby use. Refer to calculations. 3. Total incident solar radiation and net PV system production. Refer to calculations 4. PV system AC electricity generation effectiveness and rated PV module efficiency. Refer to calculations. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis. Same as baseline.	Environmental conditions (Solar radiation)	1. Time-series measurement of insolation, array area. Refer to PV Watt software. Same as baseline. 2. Total PV system production and standby use. Refer to calculations. 3. Total incident solar radiation and net PV system production. Refer to calculations 4. PV system AC electricity generation effectiveness and rated PV module efficiency. Refer to calculations. 5. Monthly Utility Bills. Refer to campus Utility Data Analysis.	1. Photos of installation.	1. Photos of installation to ensure maintenance.	Maintain equipment per manufacturer recommendations.

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Utility Rates Report

Utility Type	Utility	Rate Name	Unit	$ Per Unit	Published Date Effective
Electricity	Puget Sound Energy (PSE)	Electricity	kWh	$0.065000	05/04/11
Natural Gas	Puget Sound Energy (PSE)	Schedule 31	Therm	$1.010000	05/04/11
Electricity Demand	Puget Sound Energy (PSE)	Demand	kW	$5.000000	05/04/11

Project Financials

4.1 MAXIMUM PROJECT COST

McKinstry guarantees that the Maximum Project Cost will not exceed $2,474,188. This cost does not include sales tax, WA State Interagency fees, or the Utility rebate, which are estimated. With sales tax and interagency fees included, the estimated Project Cost will be $ 2,769,136. (McKinstry does not guarantee the value of sales tax, State fees, or the utility incentive.)

Costs presented in this proposal are valid for 30 days from the date of publication. If the notice to proceed is issued after 30 days from publication, McKinstry reserves the right to re-evaluate the project and make necessary modifications to the construction cost. Other factors that McKinstry does not have direct control may affect the ability to complete the project in the time proposed. In the event that of delay that McKinstry could not control, we reserve the right to request schedule extensions and use of contingency to cover costs associated with the delay.

4.2 PROJECT COST TABLE

See Table 4.1 – "Budget Summary Breakdown" - all fee percentages and costs are unique to the project.

4.3 ITEMS INCLUDED IN MAXIMUM PROJECT COST

Maximum project costs include the following:

1. Engineering audit, including the cost for preparation of this proposal.
2. Engineering design.
3. Construction management services.
4. Installation of McKinstry equipment including the following costs as specified in the scope of work:
   A. All costs paid by McKinstry for the installation of the equipment. This includes costs paid to subcontractors or directly to McKinstry personnel, when related to installation or system verification of McKinstry equipment.
   B. The portion of reasonable travel, lodging, and meal expenses of officers or employees incurred while traveling in discharge of duties connected with the Work.
   C. Cost of all equipment, materials, supplies, and equipment incorporated in the Work, including costs of transportation thereof.
   D. Cost or rental charges, including transportation and maintenance, of all materials, supplies, equipment, temporary facilities, and hand tools not owned by the workers, which are consumed in the performance of the Work and cost less salvage value on such items used but not consumed which remain the property of the McKinstry.
   E. Cost of premiums for all bonds and insurance, which the McKinstry is required to purchase and maintain.
   F. Sales, use or similar taxes related to the Work and for which the McKinstry is liable imposed by a governmental authority.
   G. Permit fees, royalties, and deposits lost for causes other than the McKinstry's negligence.
   H. Losses and expenses not compensated by insurance or otherwise, sustained by McKinstry in

connection with the Work, provided they have resulted from causes other than the fault or neglect of the McKinstry. Such losses shall include settlements made with the written consent and approval of the Owner. If, however, such loss requires reconstruction and the McKinstry is placed in charge thereof, he shall be paid for his services a fee.

I. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, express mail services, and similar petty cash items.

J. Demolition cost and cost of removal of all debris.

K. Costs incurred due to an emergency affecting the safety of persons and property.

L. Other costs incurred in the performance of the Work if and to the extent approved in advance in writing by the Owner.

M. The cost of contingency and an allowance for Owner initiated scope improvements.

N. Cost of equipment startup, training, system verification and balancing performed by the McKinstry.

5. Construction Bonds (including Performance & Payment and Retention bonds), Liability Insurance, and Builder's Risk Insurance.

6. McKinstry fee. This includes the McKinstry's remuneration for compensation of personnel, expenses, risks related to the project, overhead, and profit.

7. McKinstry shall provide a Schedule of Values. The schedule of values will include all costs related to the installation of the McKinstry's equipment. See TABLE 4.5 – "Construction Schedule of Values/Projected Progress Billings."

4.4 CONSTRUCTION CONTINGENCY

A construction contingency of the direct construction costs has been established for this project. McKinstry is authorized to expend the contingency for items necessary to complete the original scope of this project pending review by the Owner and the Department of General Administration. The intent of the contingency is for ESCO requested changes, unforeseen conditions or latent changes, and owner directed changes beyond what was originally estimated and scoped by the ESCO.

ESCO mark-ups on contingency funds will be addressed as follows:

- ESCO requested changes outside of scope– OH&P and CM only, design to be discussed
- ESCO requested changes inside of scope – CM only, design to be discussed
- Unforeseen or latent conditions – OH&P, CM, and applicable design
- Owner directed changes – All applicable mark-ups

All unused construction contingency funds shall reduce the overall project cost to the owner. The Owner, State GA, and McKinstry will jointly manage any contingency left after the project scope is completed.

4.5 ALLOWANCES

McKinstry may set aside allowances as identified in TABLE 4.1 - "Budget Summary Breakdown" for specific areas of work that have been identified as a potential cost impact but cannot be determined at this stage. Should the allowance not be adequate, the Owner will be advised and McKinstry will be compensated for any additional costs.

Project Financials

4.6 ONGOING SERVICES

No On-going Services in years 2-10 have been proposed for this phase of the project.

4.7 ACCOUNTING RECORDS

McKinstry shall check all material, equipment, and labor entering into the Work and shall keep account as may be necessary for proper financial management under this Agreement. The Owner shall be afforded access to all the ESCO's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to this Contract, and the Contract shall preserve all such records for a period of three years, or for such longer period as may be required by law, after the final payment.

4.8 RECONCILIATION OF LABOR & MATERIAL COSTS

The maximum project allowable cost is based on firm and estimated labor and material costs. In recognition that actual Labor & Material costs may vary from the estimate, the following procedures are established to reconcile this difference:

1. If the total project cost at completion exceeds the estimated amount (plus contingency), the additional costs will be borne by McKinstry at their expense.

2. If the total project costs at completion are less than the estimated proposal amount (less contingency), the savings will be retained by the Owner.

There shall be no cost savings split between the Owner and McKinstry

The following table outlines whether the Labor and Material costs are Estimated or Firm in this Energy Services Proposal. It further defines the method for providing firm costs during the pre-construction period (after authorization of this Energy Services Proposal). The table also clearly identifies which items are subject to reconciliation at the end of the project. As a general rule, those costs that are estimated in the proposal and bid or quoted during the pre-construction phase are reconciled at the end of the project. Those items that are firm in the proposal will be firm throughout the project, and not reconciled at the end of the project. End of Project reconcile shall be through subcontractor invoice substantiation.

L&M Costs	As Proposed In ESP	Pre-Construction Costing	End of Project - Reconciled
Controls Systems	Estimated	Proposal	Yes
Major Equipment	Estimated	Proposal	Yes
Mechanical	Estimated	Proposal	Yes
Electrical	Estimated	Proposal	Yes
ESCO Fees	Firm – Fee	Firm - Fee	No
Contingency	Estimated	Estimated	Yes

4.9 ESCO COMPENSATION

1. Terms: Net 30 days from the date of invoice, monthly billing as the job progresses.
2. Payments: At a minimum, payments will be made in the amount of 100%, less retention of five percent per the contract, at the completion and implementation of any individual Facility Improvement Measure (FIM) in the amount of that FIM as delineated in the contract. If more than one FIM is completed in a

monthly period, all of those FIM's will be paid.

3. Finance Charges on Unpaid balances: Payments due and unpaid shall be subject to interest charges per RCW 39.76.
4. Construction Period Finance: McKinstry may charge construction period finance for projects whereby the anticipated billing lags the earned schedule of values by more than 90 days. Table 4.5 provides the anticipated construction period finance charges for this project based on the estimated earned value each month vs. the anticipated billing collection schedule. Construction period finance will be calculated on the un-billed balance in excess of three months at the rate of Prime plus 2% per annum. Charges accrue until balances are paid in full. Interest charges will be calculated daily, compounded monthly.
5. Substantiation: McKinstry will do an accounting of finance charges progressively through the project, and at contract completion submit a change request itemizing the summary of additional costs for implementation. The contract will then be increased to reflect the same and finance charges will be paid within thirty days of the date of approved substantiation.

4.10 FINANCING

McKinstry enjoys over 45 years of experience within the engineering and contracting industry and its financial strength exceeds the industry average. This strength makes it possible to provide and assist with the financing needs of its customers. Long standing relationships with vendors assures reasonable pricing and excellent payment terms.

4.11 THIS PROJECT-LONG TERM FINANCING

The Department of General Administration has several options available for long term permanent financing. The State local program can provide financing terms up to a twelve-year payment plan. Third Party financing is also available through lenders such as Bank of America. Current finance rate on long-term, permanent financing is currently in the range of 2.9-3.25%. The 3/15/11 GA rate was 3.19%. The rate used in this financial model is the latest rate plus .25%, but will vary until a rate has been locked in.

Financial Scenario through State of Washington Treasurers Office: Although he Owner intends on using capital to pay for the project, the following scenario shows the maximum amount that could be barrowed at the current interest rate with a ten year loan.

Financed Amount	$934,932
Utility Rebate	$40,195
Capital Infusion	$1,794,009
Term of Loan	10 year
Interest Rate	03.44%
Number of Payment per Year	2
Annual Payment	$111,288

Table 4.3 in the end of section provides a Cash Flow Analysis for this project over 20 years.

Project Financials

4.12 TERMINATION VALUE

Refer to program guidelines for information on Termination values.

4.13 TERMS AND CONDITIONS

TERMS OF AGREEMENT

The Contract shall be effective and binding upon the parties immediately upon its execution and the period from contract execution until the Commencement Date shall be known as the "Interim Period". All energy savings achieved during the interim period will be fully credited to Owner, and may be used to offset any loss of energy savings; as mutually agreed to by the Owner and McKinstry.

INSURANCE AND BONDING

McKinstry shall provide a Payment and Performance bond, Retention bond and Builder's Risk Insurance.

For the purposes of this agreement, the "Sum Amount of Bond" shall be (See Table 4.1 –"Budget Summary Breakdown").

1. The bond amount consists of Labor and Materials and State Sales Tax.
2. This bond does not include any construction contingencies.
3. Certificates of General Liability Insurance will be provided prior to Contract Signing. The State Of Washington shall be named as An Additional Insured on all insurance certificates.
4. McKinstry shall provide a payment and performance bond in the amount of 100% of the construction cost, as defined in the Energy Services Agreement Addendum. The amount shall include all authorized changes and state sales tax. The Bond shall be in the form attached to the Conditions of the Energy Services Agreement. The Contract listed on the bond form shall be the Addendum No. and Agreement No. which incorporates the work and the "Contract Date" shall be the date of the Addendum. The full and just sum of the Bond shall be as defined above and shall include the actual cost of purchasing and installing McKinstry's Equipment. The Bond shall specifically exclude coverage for those portions of the Energy Services Agreement and/or Energy Services Agreement Addendum pertaining to design services, energy cost savings guarantee, maintenance guarantee, utility incentives, efficiency guarantees, and any other clauses which do not relate specifically to construction management and supervision of work for purchasing and installing of McKinstry's Equipment, or for work to be accomplished by the Owner. The Bond shall be with a Surety or Bonding Company that is registered with the State of Washington Insurance Commissioner's Office.

TABLE 4.1 BUDGET SUMMARY

Date: **5/5/2011 Rev-1**

Project: **Valley Medical Center**

Budget Phase **GMAX**

Building: ***East PH, Olympic Bld***

Estimator: **MB**

FIM	FIM Description	Mechanical	Electrical	EMCS	Lighting	General	Equipment	Other	TOTAL
6278	24.01-VMC Solar PV Installation-Yard Installation- Valley Medical Center	$0	$19,950	$3,180	$0	$0	$0	$0	$23,130
6650	9.02-VMC Lobby Lighting Upgrade- Valley Medical Center	$0	$0	$0	$37,450	$0	$0	$0	$37,450
6651	9.01-TLB Lighting Upgrade- Valley Medical Center	$0	$0	$0	$29,150	$0	$0	$0	$29,150
6817	9.01B-VMC Surface Parking Lighting Upgrade (LED Option)- Valley Medical	$0	$0	$0	$99,402	$0	$0	$0	$99,402
6847	1.01-VMC Heating Water Upgrade- Valley Medical Center	$509,583	$48,865	$76,390	$0	$37,100	$0	$0	$671,938
6900	3.01-VMC Dual Duct Unit Replacement- Valley Medical Center	$304,054	$32,840	$86,625	$0	$134,490	$251,810	$0	$809,819
	General Conditions / Site Supervision							$53,480	$53,480
A 1. SUBTOTAL		**$813,637**	**$101,655**	**$166,195**	**$166,002**	**$171,590**	**$251,810**	**$53,480**	**$1,724,369**
1	Comissioning / FPT	$78,068	lump sum						$78,068
A 2. SUBTOTAL		**$813,637**	**$101,655**	**$166,195**	**$166,002**	**$171,590**	**$251,810**	**$53,480**	**$1,802,437**
1	Construction Bonds	1.0%	$8,136	$1,017	$1,662	$1,660	$1,716	$2,518	$535	$18,024
	TOTAL CONSTRUCTION COST (A1+Bond) = A								**$1,820,461**
B.	**PROFESSIONAL SERVICES**								
1	Audit Fee	$52,090	lump sum						$52,090
2	Design - Lighting / ME Detailing/ Solar / Review	5.0%	B2 (%) x (A1)						$86,218
3	Construction Management & Project Admin	6.0%	B3 (%) x (A1)						$103,462
	TOTAL PROFESSIONAL SERVICES (B1+B2+B3) = B								**$241,771**
C.	**OTHER COSTS**								
1	Project Contingency (w/o Tax))	$ 99,751	lump sum						$99,751
2	Performance Assurance (M&V)	$ 5,790	lump sum						$5,790
	TOTAL OTHER COSTS = C								**$105,541**
D.	**OVERHEAD COSTS AND FEE**								
1	Overhead	10.0%	D1 (%) x (A2)						$180,244
2	Profit	7.0%	D2 (%) x (A2)						$126,171
	TOTAL ESCO FEES = D								**$306,415**
E.	**TOTAL GUARANTEED CONSTRUCTION & ESCO SERVICES (A + B + C + D) = E**								**$2,474,188**
F.	**NON-GUARANTEED COSTS**								
1	Sales Tax	9.5%	F1% x E						$235,048
3	GA Fee	$ 59,900							$59,900
	TOTAL NON-GUARANTEED COSTS = F								**$294,948**
G.	**TOTAL MAXIMUM PROJECT COST**								**$2,769,136**

Table 4.2 - Facility Improvement Measure (FIM) Summary

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Date	May 4, 2011

Facility Improvement Measures	FIM Description	Building	Budget *	Annual Utility Savings	Annual Operational Savings **	Potential Incentives ***	Non-Guaranteed Net Customer Cost (with Incentives)
01.01-VMC Heating Water Upgrade	The central boilers in the basement mechanical room provide steam to the Valley Medical Center building. This steam serves a heating water converter preheat plant in the South Penthouse and a heating water converter reheat plant in the basement mechanical room. Both plants are out of date and inefficient. Replace the preheat and reheat converters, and install variable volume heating water pumps.	Valley Medical Center	$1,113,591	$19,175	$13,265	$4,000	$1,109,591
03.01-VMC Dual Duct Unit Replacement	The Dual Duct unit in the East Penthouse is approaching end of life. Provide a new dual duct unit with VFDs and which meets Valley Medical Center performance and redundancy specifications. Include 30,000 CFM temporary unit to allow for 24/7 service to prevent service interruption.	Valley Medical Center	$1,342,099	$8,114	$12,095	$4,500	$1,337,599
09.01-TLB Lighting Upgrade	Replace existing HID fixtures located in the Gymnasium and Pool areas with energy efficient fixtures operating T5HO lamps and electronic ballasts. Existing T12 lamps and magnetic ballasts located on the 1st floor will be retrofitted with T8 lamps and electronic ballasts. Pharmacy/Gift shop fixtures will be upgraded using retrofit kits to standardize lamp and ballast quantities per fixture and improve the aesthetics of the space.	Valley Medical Center	$48,310	$2,362	$2,685	$6,317	$41,993
09.01-VMC Surface Parking Lighting Upgrade	Replace existing 250W and 400W post top metal halide and high pressure sodium area light fixtures located in the main surface parking area with 139W LED fixtures. Budget reflects the use of existing poles. Replace existing sign lighting metal halide fixtures with LED ground mount flood lights. Replace existing metal halide canopy fixtures in the main walkway with vapor tight fixtures operating fluorescent lamps and electronic ballasts.	Valley Medical Center	$164,737	$4,952	$3,800	$13,078	$151,659
09.02-VMC Lobby Lighting Upgrade	Replace existing HID downlights located above both the pool and above the 2nd floor waiting area with LED downlights. HID fixtures above both stairwells will be redesigned with pendant hung T8 linear fluorescent fixtures with integral PAR lamp.	Valley Medical Center	$62,065	$4,071	$4,408	$12,080	$49,985
24.01-VMC Solar PV Installation	Provide an AC grid-connected solar PV power system. The PV panels will be pole-mounted and installed on the VMC lawn at the entrance to HWY 167. Scope includes "SMA" brand Web-based monitoring equipment and software that will make it possible to monitor and display system performance data online.	Valley Medical Center	$38,332	$107	$0	$220	$38,112
		Totals	**$2,769,135**	**$38,782**	**$36,253**	**$40,195**	**$2,728,940**

* Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are dropped.
** For non recurring operational savings, the values are averaged over the 25 year length of this analysis.
*** Incentives are contingent on final approval and are not guaranteed. Funds are shown for reference only.

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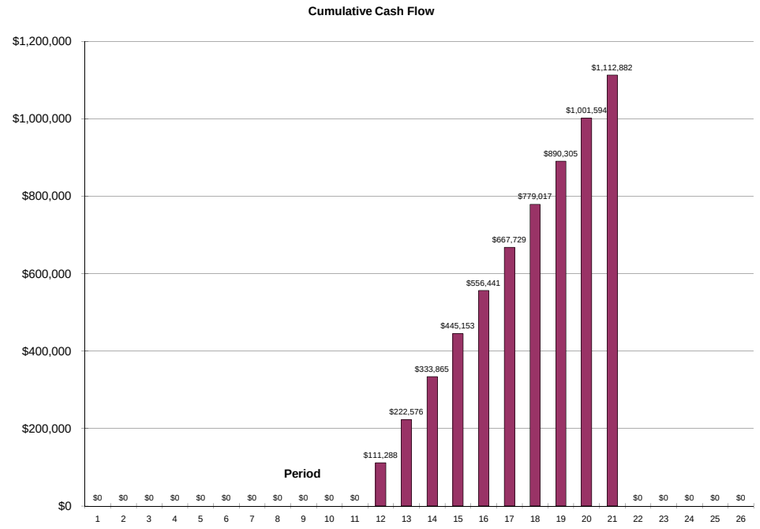
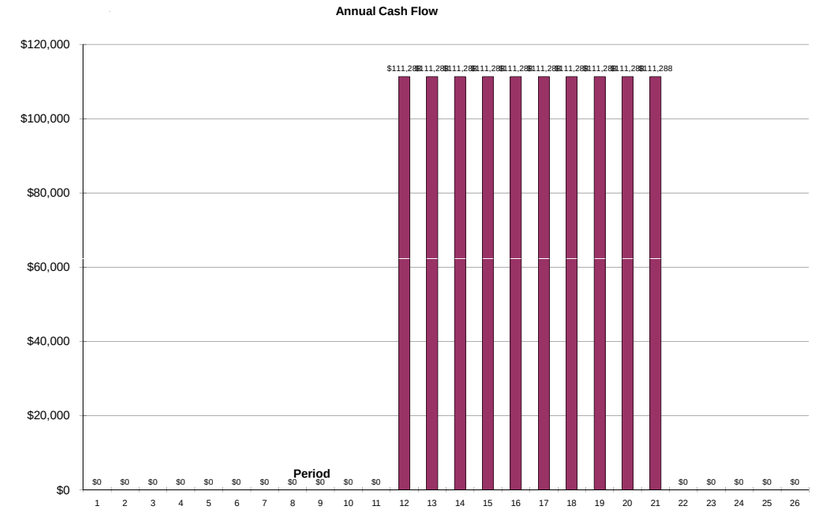
Table 4.3 Cashflow Analysis

Cash Flow Analysis 5/4/2011

Customer:	
Project:	**Valley Medical Center AHU and Lighting Upgrades**
Scenario:	**GMAX-VMC AHU and Lighting Upgrades**
Financing Source:	**TBD**
Financial Data for Scenario:	
First Cost	$2,769,136
Utility Rebate	$40,195
Net Customer Cost	$2,728,941
Capital Infusion	**$1,794,009**
Amount Financed	$934,932
Annual Utility and Maintenance Savings	$75,035
Cash Flow Analysis Period	20.0
Include Depreciation (1=Yes, 0=No)	0.0
Life of Equipment (For Depreciation)	15.0
Number of Years for O&M Savings	20.0
Annual Measure and Verification Fee	$0
M&V Start Year	2.0
M&V End Year	15.0
Financing Term (Years)	10.00
Annual Interest Rate %	3.44%
Payments per Year	2.00
First Payment Due Date	6/1/12
Discount Rate	0.00%
Inflation Rate	0.00%
Scenario Simple Payback (yrs)	36.37
Return on Investment	3%
Net Present Value (NPV) Year 10	$0
Net Present Value (NPV) Year 15	$556,441
Net Present Value (NPV) Year 25	





Cash Flow Analysis:

Period	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Year	**2009**	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
First & Replacement	$ (1,794,009)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0.0	0.0	0.0	0.0	0.0
Equipment Depreciation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tax Credit Impact	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal	**$ (1,794,009)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Annual Utility Savings		$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035	$75,035
Utility Escalation 0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Utility Savings	**$0**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**	**$75,035**
Annual O&M Savings		$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253	$36,253
O&M Escalation 0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total O&M Savings	**$0**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**	**$36,253**
M&V Fee 0.0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Savings	$0	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288
Accumulated Savings	**$0**	**$111,288**	**$222,576**	**$333,865**	**$445,153**	**$556,441**	**$667,729**	**$779,017**	**$890,305**	**$1,001,594**	**$1,112,882**	**$1,224,170**	**$1,335,458**	**$1,446,746**	**$1,558,035**	**$1,669,323**	**$1,780,611**	**$1,891,899**	**$2,003,187**	**$2,114,475**	**$2,225,764**
Annual Finance/Lease Payment	**$ -**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**($111,288)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Principal		($80,487)	($83,280)	($86,170)	($89,159)	($92,253)	($95,454)	($98,765)	($102,192)	($105,738)	($109,406)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		($30,801)	($28,008)	($25,119)	($22,129)	($19,035)	($15,835)	($12,523)	($9,096)	($5,550)	($1,882)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Cash Flow	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288	$111,288
Cumulative Cash Flow:	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$111,288**	**$222,576**	**$333,865**	**$445,153**	**$556,441**	**$667,729**	**$779,017**	**$890,305**	**$1,001,594**	**$1,112,882**
Present Value (PV) Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cumulative PV	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$111,288**	**$222,576**	**$333,865**	**$445,153**	**$556,441**	**$667,729**	**$779,017**	**$890,305**	**$1,001,594**	**$1,112,882**

P. O. Box 24567
Seattle, WA 98124

Project: Valley Medical Center - East Penthouse

Job No: _____ **Date:** i/2011-Rev-1

TABLE 4.5 - PROJECTED BILLINGS / SCHEDULE OF VALUES

Description	Contract Amount	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12
ENERGY SERVICES													
Energy Services Proposal & DES	$52,090	$52,090											
Design	$86,218		$43,109	$43,109									
Construction Management	$103,462		$10,346	$10,346	$10,346	$10,346	$10,346	$10,346	$10,346	$10,346	$10,346	$10,346	
ESCO M&V Costs	$5,790											$5,790	
ESCO OH & Profit	$306,415		$30,642	$30,642	$30,642	$30,642	$30,642	$30,642	$30,642	$30,642	$30,642	$30,642	
Sub Total Energy Services	**$553,975**	**$52,090**	**$84,097**	**$84,097**	**$40,988**	**$40,988**	**$40,988**	**$40,988**	**$40,988**	**$40,988**	**$40,988**	**$46,778**	
CONSTRUCTION													
24.01 - Solar PV	$23,130				$11,565		$11,565						
9.01, 9.01B and 9.02 - Lighting	$166,002				$83,001		$16,600	$16,600	$16,600	$16,600	$16,600		
1.01 Heating Water Upgrade	$671,938			$335,969	$55,995	$55,995	$55,995	$55,995	$55,995	$55,995			
3.01 - Dual Duct Unit Replacement	$809,819				$404,910	$67,485	$67,485	$67,485	$67,485	$67,485	$67,485		
Commissioning	$78,068							$15,614	$15,614	$15,614	$15,614	$15,614	
GC/Site Supervision//Bond	$71,504			$13,196	$21,818	$4,850	$5,956	$5,502	$5,502	$5,502	$3,303	$5,875	$0
Sub Total Construction Costs	**$1,820,461**	**$0**	**$0**	**$349,165**	**$577,288**	**$128,330**	**$157,601**	**$161,196**	**$161,196**	**$161,196**	**$103,001**	**$21,489**	**$0**
WSST (9.5%) on Project Costs	$235,048	$4,949	$7,989	$41,160	$58,736	$16,085	$18,866	$19,207	$19,207	$19,207	$13,679	$15,962	$0
GA Fee	$59,900												$59,900
TOTAL ESCO + CONSTRUCTION COSTS	$2,669,384	$57,039	$92,086	$474,422	$677,012	$185,403	$217,455	$221,391	$221,391	$221,391	$157,668	$84,228	$59,900
Invoiced Amount		**$0**	**$0**	**$623,546**	**$677,012**	**$185,403**	**$217,455**	**$221,391**	**$221,391**	**$221,391**	**$157,668**	**$84,228**	**$59,900**
OTHER COSTS													
Contingency and allotment	$99,751				(Not projected until the needs arise)								

Valley Medical Center

Heating Hot Water, Dual Duct AHU, Lighting Upgrades and Solar PV Installation

Directed Engineering Study

Valley Medical Center, Renton, WA

May 4, 2011

Prepared by: Katie Rossmann, P.E., LEED AP

McKinstry
For The Life Of Your Building

Section 5.0 Directed Engineering Study

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SECTION 5.7 FIM'S CONSIDERED BUT NOT USED

SECTION 5.8 HVAC SYSTEM DATA & TEST TRENDS

Directed Engineering Study cont.

5.1 PURPOSE AND ORGANIZATION

This exhibit documents the analysis performed to establish the utility and operational savings for the project.

The information is organized by FIM (Facility Improvement Measure) to illustrate the savings calculations and analysis. Additionally, relevant site survey data, measurement data, utility information and miscellaneous back-up information are provided in the sections following the FIM sections.

5.2 GENERAL NARRATIVE

Valley Medical Center has been in operation for over forty years. During that time the hospital's main campus and remote clinics have grown and expanded which today totals over a million square feet of facility space. Despite Valley Medical Center's growth and expansion some of its originally installed mechanical HVAC equipment still serves the hospital. Valley Medical Center is working to improve the existing infrastructure to best serve the building occupants.

BUILDING DESCRIPTION

GENERAL FACILITY DESCRIPTION

The Valley Medical Center main building is a three story building. A sub-basement contains the mechanical rooms, and the Air Handling units are located within penthouses on the roof. Through the years, the Valley Medical Center Building has gone through various additions and tenant improvements, including updates to many Penthouse Air Handling Units.

Occupancy is primarily medical space and is occupied 24 hours/day and 7 days/week.

Electricity is supplied by Puget Sound Energy, and Natural Gas is provided by IGI with transportation provided by PSE.

HVAC SYSTEM-EAST PENTHOUSE

The Valley Medical Center is served by Air Handling Units located in multiple mechanical penthouses. This study focused specifically on the East Penthouse.

There are three units in the Valley Medical Center East Penthouse.

AHU-39
AHU-39 serves the birth center and support areas. This unit was recently installed to replace two units from original construction. This unit has VFDs on the supply and return fans with modulating mixed air dampers. The main supply fan draws air through a hydronic heating coil and then blows through a chilled water coil before discharging into the primary ductwork. This unit is in good condition.

SF-1
SF-1 was installed in 1969. This unit serves the Lab and Radiology, and operates 24 hours/day throughout the week. This unit is a 100% outside air dual duct unit with a VFD on the supply fan. The outside air is preheated, the cold deck is served with chilled water, the hot deck with heating water.

SF-4
SF-4 was also installed in 1969. This unit serves the kitchen and dining room, and operates 24 hours/day throughout the week. This unit is a multizone unit with a VFD. The outside air is pre-heated, the cold deck is served with chilled water, the hot deck with heating water. The zone-level ductwork branches off within the mechanical room and penetrates the floor to serve the space below. Many zone dampers are broken and require frequent repairs.

Directed Engineering Study cont.

STEAM AND HEATING HOT WATER

HEATING HOT WATER LOOP

The Valley Medical Center building is heated by a central steam boiler plant located in the sub-basement. A steam converter, installed in 1969, provides heating hot water for the Air Handling Unit preheat coils. The preheat converter and associated pumps are located in the South Penthouse. Due to upgrades to the penthouse Air Handling units, the preheat plant is oversized. Two 30-hp pumps distribute heating water to the Air Handling Units in the penthouse. These pumps are constant volume and staged to prevent wear. The preheat pumps run 24/7 throughout the year. The preheat piping must be maintained above 90 degrees F to prevent pipe leaks.

The reheat plant is located in the sub-basement boiler room. The original reheat plant consists of one steam converter and two associated 10-hp constant volume pumps. This plant serves the original design reheat load. As the building was expanded, the plant was not longer large enough to meet the reheat load. An additional converter and two 25-hp pumps were added in a plant upgrade project. Both pumps are equipped with VFDs, however, one VFD is inoperational. The plant is manually staged so that one 10-hp and one 25-hp pump runs 24/7. The 10-hp pumps are alternated to prevent wear, and the 25-hp pump with a VFD runs as a priority unless it must be shut down for repairs.

BUILDING CONTROLS

The Valley Medical Center building is operated by a Siemens Apogee system. The controls throughout are a combination of pneumatics and DDC.

Directed Engineering Study cont.

SECTION 5.3 FACILITY IMPROVEMENT MEASURES - CALCULATIONS

FIM # 01.01-VMC: HEATING WATER UPGRADE

FIM # 03.01-VMC: DUAL DUCT UNIT REPLACEMENT

FIM # 09.01-VMC: SURFACE PARKING LIGHTING UPGRADE

FIM # 09.02-VMC: LOBBY LIGHTING UPGRADE

FIM # 09.01-TLB: LIGHTING UPGRADE

FIM # 24.01-VMC: SOLAR PV INSTALLATION

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number	6847	Valley Medical Center

Component Description 01.01-VMC Heating Water Upgrade

The central boilers in the basement mechanical room provide steam to the Valley Medical Center building. This steam serves a heating water converter preheat plant in the South Penthouse and a heating water converter reheat plant in the basement mechanical room. Both plants are out of date and inefficient. Replace the preheat and reheat converters, and install variable volume heating water pumps.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	166,769	$10,840
Electric Demand	kW	4	$18
Natural Gas	Therm	8,235	$8,317
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$19,175**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$4,000	1	1	1	

Cost (Rough Estimate Only) **

Total	$1,100,820
Net After Rebate	$1,096,820
Simple Payback (Years)	57.2

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

	VALLEY MEDICAL CENTER	**JOB NO.** P10759	**PAGE**
	DESCRIPTION: 01.01-VMC Heating Water Upgrade		1/5
	Valley Medical Center Converter Replacement Summary of Savings		**BY** KMR
			DATE 5/4/2011

Below is a summary of savings calculated as a result of upgrading the existing reheat and preheat plants at Valley Medical Center. These savings are acquired through improved insulation values and VFDs on the associated pumps.

VALLEY MEDICAL CENTER

Pre-heat System Converter Replacement Savings

	Summary of Savings	Units	Savings	Reference
A	Natural Gas Savings per Year	Therms	3,923	Page 2 of 5

Re-heat System Converter Replacement Savings

	Summary of Savings	Units	Savings	Reference
AA	Natural Gas Savings per Year	Therms	5,227	Page 3 of 5

Pre-heat System Pump Replacement Savings

	Summary of Savings	Units	Savings	Reference
BA	Electricity Savings per Year	kWh	124,527	Page 4 of 5
BB	Electric Demand Savings per Year	kW	-2.02	Page 4 of 5

Re-heat System Pump Replacement Savings

	Summary of Savings	Units	Savings	Reference
CA	Electricity Savings per Year	kWh	49,963	Page 5 of 5
CB	Electric Demand Savings per Year	kW	5.59	Page 5 of 5

Total Converter Replacement Savings

01.01-VMC HEATING WATER UPGRADE SUMMARY OF SAVINGS

	Summary of Savings	Units	Savings	Reference
DA	Electricity Savings per Year	kWh	174,490	BA+CA
DB	Electric Demand Savings per Year	kW	3.57	BB+CB
DC	Natural Gas Savings per Year	Therms	9,150	A+AA

McKinstry For The Life Of Your Building	**VALLEY MEDICAL CENTER**	**JOB NO.** P10759	**PAGE**
	DESCRIPTION: 01.01-VMC Heating Water Upgrade		2/5
	Valley Medical Center Converter Replacement Pre-heat System Savings		**BY** KMR
			DATE 5/4/2011

Below is a summary of savings calculated as a result of upgrading the existing Pre-heat system at Valley Medical Center. These savings are acquired through improved insulation values and VFDs on the pumps.

The Pre-heat converter was installed in 1969, and it is assumed the insulation has been downgraded due to age of equipment.

Existing: One large heat exchanger and two 30-hp constant volume pumps. The existing plant is oversized for the revised preheat load in the penthouses.

Proposed: Replace preheat plant with two 5,169 MBH heat exchangers and two 20-hp pumps with VFDs. Each heat exchanger is sized for 60% of the load, each pump is also sized for 60% of the load.

VALLEY MEDICAL CENTER

Converter Insulation Upgrade

Existing Steam Converter-1969		**Units**	**Savings**	**Reference**
A	Peak energy input to converter	Btu/hr	19,500,000	Design Value
B	Converter Jacket Loss	%	0.25%	Estimated-Equipment Age
D	Average energy input to converter	Btu/hr	48,750	A*B/C
E	Efficiency of steam boiler	%	80%	Code Min
F	Average boiler gas usage	Btu/hr	60,938	D/E
I	Total hours per year	hours/year	8760	24/7 operation
J	Average Boiler Gas Usage	Btu/Year	533,812,500	F*I
K	Average Power Plant boiler gas usage	**Therms/Year**	**5,338**	Q/100,000

Proposed Steam Converter		**Units**	**Savings**	**Reference**
AA	Peak energy input to converter	Btu/hr	10,338,000	Equipment Schedules
AB	Converter Jacket Loss	%	0.13%	Estimated-Equipment Age
AD	Average energy input to converter	Btu/hr	12,923	A*B/C
AE	Efficiency of steam boiler	%	80%	Code Min
AF	Average boiler gas usage	Btu/hr	16,153	D/E
AG	Daily Usage	hours/day	24	24/7 operation
AH	Average Weekly Usage	hours/week	168	24/7 operation
AI	Total hours per year	hours/year	8760	24/7 operation
AJ	Average Boiler Gas Usage	Btu/Year	141,501,375	F*H
AK	Average Power Plant boiler gas usage	**Therms/Year**	**1,415**	Q/100,000

Savings Summary		**Units**	**Savings**	**Reference**
BA	Average Existing Gas Usage	Therms/Yr	5,338	K+V
BB	Average Proposed Gas Usage	Therms/Yr	1,415	AK
BC	Average Annual Savings	Therms/Yr	3,923	BA-BC

Total Converter Replacement Savings

	Summary of Savings	**Units**	**Savings**	**Reference**
CA	Natural Gas Savings per Year	Therms	3,923	BC

McKinstry For The Life Of Your Building	**VALLEY MEDICAL CENTER**	**JOB NO.** P10759	**PAGE**
	DESCRIPTION: 01.01-VMC Heating Water Upgrade		3/5
	Valley Medical Center Converter Replacement Re-heat System Savings		**BY** KMR
			DATE 5/4/2011

Below is a summary of savings calculated as a result of upgrading the existing Pre-heat system at Valley Medical Cetner. These savings are acquired through improved insulation values and VFDs on the pumps.

The Reheat converter is aging, and it is assumed the insulation has been downgraded due to age of equipment.

Existing: One heat exchanger plant and two associated constant volume 10-hp pumps were not large enough to meet the building reheat load, so an additional heat exchanger and two 25-hp pumps with VFDs were added in a plant upgrade project.

Proposed: Combine both plants into one plant served by two 14,905 MBH heat exchangers and three 50-hp pumps with VFDs. Each heat exchanger is sized for 100% of the load.

VALLEY MEDICAL CENTER

Converter Insulation Upgrade

Existing Steam Converter-1969		**Units**	**Savings**	**Reference**
A	Peak energy input to converter	Btu/hr	4,000,000	Design Value
B	Converter Jacket Loss	%	0.50%	Estimated-Equipment Age
C	Average percentage of peak usage	%	100%	Estimated-System undersized
D	Average energy input to converter	Btu/hr	20,000	A*B/C
E	Efficiency of steam boiler	%	80%	Code Min
F	Average boiler gas usage	Btu/hr	25,000	D/E
G	Daily Usage	hours/day	24	24/7 operation
H	Average Weekly Usage	hours/week	168	24/7 operation
I	Total hours per year	hours/year	8760	24/7 operation
J	Average Boiler Gas Usage	Btu/Year	219,000,000	F*H
K	**Average Power Plant boiler gas usage**	**Therms/Year**	**2,190**	**Q/100,000**

Existing Steam Converter-1981		**Units**	**Savings**	**Reference**
L	Peak energy input to converter	Btu/hr	13,000,000	Design Value
M	Converter Jacket Loss	%	0.50%	Estimated-Equipment Age
N	Average percentage of peak usage	%	100%	Estimated-System undersized
O	Average energy input to converter	Btu/hr	65,000	A*B/C
P	Efficiency of steam boiler	%	80%	Code Min
Q	Average boiler gas usage	Btu/hr	81,250	D/E
R	Daily Usage	hours/day	24	24/7 operation
S	Average Weekly Usage	hours/week	168	24/7 operation
T	Total hours per year	hours/year	8760	24/7 operation
U	Average Boiler Gas Usage	Btu/Year	711,750,000	F*H
V	**Average Power Plant boiler gas usage**	**Therms/Year**	**7,118**	**Q/100,000**

Proposed Steam Converter		**Units**	**Savings**	**Reference**
AA	Peak energy input to converter	Btu/hr	14,905,000	Design Value
AB	Converter Jacket Loss	%	0.25%	Estimated-Equipment Age
AC	Average percentage of peak usage	%	100%	Design Intent
AD	Average energy input to converter	Btu/hr	37,263	A*B/C
AE	Efficiency of steam boiler	%	80%	Code Min
AF	Average boiler gas usage	Btu/hr	46,578	D/E
AG	Daily Usage	hours/day	24	24/7 operation
AH	Average Weekly Usage	hours/week	168	24/7 operation
AI	Total hours per year	hours/year	8760	24/7 operation
AJ	Average Boiler Gas Usage	Btu/Year	408,024,375	F*H
AK	**Average Power Plant boiler gas usage**	**Therms/Year**	**4,080**	**Q/100,000**

Savings Summary		**Units**	**Savings**	**Reference**
BA	Average Existing Gas Usage	Therms/Yr	9,308	K+V
BB	Average Proposed Gas Usage	Therms/Yr	4,080	AK
BC	Average Annual Savings	Therms/Yr	5,227	BA-BC

Total Converter Replacement Savings

Summary of Savings		**Units**	**Savings**	**Reference**
EB	Natural Gas Savings per Year	Therms	5,227	BC

Valley Medical Center Reheat Coil

PAGE
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Replace two 30-hp constant volume pumps, each sized for 100% of load with two 20-hp pumps sized for 60% of the load with VFDs

User Inputs

INPUTS:

				Reference
AA	Hydronic Pump Peak Brake Horsepower	34.5	bhp	AJ*AB*1/(3960*AD)
AA.1	New Hydronic Pump Peak Brake Horsepower	27.1	bhp	AJ*AB.1*1/(3960*AD.1)
AB	Building Head Pressure	80	ft hd	Assuming the Same as Design
AB.1	New Building Head Pressure	80	ft hd	Design Schedule
AC	kW Exponent Used for Pump Affinity Laws	1.0		Theoretical is 3
AD	Pump & Motor Efficiency	60.5%	Percent	NEMA Motor Efficiency (93% from nameplate) x pump curve efficiency (65% from assumption)
AD.1	New Pump & Motor Efficiency	77.2%	Percent	NEMA Motor Efficiency (93% assumption) x pump curve efficiency (83% from schedule)
AE	Peak kW without VFD	24.94	kW	Measured Amps-kW
AE.1	New Peak KW without VFD	26.15	KW	AA.1*0.746/AD.1
AF	VFD Efficiency	97%	Percent	Danfoss HVAC VFD
AG	Peak kW with VFD	26.96	kW	AE.1/AF
AH	Minimum kW % of Peak kW	30%	Percent	((0.4^AC)*AA.1*0.746)/AG
AJ	Peak Design Coil Flow	1,033.8	gpm	Design Schedule
AK	Trended Average Delta T	20.0	Degrees F	Trended Data
AL	Design Peak Capacity	10338	MBH	500*AJ*AK/1000
AM	Converter Minimum Flow Rate	10.0	gpm	Assumption

Summary:

Existing Energy Use	218,189 kWh
Proposed Energy Use	93,661 kWh
Savings Summary:	**124,527 kWh**
Demand Savings:	**-2.02 kW**

NOTES:

Trend the following:

1. on/off of pumps to see how they operate: One pump runs at a time. Run 24/7
2. Delta T to determine what flow is typically needed-VFD operation
3. snapshot of amps: 30 Amps, 480 V

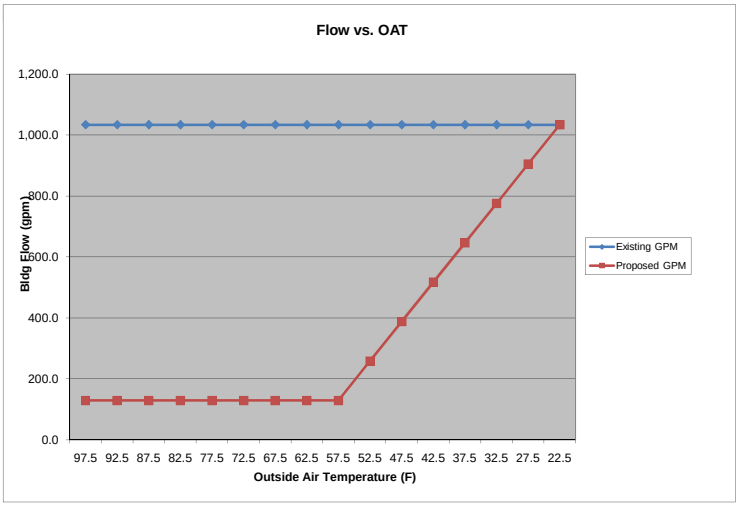
TRENDED DATA:

Pump Peak kW without VFD	
Measured Amps	30
Volts	480
kW	24.94

ok	ok	ok	ok-May change	ok	ok	ok	ok	ok	ok	ok
A	B	C	D	E	F	G	J	K	L	M
BIN NUMBERS	SEATTLE BIN HOURS	Assumption	Linear Fit with max load on design day and min load at 57 deg	C/AJ (CV Pump Existing	E^AC*AE	F*B	MAXIMUM OF D*1000/(500*AK) OR AM	J/AJ	MAXIMUM OF K^AC*AG OR AH*AG	L*B
OSAT (°F)	**BIN (Hours) (1)**	**Existing Coil Flow (gpm)**	**Existing Coil Load (MBH)**	**Existing Pump Load %**	**Power Existing (kW)**	**Power Consumption Existing (kWh)**	**Proposed Flow (gpm)**	**Proposed Pump Load %**	**VSD Power Proposed (kW)**	**VSD Power Consumption Proposed (kWh)**
97.5	4	1,033.8	1,292.3	100.0%	24.94	100	129.2	12.5%	8.07	32
92.5	4	1,033.8	1,292.3	100.0%	24.94	100	129.2	12.5%	8.07	32
87.5	4	1,033.8	1,292.3	100.0%	24.94	100	129.2	12.5%	8.07	32
82.5	78	1,033.8	1,292.3	100.0%	24.94	1,945	129.2	12.5%	8.07	630
77.5	137	1,033.8	1,292.3	100.0%	24.94	3,417	129.2	12.5%	8.07	1,106
72.5	348	1,033.8	1,292.3	100.0%	24.94	8,680	129.2	12.5%	8.07	2,810
67.5	406	1,033.8	1,292.3	100.0%	24.94	10,126	129.2	12.5%	8.07	3,278
62.5	1018	1,033.8	1,292.3	100.0%	24.94	25,390	129.2	12.5%	8.07	8,219
57.5	1379	1,033.8	1,292.3	100.0%	24.94	34,394	129.2	12.5%	8.07	11,134
52.5	1335	1,033.8	2,584.5	100.0%	24.94	33,297	258.5	25.0%	8.07	10,778
47.5	1450	1,033.8	3,876.8	100.0%	24.94	36,165	387.7	37.5%	10.11	14,658
42.5	1175	1,033.8	5,169.0	100.0%	24.94	29,306	516.9	50.0%	13.48	15,837
37.5	1098	1,033.8	6,461.3	100.0%	24.94	27,386	646.1	62.5%	16.85	18,499
32.5	280	1,033.8	7,753.5	100.0%	24.94	6,984	775.4	75.0%	20.22	5,661
27.5	40	1,033.8	9,045.8	100.0%	24.94	998	904.6	87.5%	23.59	944
22.5	4	1,033.8	10,338.0	100.0%	24.94	100	1,033.8	100.0%	26.96	108
	8,760					**218,189**				**93,661**

Notes:

(1) BIN hours for operation 24/7



Valley Medical Center Reheat Coil
Existing Pump Operation per Jon Ault (Building operator)
P-4 and P-5 serve the newer parts of the building, but as rennovations happen they get added to this loop. P-4 has a VFD, P-5's is inoperational. P-4 is typically running with P-5 as backup
P-6 and P-7 are CV. One pump runs 100% at a time. They are staged to prevent wear

Calculation Description
This measure will replace the four pumps with three 50 pumps sized for 50% of the load with VFDs. This calculation shows the savings for one (1) 10-hp CV pump converted to one (1) 10-hp pump with a VFD

User Inputs

	INPUTS:			Reference
AA	Hydronic Pump Peak Brake Horsepower	7.5	bhp	10 hp
AA.1	New Hydronic Pump Peak Brake Horsepower	7.5	bhp	10 hp
AB	Building Head Pressure	N/A	ft hd	Assuming the Same as Design
AB.1	New Building Head Pressure	N/A	ft hd	Design Schedule
AC	kW Exponent Used for Pump Affinity Laws (Theoretical is 3)	1.0		Theoretical is 3
AD	Pump & Motor Efficiency	60.5%	Percent	NEMA Motor Efficiency (93% assumption based on age) x pump curve efficiency (65% from assumption)
AD.1	New Pump & Motor Efficiency	68.8%	Percent	NEMA Motor Efficiency (93% assumption) x pump curve efficiency (74% from schedule)
AE	Peak kW without VFD	6.98	kW	AA*0.746/AD
AE.1	New Peak KW without VFD	8.13	KW	AA.1*0.746/AD.1
AF	VFD Efficiency	97%	Percent	Danfoss HVAC VFD
AG	Peak kW with VFD	8.38	kW	AE.1/AF
AH	Minimum kW % of Peak kW	26.70%	Percent	((0.4^AC)*AA.1*0.746)/AG
AJ	Peak Design Coil Flow	400.0	gpm	AL*1000/(500*AK)
AK	Trended Average Delta T	20.0	Degrees F	Trended Data
AL	Design Peak Capacity	4,000	MBH	Design Schedule
AM	Proposed Design Flow	800.0	gpm	AJ
AN	Proposed Minimum Delta T	10.0	Degrees F	
AM	Converter Minimum Flow Rate	10.0	gpm	Assumption
AN	Existing Plant Minimum Pump Load	100%	%	Assumption

Summary:

Existing Energy Use	85,113	kWh
Proposed Energy Use	35,150	kWh
Savings Summary:	**49,963**	**kWh**
Demand Savings:	**5.59**	**kW**

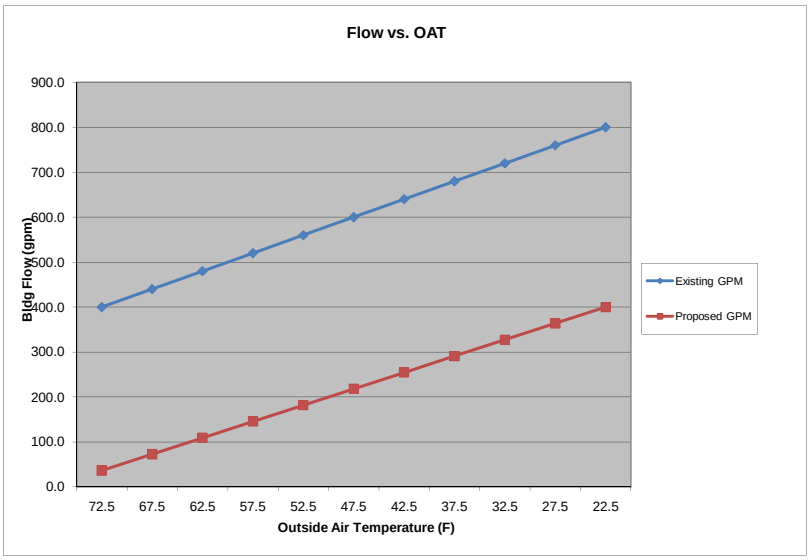
NOTES:
Trend the following:
1. On/off of pumps to see how they operate: See note above
2. Delta T to determine what flow is typically needed-VFD operation
3. Snapshot of amps on 10 hp pump: 8.4 Amps/473 V

TRENDED DATA

Pump Peak kW without VFD	
Measured Amps	8.4
Volts	480
kW	6.98

A	B	C	D	E	F	G	J	K	L	M
BIN NUMBERS	SEATTLE BIN HOURS	Min can ramp down is AN	Linear Fit with max load on design day and min load at 72.5 deg	C/AJ (CV Pump Existing	E^AC*AE	F*B	MAXIMUM OF D*1000/(500*AK) OR AM	J/AJ	MAXIMUM OF K^AC*AG OR AH*AG	L*B
OSAT (°F)	**BIN (Hours) (1)**	**Existing Coil Flow (gpm)**	**Existing Coil Load (MBH)**	**Existing Pump Load %**	**Power Existing (kW)**	**Power Consumption Existing (kWh)**	**Proposed Flow (gpm)**	**Proposed Pump Load %**	**VSD Power Proposed (kW)**	**VSD Power Consumption Proposed (kWh)**
72.5	348	400.0	363.6	100.0%	6.98	2,430	36.4	9.1%	2.24	779
67.5	406	440.0	727.3	110.0%	7.68	3,119	72.7	18.2%	2.24	909
62.5	1018	480.0	1,090.9	120.0%	8.38	8,531	109.1	27.3%	2.29	2,327
57.5	1379	520.0	1,454.5	130.0%	9.08	12,520	145.5	36.4%	3.05	4,203
52.5	1335	560.0	1,818.2	140.0%	9.78	13,052	181.8	45.5%	3.81	5,086
47.5	1450	600.0	2,181.8	150.0%	10.48	15,189	218.2	54.5%	4.57	6,629
42.5	1175	640.0	2,545.5	160.0%	11.17	13,129	254.5	63.6%	5.33	6,267
37.5	1098	680.0	2,909.1	170.0%	11.87	13,036	290.9	72.7%	6.10	6,693
32.5	280	720.0	3,272.7	180.0%	12.57	3,520	327.3	81.8%	6.86	1,920
27.5	40	760.0	3,636.4	190.0%	13.27	531	363.6	90.9%	7.62	305
22.5	4	800.0	4,000.0	200.0%	13.97	56	400.0	100.0%	8.38	34
	8,591					**85,113**				**35,150**

Notes:
(1) BIN hours year-round 24/7



FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number 6900 Valley Medical Center

Component Description 03.01-VMC Dual Duct Unit Replacement

The Dual Duct unit in the East Penthouse is approaching end of life. Provide a new dual duct unit with VFDs and which meets Valley Medical Center performance and redundancy specifications. Include 30,000 CFM temporary unit to allow for 24/7 service to prevent service interruption.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	52,188	$3,392
Electric Demand	kW	0	$0
Natural Gas	Therm	4,676	$4,722
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$8,114**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$4,500	1	1	1	

Cost (Rough Estimate Only) **

Total $1,337,551

Net After Rebate $1,333,051

Simple Payback (Years) 164.3

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

McKinstry For The Life Of Your Building	**Valley Medical Center**	**JOB NO.** P10759	**PAGE** 1/3
	DESCRIPTION: 03.01-VMC Dual Duct Unit Replacement		
	VMC Dual Duct Replacement Filter Loading-Static Pressure and Horsepower Calculation		**BY** KMR
			DATE 5/4/2011

Below is a summary of the fan power associated with installing VFD on the hot and cold deck fans of SF-1:

-The design condition calculates the fan horsepower required to meet increased static pressure in the system (dirty filters) as dictated by the fan curve.
-The baseline condition calculations the fan horsepower required to meet decreased static pressure in the system (clean filters) as dictated by the fan curve.
-The proposed condition calculates the fan horsepower required to meet decreased static pressure in the system (clean filters) by adjusting the fan speed with a VFD.

Dual Duct Fan Power Summary

Design Fan Power		**Design**	**Units**	**Reference**
A	Supply Air CFM	28,700	CFM	Calculation Pages 2&3; Total Supply Fan CFM
B	Total Fan Static Pressure	8.86	inch wc	Calculation Pages 2&3; TSP
C	Motor Brake Horsepower	45	BHP	Calculation Pages 2&3; Total BHP

Baseline Fan Power		**Baseline**	**Units**	**Reference**
AA	Supply Air CFM	30,184	CFM	Calculation Pages 2&3; Total Supply Fan CFM
AB	Total Fan Static Pressure	8.7	inch wc	Calculation Pages 2&3; TSP
AC	Motor Brake Horsepower	52.60	BHP	Calculation Pages 2&3; Total BHP

Proposed Fan Power		**Proposed**	**Units**	**Reference**
BA	Supply Air CFM	28,700	CFM	Calculation Pages 2&3; Total Supply Fan CFM
BD	Total Fan Static Pressure	7.86	inch wc	Calculation Pages 2&3; TSP
BE	Motor Brake Horsepower	45	BHP	Calculation Pages 2&3; Total BHP

REFER TO BIN CALCULATION FOR FINAL MEASURE SAVINGS

McKinstry For The Life Of Your Building	**Valley Medical**	**JOB NO.** P10759	**PAGE** 2/3
	DESCRIPTION: 03.01-VMC Dual Duct Unit Replacement		
	VMC Dual Duct Replacement Filter Loading-Hot Deck Static Pressure and Horsepower Calculation		**BY** KMR
			DATE 5/4/2011

Below is a calculation representing the savings achieved by:

1. Installing a 15 HP VFD on the hot deck fans of SF-1.
   -The design condition calculates the fan horsepower required to meet increased static pressure in the system (dirty filters) as dictated by the fan curve.
   -The baseline condition calculations the fan horsepower required to meet decreased static pressure in the system (clean filters) as dictated by the fan curve.
   -The proposed condition calculates the fan horsepower required to meet decreased static pressure in the system (clean filters) by adjusting the fan

Dual Duct Hot Deck Fan Power

Design Fan Power		**Design**	**Units**	**Reference**
A	Supply Air CFM	7,700	CFM	Design Submittal HD Airflow
B	Supply Fan Static Pressure	3.43	inch wc	Design Submittal HD Static
C	Additional Fan Static Pressure	1	inch wc	Dirty Filter Pressure Drop
D	Total Fan Static Pressure	4.43	inch wc	B+C
E1	Max Fan CFM	8,700	CFM	Fan Curve
E2	Max Fan Static Pressure	12	inch wc	Fan Curve
E3	Midpoint Fan CFM	5,800	CFM	Fan Curve
E4	Midpoint Fan Static Pressure	6.5	inch wc	Fan Curve
F	Motor Horsepower	15	HP	Design Submittal
G	CFM per Inch SP	898	CFM/SP	Fan Curve Equation
H	HP/CFM at design point	0.0019	HP/CFM	F/A
J	Motor Brake Horsepower	15	BHP	H*A*B/B

Baseline Fan Power		**Baseline**	**Units**	**Reference**
AA	Supply Air CFM	8,236	CFM	Goal Seek until AM=0
AB	Supply Fan Static Pressure	3.9	inch wc	(AA/A)^2*B
AC	Additional Fan Static Pressure	0.5	inch wc	Clean Filter Pressure Drop
AD	Total Fan Static Pressure	4.4	inch wc	AB+AC
AJ	Motor Brake Horsepower	18.36	BHP	H*AA*AB/B
AK	Additional CFM required to meet decreased SP	5	CFM	(D-AD)*G (From Fan Curve)
AL	Additional CFM required to meet decreased SP	5	CFM	AA-A
AM	CFM Error	0	CFM	AK-AL (Should be zero)

Proposed Fan Power		**Baseline**	**Units**	**Reference**
BA	Supply Air CFM	7,700	CFM	A
BB	Supply Fan Static Pressure	3.43	inch wc	B
BC	Additional Fan Static Pressure	0.5	inch wc	Clean Filter Pressure Drop
BD	Total Fan Static Pressure	3.93	inch wc	BB+BC
BE	Motor Brake Horsepower	15	BHP	H*BA*BB/B

McKinstry For The Life Of Your Building	**Valley Medical Center**	**JOB NO.** P10759	**PAGE** 3/3
	DESCRIPTION: 03.01-VMC Dual Duct Unit Replacement		
	VMC Dual Duct Replacement Filter Loading- Hot Deck Static Pressure and Horsepower Calculation		**BY** KMR
			DATE 5/4/2011

Below is a calculation representing the savings achieved by:

1. Installing a 30 HP VFD on the cold deck fan of SF-1.
   -The design condition calculates the fan horsepower required to meet increased static pressure in the system (dirty filters) as dictated by the fan curve.
   -The baseline condition calculations the fan horsepower required to meet decreased static pressure in the system (clean filters) as dictated by the fan curve.
   -The proposed condition calculates the fan horsepower required to meet decreased static pressure in the system (clean filters) by adjusting the fan speed with a VFD.

Dual Duct Cold Deck Fan Power

Design Fan Power		**Design**	**Units**	**Reference**
A	Supply Air CFM	21,000	CFM	Design Submittal CD Airflow
B	Supply Fan Static Pressure	3.43	inch wc	Design Submittal CD Static
C	Additional Fan Static Pressure	1	inch wc	Dirty Filter Pressure Drop
D	Total Fan Static Pressure	4.43	inch wc	B+C
E1	Max Fan CFM	26000	CFM	Design Submittal Fan Curve
E2	Max Fan Static Pressure	7.5	inch wc	Design Submittal Fan Curve
E3	Midpoint Fan CFM	4.5	CFM	Design Submittal Fan Curve
E4	Midpoint Fan Static Pressure	19000	inch wc	Design Submittal Fan Curve
F	Motor Horsepower	30	HP	Design Submittal CD Fan HP
G	CFM per Inch SP	5160	CFM/SP	Fan Curve Equation
H	HP/CFM at design point	0.0014	HP/CFM	F/A
J	Motor Brake Horsepower	30	BHP	H*A*B/B

Baseline Fan Power		**Baseline**	**Units**	**Reference**
AA	Supply Air CFM	21,947	CFM	Goal Seek until AM=0
AB	Supply Fan Static Pressure	3.7	inch wc	(AA/A)^2*B
AC	Additional Fan Static Pressure	0.5	inch wc	Clean Filter Pressure Drop
AD	Total Fan Static Pressure	4.2	inch wc	AB+AC
AJ	Motor Brake Horsepower	34.25	BHP	H*AA*AB/B
AK	Additional CFM required to meet decreased SP	947	CFM	(D-AD)*G (From Fan Curve)
AL	Additional CFM required to meet decreased SP	947	CFM	AA-A
AM	CFM Error	0	CFM	AK-AL (Should be zero)

Proposed Fan Power		**Baseline**	**Units**	**Reference**
BA	Supply Air CFM	21,000	CFM	A
BB	Supply Fan Static Pressure	3.43	inch wc	B
BC	Additional Fan Static Pressure	0.5	inch wc	Clean Filter Pressure Drop
BD	Total Fan Static Pressure	3.93	inch wc	BB+BC
BE	Motor Brake Horsepower	30	BHP	H*BA*BB/B

McKinstry For The Life Of Your Building	**Project: VMC Phase 1** Job #: P10759	Page 1/5
	FIM Number: 3.01	By KMR
	FIM Name: VMC East Penthouse SF Replaceme	Date 5/4/2011

This sheet summarizes the inputs to McKinstry's standard 8760 weather bin calculation for this FIM. Note: Inputs that are identical for Base vs. Proposed may not be shown.

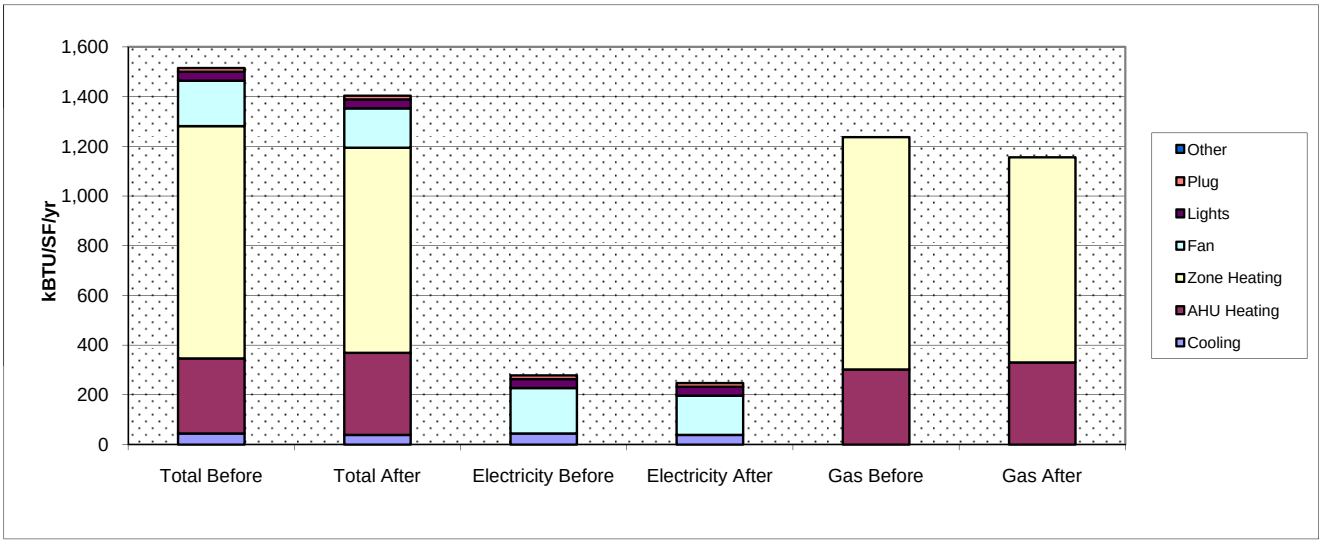
INPUTS:			**Base**	**Proposed**	
Perimeter Zones					
PA	Maximum AHU CFM (Perimeter)		30,184	28,700	CFM
PB	Floor Area of Perimeter Zone		6,435	6,435	SF
PI	Space Height		12	12	Feet
PJ	Infiltration		0.3	0.3	ach
All Zones					
ZA	# of occupants during occupied hrs		32	32	people
ZB	Lights Occupied (Includes Diversity)		1.2	1.2	W/SF
ZC	Plug Load Occupied (Includes Diversity)		0.50	0.50	W/SF
ZD	Lights Unoccupied		1	1	W/SF
ZE	Plug Loads Unoccupied		0.5	0.5	W/SF
Air Handler					
AA	Maximum OSA Percent		100%	100%	Percent
AB	Min OSA% x (1 - Heat Recovery Effectiveness %		100%	100%	Percent
AC	Minimum AHU Fan CFM		100%	100%	% of Max
AD	AHU Fan Power based on Control Type		CV	VFD	Type
AE	HVAC On Room Setpoint		72	72	oF
AF	HVAC Off Room Setpoint		72	72	oF
AH	HVAC Off Room Cooling Setpoint		72	72	oF
AI	AHU Heat Eff. or COP (full load)		0.75	0.75	COP
AJ	AHU Heating Energy Source		Gas	Gas	Type
AK	AHU Heating Lockout Above		100	100	oF
AL	AHU Cooling Efficiency		12.0	12.0	BTU/Watt
AM	AHU Cooling Lockout Below		-20	-20	oF
AN	Air or Water Cooled Condenser		Water	Water	Air, Water
AO	AHU Fan TSP (At Max CFM)		8.7	7.9	in H2O
AP	Supply Air Temp. at OSA =	82.5	55	55	oF
AQ	Supply Air Temp. at OSA =	27.5	55	57	oF
Terminal Devices (Reheat Coils, VAV Boxes, Baseboard Heat, etc.)					
TA	Zone Heating Efficiency or COP (at full load)		0.75	0.75	Efficiency
TB	Heating Energy Source Zone		Gas	Gas	Elec, Gas, Steam
TC	Unoccupied Heating Done By		AHU Coil	AHU Coil	Zone, AHU

Project: VMC Phase 1	Job #: P10759	Page 2/5
FIM Number: 3.01		By KMR
FIM Name: VMC East Penthouse SF Replacement		Date 5/4/2011

This sheet shows the summary output from McKinstry's standard bin calculation for this FIM.

OUTPUTS (End Use Breakdown):		**Base**	**EUI**	**Proposed**	**EUI**	**Savings**	
DA	Cooling kWh	83,885	44.5	73,104	38.7	10,781	per year
DB	AHU Heating kWh						per year
DC	Zone Heating kWh						per year
DD	Fan kWh	345,582	183.1	298,376	158.1	47,206	per year
DE	Lights kWh	67,645	35.8	67,645	35.8		per year
DF	Plug Loads kWh	28,185	14.9	28,185	14.9		per year
DG	Other kWh						per year
DH	**Total kWh**	**525,297**	**278.4**	**467,311**	**247.6**	**57,987**	**per year**
DI	Cooling Peak kW	88		84		4	Annual Peak
DJ	AHU Heating Peak kW	-					Annual Peak
DK	Zone Heating Peak kW	-		-			Annual Peak
DL	Fan Peak kW	39		34		5	Annual Peak
DM	Lights Peak kW	8		8			Annual Peak
DN	Plug Loads Peak kW	3		3			Annual Peak
DO	Other Peak kW						Annual Peak
DP	**Peak kW (sum of peaks)**	**138**		**129**		**10**	Annual Peak
DP	**Peak kW (coincident)**	**138**		**129**		**10**	Annual Peak
DQ	AHU Heating Therm	19,455	302.3	21,251	330.2	-1,796	per year
DR	Zone Heating Therm	60,131	934.4	53,140	825.8	6,991	per year
DS	Other Therm						per year
DT	**Total Therm**	**79,585**	**1,236.8**	**74,391**	**1,156.0**	**5,195**	**per year**
DY	**Total Energy MMBTU/yr**	**9,750**	**1,515.1**	**9,033**	**1,403.7**	**717**	
DZ	**Total Cooling Water**	**240**		**210**		**31**	**CCF per year**

END USE BREAKDOWN CHART



McKinstry For The Life Of Your Building	**Project: VMC Phase 1** **Job #: P10759**	Page 3/5
	FIM Number: 3.01	By KMR
	FIM Name: VMC East Penthouse SF Replacement	Date 5/4/2011

This shows the summary checksums from McKinstry's standard bin calc.

CHECK SUMS:		**Base**	**Proposed**	**Savings**	
EB	Fan BHP AHU peak	53	45	7.19	hp
EC	Perimeter Peak CFM/SF	**4.7**	**4.5**	0.23	CFM/SF
EE	Peak Cooling Load Tons	**88**	**84**	4.33	tons
EF	Peak Cooling Load SF/Ton	**73**	**77**	-3.78	SF/ton
EG	Peak Cooling Load CFM/Ton	343	343		CFM/ton
EH	Evap Cooling Ton Hours	-	-		Ton hours/yr
EI	Cooling Use	953	873	80	Full Load Hours
EJ	Calculated Cooling Use	83,885	73,104	10,781	Ton hours/yr
EK	AHU Heating BTU	1,945,466,967	2,125,093,747	(179,626,781)	BTU/yr
EL	Zone Heating BTU	6,013,075,469	5,313,969,581	699,105,888	BTU/yr
EM	Occupant Heat Gain: Occupied	8,205	8,205		Btu/h
EN	Total SF	6,435	6,435		SF
EO	Space Volume	77,220	77,220		CF
EP	Total Hours Modeled	8,760	8,760		hours
EQ	Total Internal Load Occupied	2.07	2.07		W/SF
ER	Total Internal Load Unoccupied	1.50	1.50		W/SF

McKinstry For The Life Of Your Building	**Project: VMC Phase 1** **Job #: P10759** **FIM Number: 3.01** **FIM Name: VMC East Penthouse SF Replacement**	Page 4/5 By KMR Date 5/4/2011

This shows several sample rows and selected columns from the bin calculation.

COL	A	B	M	N	O	P	Q	R	S

Occupied Hours Base

ROW	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
6	87.5	19	100%	87.5	55.0	39.5	1,056,436	0	-500,644
9	72.5	282	100%	72.5	55.0	39.5	568,850	0	-506,881
12	57.5	1342	100%	57.5	55.0	39.5	81,264	0	-513,118
15	42.5	1240	100%	42.5	55.0	39.5	0	-406,321	-519,355
18	27.5	49	100%	27.5	55.0	39.5	0	-893,907	-525,592
21	12.5	0	100%	12.5	55.0	39.5	0	-1,381,493	-531,829

Occupied Hours Proposed

	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
70	87.5	19	100%	87.5	55.0	34.1	1,004,496	0	-473,475
73	72.5	282	100%	72.5	55.4	34.1	529,643	0	-468,473
76	57.5	1342	100%	57.5	55.9	34.1	49,171	0	-457,852
79	42.5	1240	100%	42.5	56.5	34.1	0	-431,301	-447,230
82	27.5	49	100%	27.5	57.0	34.1	0	-911,773	-436,608
85	12.5	0	100%	12.5	57.0	34.1	0	-1,375,387	-442,845

Unoccupied Hours Base (HVAC On)

	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
134	87.5	0	100%	87.5	55.0	39.5	1,056,436	0	-513,237
137	72.5	0	100%	72.5	55.0	39.5	568,850	0	-519,474
140	57.5	0	100%	57.5	55.0	39.5	81,264	0	-525,711
143	42.5	0	100%	42.5	55.0	39.5	0	-406,321	-531,948
146	27.5	0	100%	27.5	55.0	39.5	0	-893,907	-538,185
149	12.5	0	100%	12.5	55.0	39.5	0	-1,381,493	-544,422

Unoccupied Hours Proposed (HVAC On)

	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
198	87.5	0	100%	87.5	55.0	34.1	1,004,496	0	-486,069
201	72.5	0	100%	72.5	55.4	34.1	529,643	0	-481,067
204	57.5	0	100%	57.5	55.9	34.1	49,171	0	-470,445
207	42.5	0	100%	42.5	56.5	34.1	0	-431,301	-459,823
210	27.5	0	100%	27.5	57.0	34.1	0	-911,773	-449,201
213	12.5	0	100%	12.5	57.0	34.1	0	-1,375,387	-455,438

Un-Occupied Hours Base (HVAC Off) (Includes Warm-up hours if OSA is Closed)

	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
262	87.5	0	0%	0.0	0.0	0.0	39,360	0	0
265	72.5	0	0%	0.0	0.0	0.0	33,123	0	0
268	57.5	0	0%	0.0	0.0	0.0	0	0	0
271	42.5	0	0%	0.0	0.0	0.0	0	0	0
274	27.5	0	0%	0.0	0.0	0.0	0	0	0
277	12.5	0	0%	0.0	0.0	0.0	0	0	0

Un-Occupied Hours Proposed (HVAC Off) (Includes Warm-up hours if OSA is Closed)

	OSAT (DB) (oF)	BIN (Hours)	OSA x (1-HR eff) Percent	MAT (oF)	SAT Actual (oF)	AHU Fan Power (kW)	AHU Cool Load (Btu/h)	AHU Heat Load (Btu/h)	Zone Heat Coil (Btu/h)
326	87.5	0	0%	0.0	0.0	0.0	39,360	0	0
329	72.5	0	0%	0.0	0.0	0.0	33,123	0	0
332	57.5	0	0%	0.0	0.0	0.0	0	0	0
335	42.5	0	0%	0.0	0.0	0.0	0	0	0
338	27.5	0	0%	0.0	0.0	0.0	0	0	0
341	12.5	0	0%	0.0	0.0	0.0	0	0	0

McKinstry For The Life Of Your Building	**Project: VMC Phase 1** Job #: P10759	Page 5/5
	FIM Number: 3.01	By KMR
	FIM Name: VMC East Penthouse SF Replacement	Date 5/4/2011

This sheet summarizes the time of day and holiday schedules used for this FIM. All schedules are applied to TMY3 data.

Time Schedule A - 24 hr/day Occupancy

Time		Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 to	1	2	2	2	2	2	2	2
1 to	2	2	2	2	2	2	2	2
2 to	3	2	2	2	2	2	2	2
3 to	4	2	2	2	2	2	2	2
4 to	5	2	2	2	2	2	2	2
5 to	6	2	2	2	2	2	2	2
6 to	7	2	2	2	2	2	2	2
7 to	8	2	2	2	2	2	2	2
8 to	9	2	2	2	2	2	2	2
9 to	10	2	2	2	2	2	2	2
10 to	11	2	2	2	2	2	2	2
11 to	12	2	2	2	2	2	2	2
12 to	13	2	2	2	2	2	2	2
13 to	14	2	2	2	2	2	2	2
14 to	15	2	2	2	2	2	2	2
15 to	16	2	2	2	2	2	2	2
16 to	17	2	2	2	2	2	2	2
17 to	18	2	2	2	2	2	2	2
18 to	19	2	2	2	2	2	2	2
19 to	20	2	2	2	2	2	2	2
20 to	21	2	2	2	2	2	2	2
21 to	22	2	2	2	2	2	2	2
22 to	23	2	2	2	2	2	2	2
23 to	24	2	2	2	2	2	2	2

Weather Sation: WA, SEATTLE BOEING FIELD [ISIS]
File: 727935TY.xls

-1	Unoccupied On (Base)
-1	Unoccupied Off (Proposed)
	Unoccupied OFF
1	Unoccupied ON
2	Occupied

Annual Hours	Base	Proposed
Occupied	8,760	8,760
On Unoccupied		
Off		
Total	8,760	8,760

Calendar Table

	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec
1	A	A	A	A	A	A	A	A	A	A	A	A
2	A	A	A	A	A	A	A	A	A	A	A	A
3	A	A	A	A	A	A	A	A	A	A	A	A
4	A	A	A	A	A	A	A	A	A	A	A	A
5	A	A	A	A	A	A	A	A	A	A	A	A
6	A	A	A	A	A	A	A	A	A	A	A	A
7	A	A	A	A	A	A	A	A	A	A	A	A
8	A	A	A	A	A	A	A	A	A	A	A	A
9	A	A	A	A	A	A	A	A	A	A	A	A
10	A	A	A	A	A	A	A	A	A	A	A	A
11	A	A	A	A	A	A	A	A	A	A	A	A
12	A	A	A	A	A	A	A	A	A	A	A	A
13	A	A	A	A	A	A	A	A	A	A	A	A
14	A	A	A	A	A	A	A	A	A	A	A	A
15	A	A	A	A	A	A	A	A	A	A	A	A
16	A	A	A	A	A	A	A	A	A	A	A	A
17	A	A	A	A	A	A	A	A	A	A	A	A
18	A	A	A	A	A	A	A	A	A	A	A	A
19	A	A	A	A	A	A	A	A	A	A	A	A
20	A	A	A	A	A	A	A	A	A	A	A	A
21	A	A	A	A	A	A	A	A	A	A	A	A
22	A	A	A	A	A	A	A	A	A	A	A	A
23	A	A	A	A	A	A	A	A	A	A	A	A
24	A	A	A	A	A	A	A	A	A	A	A	A
25	A	A	A	A	A	A	A	A	A	A	A	A
26	A	A	A	A	A	A	A	A	A	A	A	A
27	A	A	A	A	A	A	A	A	A	A	A	A
28	A	A	A	A	A	A	A	A	A	A	A	A
29	A		A	A	A	A	A	A	A	A	A	A
30	A		A	A	A	A	A	A	A	A	A	A
31	A		A		A		A	A		A		A

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number 6651 | Valley Medical Center

Component Description 09.01-TLB Lighting Upgrade

Replace existing HID fixtures located in the Gymnasium and Pool areas with energy efficient fixtures operating T5HO lamps and electronic ballasts. Existing T12 lamps and magnetic ballasts located on the 1st floor will be retrofitted with T8 lamps and electronic ballasts. Pharmacy/Gift shop fixtures will be upgraded using retrofit kits to standardize lamp and ballast quantities per fixture and improve the aesthetics of the space.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	30,007	$1,950
Electric Demand	kW	106	$532
Natural Gas	Therm	-119	($120)
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,362**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$6,317	1	1	1	

Cost (Rough Estimate Only) **

Total	$48,616
Net After Rebate	$42,299
Simple Payback (Years)	17.9

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number 6817 Valley Medical Center

Component Description 09.01-VMC Surface Parking Lighting Upgrade

Replace existing 250W and 400W post top metal halide and high pressure sodium area light fixtures located in the main surface parking area with 139W LED fixtures. Budget reflects the use of existing poles. Replace existing sign lighting metal halide fixtures with LED ground mount flood lights. Replace existing metal halide canopy fixtures in the main walkway with vapor tight fixtures operating fluorescent lamps and electronic ballasts.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	64,929	$4,220
Electric Demand	kW	146	$732
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$4,952**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$13,078	1	1	1	

Cost (Rough Estimate Only) **

Total	$165,780
Net After Rebate	$152,702
Simple Payback (Years)	30.8

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number 6650 Valley Medical Center

Component Description 09.02-VMC Lobby Lighting Upgrade

Replace existing HID downlights located above both the pool and above the 2nd floor waiting area with LED downlights. HID fixtures above both stairwells will be redesigned with pendant hung T8 linear fluorescent fixtures with integral PAR lamp.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	57,513	$3,738
Electric Demand	kW	85	$423
Natural Gas	Therm	-89	($90)
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$4,071**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$12,080	1	1	1	

Cost (Rough Estimate Only) **

Total $62,458

Net After Rebate $50,378

Simple Payback (Years) 12.4

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

								Proposed									Energy											
ID	Building Name	Floor	Location	# of Fixtures	Mounting	Description	Operating Hours	Fixture Code	# of Fixtures (if different from existing)	Description	Lamp Type	Watts per Fixture	# of Lamps	Occ Sensor Type	# of Sensors	Operating Hours	Existing kW	Proposed kW	Existing kWh	Proposed kWh	kW Savings per Month	kW Savings per Year	kWh Savings per Year	Heating Penalty (kWh)	Cooling Credit (kWh)	Net kWh Savings per Year	Net Energy Cost Savings per Year
2	**9.01-VMC Exterior Lighting (LED)**		West Parking Lot	18	Pole	Area / MH 400W / HID Magnetic	5110	LED-AREA	36	LED 156W Area post top fixture with tenon arm mount	LED	156	0			5110	6.6	4.5	33,701	22,958	2.10	25.23	10,743	0	0	10,743	$ 824
3	**9.01-VMC Exterior Lighting (LED)**		East Parking Lot	28	Pole	Area / MH 250W / HID Magnetic	5110	LED-AREA	28	LED 156W Area post top fixture with tenon arm mount	LED	156	0			5110	6.6	3.5	33,767	17,856	3.11	37.36	15,910	0	0	15,910	$ 1,221
4	**9.01-VMC Exterior Lighting (LED)**		Sign Lighting	16	Surface	Flood / MH 175W / HID Magnetic	5110	LED-FL24W	16	LED Flood 24W with ground mount.	LED	24	0			5110	2.7	0.3	13,736	1,570	2.38	28.57	12,166	0	0	12,166	$ 934
5	**9.01-VMC Exterior Lighting (LED)**		Walkway	34	Surface	Canopy / MH 70W / HID Magnetic	5110	WL04T801	17	4' Wet location wrap w/ (1) T8 lamp operated via one electronic ballast	F-32	28	17			5110	2.4	0.4	12,509	1,946	2.07	24.81	10,563	0	0	10,563	$ 811
6	**9.01-VMC Exterior Lighting (LED)**		New Parking Area	16	Pole	Area / MH 250W / HID Magnetic	5110	N	16	No Retrofit Proposed	N/A	295	16			5110	3.8	3.8	19,295	19,295	0.00	0.00	0	0	0	0	$ -
7	**9.01-TLB Lighting Upgrade**	First Floor	Gymnasium	14	Surface	Shoebox / MH 400W / HID Magnetic	3129	T504PRI24	14	HID replacement w/ (4) T5HO lamps, lens in door frame.	F-54	234	56	WS OCC	4	2190	5.1	2.6	16,048	5,740	2.51	30.11	10,309	-1,122	440	9,627	$ 776
8	**9.01-TLB Lighting Upgrade**	First Floor	Gymnasium	24	Wall	4' Strip / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	24	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	48			2190	1.4	0.9	4,325	2,018	0.46	5.53	2,307	-251	98	2,154	$ 168
9	**9.01-TLB Lighting Upgrade**	First Floor	Pool	18	Recessed	2x2 Prismatic / MV 250W / HID Magnetic	3129	PRIS24-2T5HO	18	2x4 Prismatic, (2) 54W T5HO Lamps, Electronic Ballast	F-54	117	36			3129	4.1	1.7	12,840	5,271	2.42	29.03	7,569	-823	323	7,068	$ 605
10	**9.01-TLB Lighting Upgrade**	First Floor	Pool	2	Wall	Wall Bracket / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	4			3129	0.1	0.1	360	240	0.04	0.46	120	-13	5	112	$ 10
11	**9.01-TLB Lighting Upgrade**	First Floor	Mens Locker Room	2	Surface	4' Acrylic Wrap / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	4	L OCC+WS	3	2503	0.1	0.1	360	192	0.04	0.46	168	-18	7	157	$ 13
12	**9.01-TLB Lighting Upgrade**	First Floor	Mens Locker Room	1	Wall	Vanity / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB1LL	1	Lamp & Ballast retrofit, (1) 32W T8 & low ballast factor electronic ballast.	F-32	25	1			3129	0.0	0.0	108	63	0.01	0.17	45	-5	2	42	$ 4
13	**9.01-TLB Lighting Upgrade**	First Floor	Mens Locker Room	6	Surface	Wet Location / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	12			2503	0.3	0.2	1,081	577	0.12	1.38	505	-55	22	471	$ 38
14	**9.01-TLB Lighting Upgrade**	First Floor	Womens Locker Room	9	Surface	Wet Location / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	9	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	18	L OCC+WS	3	2503	0.5	0.3	1,622	865	0.17	2.07	757	-82	32	707	$ 56
15	**9.01-TLB Lighting Upgrade**	First Floor	Womens Locker Room	3	Surface	Vanity / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB1LL	3	Lamp & Ballast retrofit, (1) 32W T8 & low ballast factor electronic ballast.	F-32	25	3			3129	0.1	0.1	323	188	0.04	0.52	135	-15	6	126	$ 11
16	**9.01-TLB Lighting Upgrade**	First Floor	Main Corridor	14	Recessed	2x2 Parabolic / U-lamp, 34W Fluorescent, T12 / Standard Magnetic, T12	3129	EB2LU	14	Lamp & Ballast retrofit, (2) 32W T8 U-lamps & normal ballast factor electronic ballast.	F-32U	55	28	L OCC+WS	3	2503	0.9	0.6	2,873	1,542	0.30	3.63	1,332	-145	57	1,243	$ 99
17	**9.01-TLB Lighting Upgrade**	First Floor	Mens Restroom	1	Wall	4' Strip / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	1	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	2	WS OCS	1	2503	0.1	0.0	180	96	0.02	0.23	84	-9	4	79	$ 6

Room Data

								Proposed									Energy										
ID	Building Name	Floor	Location	# of Fixtures	Mounting	Description	Operating Hours	Fixture Code	# of Fixtures (if different from existing)	Description	Lamp Type	Watts per Fixture	# of Lamps	Occ Sensor Type	# of Sensors	Operating Hours	Existing kW	Proposed kW	Existing kWh	Proposed kWh	kW Savings per Month	kW Savings per Year	kWh Savings per Year	Heating Penalty (kWh)	Cooling Credit (kWh)	Net kWh Savings per Year	Net Energy Cost Savings per Year
18	**9.01-TLB Lighting Upgrade**	First Floor	Womens Restroom	1	Wall	4' Strip / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	1	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	2	WS OCS	1	2503	0.1	0.0	180	96	0.02	0.23	84	-9	4	79	$ 6
19	**9.01-TLB Lighting Upgrade**	First Floor	Peak Performance	6	Recessed	2x4 Parabolic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	12	L OCC+WS	2	2503	0.3	0.2	1,081	577	0.12	1.38	505	-55	22	471	$ 38
20	**9.01-TLB Lighting Upgrade**	First Floor	Massage Therapy	2	Recessed	2x4 Parabolic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	1564	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	4			1564	0.1	0.1	180	120	0.04	0.46	60	-7	3	56	$ 6
21	**9.01-TLB Lighting Upgrade**	First Floor	Storage	3	Surface	4' Industrial w/reflectors / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	1043	EB2LL	3	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor electronic ballast.	F-32	48	6			1043	0.2	0.1	180	120	0.06	0.69	60	-7	3	56	$ 7
22	**9.01-TLB Lighting Upgrade**	First Floor	Pharmacy/Gift Shop	8	Recessed	2x4 Parabolic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3285	RK24-2	8	Retrokit with reflector, (2) 32W T8 & EB2L electronic ballast	F-32	55	16			3285	0.9	0.4	3,027	1,156	0.57	6.84	1,871	-204	80	1,747	$ 148
23	**9.01-TLB Lighting Upgrade**	First Floor	Pharmacy/Gift Shop	25	Recessed	2x4 Parabolic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3285	RK24-2	25	Retrokit with reflector, (2) 32W T8 & EB2L electronic ballast	F-32	55	50			3285	2.9	1.1	9,461	3,614	1.78	21.36	5,847	-636	249	5,461	$ 462
24	**9.01-TLB Lighting Upgrade**	First Floor	Pharmacy/Gift Shop	4	Recessed	4' Strip / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3285	EB1LL	4	Lamp & Ballast retrofit, (1) 32W T8 & low ballast factor electronic ballast.	F-32	25	4			3285	0.1	0.1	452	263	0.06	0.69	189	-21	8	177	$ 15
25	**9.01-TLB Lighting Upgrade**	First Floor	Pharmacy/Gift Shop	15	Recessed	Downlight / Halogen, MR16 / N/A	3285	LED-MR16	15	LED 5W MR-16 bi-pin lamp	LED	5	0			3285	0.4	0.1	1,380	197	0.36	4.32	1,183	-129	50	1,104	$ 93
26	**9.01-TLB Lighting Upgrade**	First Floor	Mechanical Room	2	Recessed	4' Industrial w/reflectors / 32W Fluorescent, 4'-0" T8 / Electronic, T8	3285	N	2	No Retrofit Proposed	N/A	63	4			3285	0.1	0.1	331	331	0.00	0.00	0	0	0	0	$ -
27	**9.01-TLB Lighting Upgrade**	First Floor	Elevator Lobby	2	Surface	4' Acrylic Wrap / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3285	EB1LL	2	Lamp & Ballast retrofit, (1) 32W T8 & low ballast factor electronic ballast.	F-32	25	2			3285	0.1	0.0	226	131	0.03	0.35	95	-10	4	88	$ 7
28	**9.01-TLB Lighting Upgrade**	First Floor	Elevator Lobby	4	Recessed	Downlight / Compact Fluorescent, 26W Triple / N/A	3285	N	4	No Retrofit Proposed	N/A	30	4			3285	0.1	0.1	315	315	0.00	0.00	0	0	0	0	$ -
29	**9.01-TLB Lighting Upgrade**	First Floor	Elevator Lobby	4	Wall	Sconce / Incandescent, A lamp / N/A	3285	SI-18I	4	Screw-in, compact fluorescent retrofit, integral, (1) 18W lamp, electronic ballast.	SI-18I	18	4			3285	0.2	0.1	788	189	0.18	2.19	599	-65	26	560	$ 47
86	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Lobby (Over Pool)	7	Unistrut	Downlight / MH 250W / HID Magnetic	8760	LED-LR6-1000	21	LED 12.5W LED deep recessed downlight with recssed can	LED	13	0			8760	1.7	0.2	14,472	1,840	1.44	17.30	12,632	-1,374	539	11,797	$ 853
87	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Lobby (Over Pool)	9	Unistrut	Downlight / MH 250W / HID Magnetic	8760	LED-LR6-1000	16	LED 12.5W LED deep recessed downlight with recssed can enclosure.	LED	13	0			8760	2.1	0.2	18,606	1,402	1.96	23.57	17,205	-1,872	734	16,067	$ 1,162
88	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Staircase East	3	Unistrut	Downlight / MH 250W / HID Magnetic	8760	LED-LR6-1000	4	LED 12.5W LED deep recessed downlight with recssed can enclosure.	LED	13	0			8760	0.7	0.0	6,202	350	0.67	8.02	5,852	-637	250	5,465	$ 395
89	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Staircase East	3	Unistrut	Downlight / MH 250W / HID Magnetic	8760	FS4-3L Pend	1	4' (3) 32W T8 and EB3LL ballast.	F-32	71	3			8760	0.7	0.1	6,202	498	0.65	7.81	5,705	-621	243	5,327	$ 385
90	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Staircase West	3	Unistrut	Downlight / MH 250W / HID Magnetic	8760	LED-LR6-1000	4	LED 12.5W LED deep recessed downlight with recssed can enclosure.	LED	13	0			8760	0.7	0.0	6,202	350	0.67	8.02	5,852	-637	250	5,465	$ 395
91	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Staircase East	3	Unistrut	Downlight / MH 250W / HID Magnetic	8760	FS4-3L Pend	1	4' (3) 32W T8 and EB3LL ballast.	F-32	71	3			8760	0.7	0.1	6,202	498	0.65	7.81	5,705	-621	243	5,327	$ 385

								Proposed									Energy										
ID	Building Name	Floor	Location	# of Fixtures	Mounting	Description	Operating Hours	Fixture Code	# of Fixtures (if different from existing)	Description	Lamp Type	Watts per Fixture	# of Lamps	Occ Sensor Type	# of Sensors	Operating Hours	Existing kW	Proposed kW	Existing kWh	Proposed kWh	kW Savings per Month	kW Savings per Year	kWh Savings per Year	Heating Penalty (kWh)	Cooling Credit (kWh)	Net kWh Savings per Year	Net Energy Cost Savings per Year
92	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Lobby (Over 2nd Floor)	66	Surface	2x2 Paracube / U-Bend 6" 32W Fluorescent,T8 / Electronic, T8	8760	N	66	No Retrofit Proposed	N/A	63	132			8760	3.3	3.3	29,139	29,139	0.00	0.00	0	0	0	0	$ -
93	**9.01-VMC Lobby Lighting Upgrade**	Third Floor	Lobby (Over 2nd Floor)	6	Unistrut	Downlight / MH 250W / HID Magnetic	8760	LED-LR6-1000	6	LED 12.5W LED deep recessed downlight with recssed can enclosure.	LED	13	0			8760	1.4	0.1	12,404	526	1.36	16.27	11,879	-1,292	507	11,093	$ 802
107	**9.01-VMC Radiology Lighting Upgrade**	Lower Level	Main Corridor	55	Recessed	2x2 Parabolic / 32W Fluorescent, 4'-0" T8 / Electronic, T8	4380	N	55	No Retrofit Proposed	N/A	86	165			4380	3.8	3.8	16,574	16,574	0.00	0.00	0	0	0	0	$ -
108	**9.01-VMC Radiology Lighting Upgrade**	Lower Level	Stairwell	4	Surface	1x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	8760	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8			8760	0.2	0.2	2,018	1,346	0.08	0.92	673	-73	29	628	$ 45
109	**9.01-VMC Radiology Lighting Upgrade**	Lower Level	Corridor	18	Wall	4' Strip / 32W Fluorescent, 4'-0" T8 / Electronic, T8	2346	N	18	No Retrofit Proposed	N/A	63	36	L OCC+WS	2	1408	0.9	0.9	2,129	1,277	0.00	0.00	851	-93	36	795	$ 52
110	**9.01-VMC Day Surgery Building**		Main Waiting Room	10	Recessed	Downlight / Compact Fluorescent, 13W PL / N/A	2346	N	10	No Retrofit Proposed	N/A	28	20			2346	0.2	0.2	526	526	0.00	0.00	0	0	0	0	$ -
111	**9.01-VMC Day Surgery Building**		Main Waiting Room	6	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	12			2346	0.3	0.2	811	541	0.12	1.38	270	-29	12	252	$ 23
112	**9.01-VMC Day Surgery Building**		Recover Lounge Phase 2	6	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	12	L OCC+WS	1	1877	0.3	0.2	811	432	0.12	1.38	378	-41	16	353	$ 30
113	**9.01-VMC Day Surgery Building**		Recover Lounge Phase 1	6	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	12	L OCC+WS	1	1877	0.3	0.2	811	432	0.12	1.38	378	-41	16	353	$ 30
114	**9.01-VMC Day Surgery Building**		Nurses Station	1	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	1	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	2			2346	0.1	0.0	135	90	0.02	0.23	45	-5	2	42	$ 4
115	**9.01-VMC Day Surgery Building**		Private Restroom	1	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	1564	EB2LL	1	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	2			1564	0.1	0.0	90	60	0.02	0.23	30	-3	1	28	$ 3
116	**9.01-VMC Day Surgery Building**		Corridor	6	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	3129	EB2LL	6	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	12			3129	0.3	0.2	1,081	721	0.12	1.38	360	-39	15	337	$ 29
117	**9.01-VMC Day Surgery Building**		Equipment Room	2	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	4			2346	0.1	0.1	270	180	0.04	0.46	90	-10	4	84	$ 8
118	**9.01-VMC Day Surgery Building**		Operating Room 1	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8			2346	0.2	0.2	541	360	0.08	0.92	180	-20	8	168	$ 16
119	**9.01-VMC Day Surgery Building**		Operating Room 2	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8			2346	0.2	0.2	541	360	0.08	0.92	180	-20	8	168	$ 16
120	**9.01-VMC Day Surgery Building**		Operating Room 3	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8			2346	0.2	0.2	541	360	0.08	0.92	180	-20	8	168	$ 16
121	**9.01-VMC Day Surgery Building**		Staff Lounge	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8	L OCC+WS	1	1877	0.2	0.2	541	288	0.08	0.92	252	-27	11	236	$ 20
122	**9.01-VMC Day Surgery Building**		Staff Lounge	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8	L OCC+WS	1	1877	0.2	0.2	541	288	0.08	0.92	252	-27	11	236	$ 20
123	**9.01-VMC Day Surgery Building**		Womens Locker Room	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8	L OCC+WS	1	1877	0.2	0.2	541	288	0.08	0.92	252	-27	11	236	$ 20
124	**9.01-VMC Day Surgery Building**		Mens Locker Room	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8	L OCC+WS	1	1877	0.2	0.2	541	288	0.08	0.92	252	-27	11	236	$ 20
125	**9.01-VMC Day Surgery Building**		Pre Operation	4	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	4	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	8	L OCC+WS	1	1877	0.2	0.2	541	288	0.08	0.92	252	-27	11	236	$ 20
126	**9.01-VMC Day Surgery Building**		Holding Area	2	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	4	L OCC+WS	1	1877	0.1	0.1	270	144	0.04	0.46	126	-14	5	118	$ 10
127	**9.01-VMC Day Surgery Building**		Private Office 1	2	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	4	WS OCS	1	1877	0.1	0.1	270	144	0.04	0.46	126	-14	5	118	$ 10
128	**9.01-VMC Day Surgery Building**		Private Office 2	2	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	4	WS OCS	1	1877	0.1	0.1	270	144	0.04	0.46	126	-14	5	118	$ 10

Room Data

								Proposed									Energy										
ID	Building Name	Floor	Location	# of Fixtures	Mounting	Description	Operating Hours	Fixture Code	# of Fixtures (if different from existing)	Description	Lamp Type	Watts per Fixture	# of Lamps	Occ Sensor Type	# of Sensors	Operating Hours	Existing kW	Proposed kW	Existing kWh	Proposed kWh	kW Savings per Month	kW Savings per Year	kWh Savings per Year	Heating Penalty (kWh)	Cooling Credit (kWh)	Net kWh Savings per Year	Net Energy Cost Savings per Year
129	**9.01-VMC Day Surgery Building**		Private Office 3	2	Recessed	2x4 Prismatic / 34W Fluorescent, 4'-0" T12 / Energy Savings Magnetic, T12	2346	EB2LL	2	Lamp & Ballast retrofit, (2) 32W T8 & low ballast factor	F-32	48	4	WS OCS	1	1877	0.1	0.1	270	144	0.04	0.46	126	-14	5	118	$ 10
Total	**59**			**537**					**557**				**856**		**30**		**61**	**33**	**####**	**147,407**	**28**		**####**				**$ 11,192**

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	GMAX-VMC AHU and Lighting Upgrades
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number 6278 | Valley Medical Center

Component Description 24.01-VMC Solar PV Installation

Provide an AC grid-connected solar PV power system. The PV panels will be pole-mounted and installed on the VMC lawn at the entrance to HWY 167. Scope includes "SMA" brand Web-based monitoring equipment and software that will make it possible to monitor and display system performance data online.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	1,649	$107
Electric Demand	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$107**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$220	1	1	1	

Cost (Rough Estimate Only) **

Total	$38,576
Net After Rebate	$38,356
Simple Payback (Years)	357.9

Other FIM Considerations

Impact $0

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

McKinstry For The Life Of Your Building	**VALLEY MEDICAL CENTER**	**JOB NO.** P10759	**PAGE** 1/1
	DESCRIPTION: 24.01-VMC Solar PV Installation		
	Install 1.5 kW Solar Array Pre-heat System Savings		**BY** KMR
			DATE 5/4/2011

The Baseline energy delivery is established using PV Watts Version 2. This modeling tool is a widely used performance calculator use for grid-connected PV systems. It uses typical meteorological year weather data for any selected location, and determines the solar radiation incident of the PV array and the PV cel temperature for each hour of the year. The energy for each hour is calculated from the pV system rating and the incident solar radiation and then corrected for the PV cell temperature.

Resource Assessment:	
- Solar Tracking Mode	Fixed
- Array Tilt	47.2º
- Azimuth	180º

*Results from Retscreen Software

Month	Daily Solar Radiation	Electricity Exported to Grid (kWh)	Month	Daily Solar Radiation	Electricity Exported to Grid (kWh)
January	1.98	65	July	7.33	242
February	3.26	100	August	6.89	226
March	4.38	150	September	6.16	198
April	5.46	182	October	3.92	130
May	5.96	202	November	2.05	66
June	6.76	219	December	1.65	52
	27.80	918.0		28.0	914.0

Annual Production:	**1832.0**

Solar PV Panel	kW	Panel Type	Panel Efficiency	Annual MWh Production	Solar Collection Area (m²)	Inverter Efficiency
Proposed System Size:	2					
System Type		TBD				
System Efficiency			TBD			
Annual MWh				1.8		
Collection Area					TBD	
DC to AC Derate Factor						0.77

AC Energy & Cost Savings

Cautions for Interpreting the Results

Valley Medical Center Solar PV Generation 5-4-2011

Station Identification

Cell ID:	0191329
State:	Washington
Latitude:	47.2 ° N
Longitude:	122.1 ° W

PV System Specifications

DC Rating:	1.50 kW
DC to AC Derate Factor:	0.770
AC Rating:	1.15 kW
Array Type:	1-Axis Tracking
Array Tilt:	47.2 °
Array Azimuth:	180.0 °

Energy Specifications

Cost of Electricity:	6.5 ¢/kWh

Results

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	1.98	65	4.22
2	3.26	100	6.50
3	4.38	150	9.75
4	5.46	182	11.83
5	5.96	202	13.13
6	6.76	219	14.23
7	7.33	242	15.73
8	6.89	226	14.69
9	6.16	198	12.87
10	3.92	130	8.45
11	2.05	66	4.29
12	1.65	52	3.38
Year	4.66	1832	119.08

Output Hourly Performance Data

(Gridded data is monthly, hourly output not available.)

Output Results as Text

Saving Text from a Browser

Run PVWATTS v.2 for another location

Run PVWATTS v.1

Please send questions and comments to Webmaster

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RReDC home page (*http://rredc.nrel.gov*)

SECTION 5.4 NET PRESENT VALUE ANALYSIS

NET PRESENT VALUE SPREADSHEET EXPLANATION

Source
The Net Present Value spreadsheet used in this analysis is taken from the Washington State General Administration to verify that projects qualify as energy projects. A proposed project with a greater NPV than the base cost qualifies as an energy project.

Net Present Value Analysis
The NPV spreadsheet takes into consideration annual energy savings (Table 3.1), maintenance savings and replacement costs for Air Handling Unit, Heat Exchanger, controls and lighting upgrades (Table 4.1). It can be used to compare initial costs along with replacement costs at future dates and allows for inflation and utility rate escalations.

Base Case Calculation – No Improvements
This study examines the feasibility of installing an HVAC and lighting system over a 30-year time period. The base case looks at maintaining the existing HVAC and lighting throughout the 30 years. Annual electric and gas costs are initially based on the existing system efficiency. The base case 30 year NPV is $2,827,073.

Proposed Calculation
The proposed case looks at installing the new Air Handling Unit, Heat Exchangers and lighting in 2011. The proposed 30 year NPV is $2,782,880.

NPV Comparison Conclusion
The NPV of installing the revised HVAC and lighting upgrades now is $44,193 greater than the base case option. This qualifies the project as an energy project.

Figure 5.1 ENERGY LIFE CYCLE COST SPREADSHEET

ELCCA2005.xls 06-May-11

----------P R O J E C T D A T A----------

PROJECT: VMC AHU and Lighting Upgrade McKinstry
Base Case: No Improvements Katie Rossmann

----------D I S C O U N T & E S C A L A T I O N Real Rates as of November 2004----------

Enter 1 or 0 for each fuel type:			Years:	Rate:
	1 = Yes	Real Discount Rate (i)	2005 - 2040	1.0%
	0 = No	Electricity.	2005 - 2015 . . .	3.0%
IOU Electricity Source*	1	(Investor Owned Utility)	2016 - 2025 . . .	3.0%
POU Electricity Source**	0		2026 - 2040 . . .	3.0%
Natural Gas Fuel?	1	Natural Gas	2005 - 2015 . . .	3.0%
Propane Fuel?	0	And other fossil fuels	2016 - 2025 . . .	3.0%
Oil Fuel?	0		2026 - 2040 . . .	3.0%
		Maintenance	2005 - 2040	3.0%
		Inflation (Nominal , not used)	2005 - 2040	3.0%

* IOU = Invester Owned Utility
** POU = Publicly Owned Utility

$2,827,073 **=30-year LCC**

----------A N N U A L R E A L C A S H F L O W S----------

(Begin) Year	After Rebate First & Replace. Costs	Annual Maint. Costs	Annual Energy Costs		Total Annual Costs	Present Worth Factor	Present Worth of Annual Costs	Present Worth of Cumulative Costs
2011	$0	$36,253	$38,782	$0	$75,035	(1+i)^-n		
2011	$0	--	--	--	$0	1.00	$0	$0
2012	0	37,341	39,946	0	77,286	0.99	76,521	76,521
2013	0	38,461	41,144	0	79,605	0.98	78,036	154,557
2014	0	39,615	42,378	0	81,993	0.97	79,582	234,139
2015	0	40,803	43,650	0	84,453	0.96	81,157	315,296
2016	0	42,027	44,959	0	86,986	0.95	82,765	398,061
2017	0	43,288	46,308	0	89,596	0.94	84,403	482,464
2018	0	44,587	47,697	0	92,284	0.93	86,075	568,539
2019	0	45,924	49,128	0	95,052	0.92	87,779	656,318
2020	0	47,302	50,602	0	97,904	0.91	89,517	745,836
2021	0	48,721	52,120	0	100,841	0.91	91,290	837,126
2022	0	50,183	53,684	0	103,866	0.90	93,098	930,224
2023	0	51,688	55,294	0	106,982	0.89	94,941	1,025,165
2024	0	53,239	56,953	0	110,192	0.88	96,821	1,121,986
2025	0	54,836	58,662	0	113,497	0.87	98,739	1,220,725
2026	0	56,481	60,421	0	116,902	0.86	100,694	1,321,419
2027	0	58,175	62,234	0	120,409	0.85	102,688	1,424,106
2028	0	59,921	64,101	0	124,022	0.84	104,721	1,528,828
2029	0	61,718	66,024	0	127,742	0.84	106,795	1,635,622
2030	0	63,570	68,005	0	131,575	0.83	108,910	1,744,532
2031	0	65,477	70,045	0	135,522	0.82	111,066	1,855,598
2032	0	67,441	72,146	0	139,588	0.81	113,266	1,968,864
2033	0	69,464	74,311	0	143,775	0.80	115,508	2,084,372
2034	0	71,548	76,540	0	148,088	0.80	117,796	2,202,168
2035	0	73,695	78,836	0	152,531	0.79	120,128	2,322,296
2036	0	75,906	81,201	0	157,107	0.78	122,507	2,444,803
2037	0	78,183	83,637	0	161,820	0.77	124,933	2,569,736
2038	0	80,528	86,146	0	166,675	0.76	127,407	2,697,143
2039	0	82,944	88,731	0	171,675	0.76	129,930	2,827,073
Totals:	$0	$1,603,066	$1,714,904	$0	$3,317,970		**$2,827,073**	**=30-year LCC**
	1st+Repl	Maint	Fuel	Elec	Total Annual			

Figure 5.1 ENERGY LIFE CYCLE COST SPREADSHEET

ELCCA2005.xls 06-May-11

----------P R O J E C T D A T A----------

PROJECT: VMC AHU and Lighting Upgrade McKinstry
Option 1: Implement ESCO Recommendations Katie Rossmann

----------D I S C O U N T & E S C A L A T I O N Real Rates as of November 2004----------

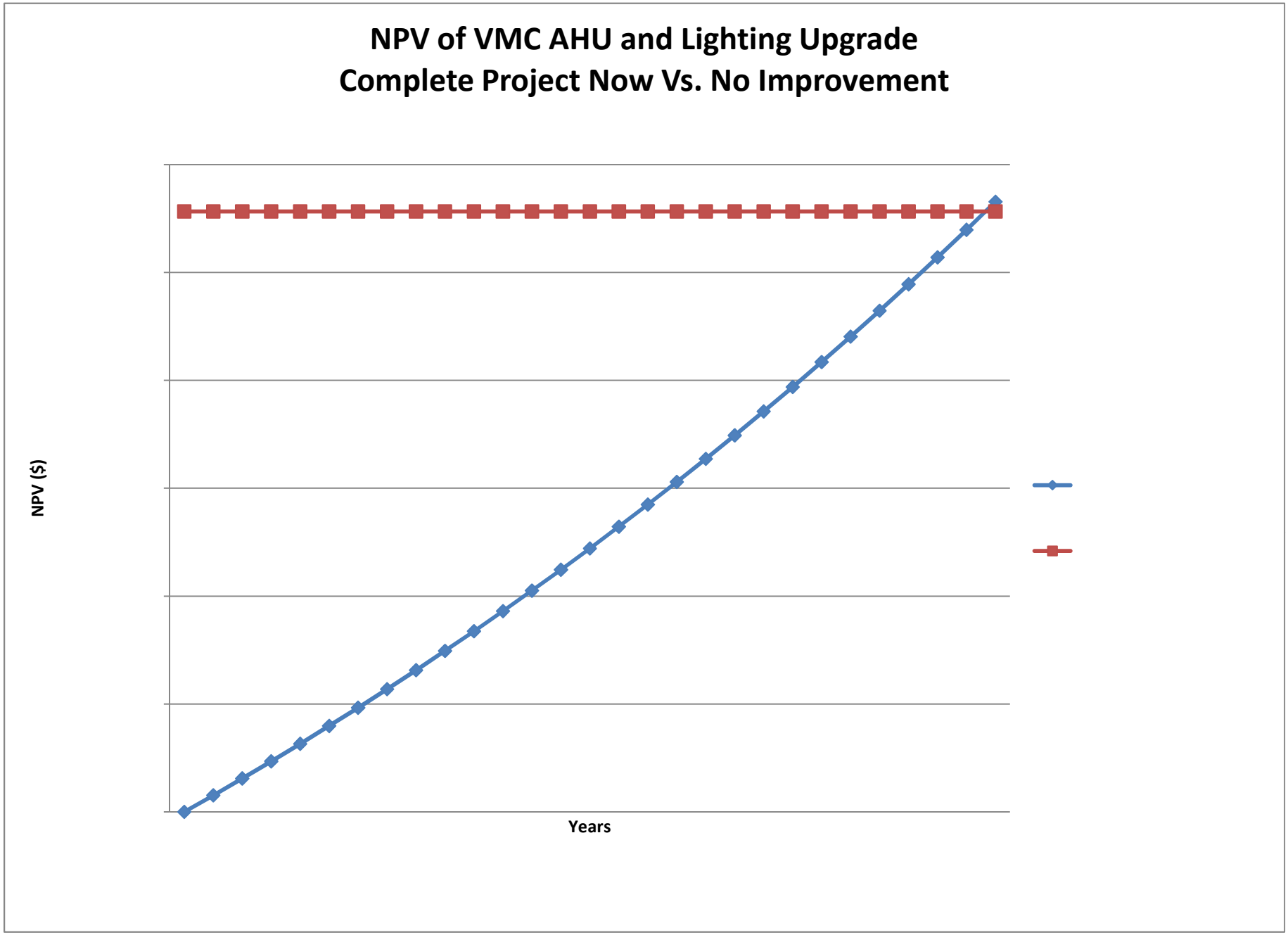
Enter 1 or 0 for each fuel type:			Years:	Rate:
	1 = Yes	Real Discount Rate (i)	2005 - 2040	1.0%
	0 = No	Electricity.	2005 - 2015 . . .	3.0%
IOU Electricity Source*	1	(Investor Owned Utility)	2016 - 2025 . . .	3.0%
POU Electricity Source**	0		2026 - 2040 . . .	3.0%
Natural Gas Fuel?	1	Natural Gas	2005 - 2015 . . .	3.0%
Propane Fuel?	0	And other fossil fuels	2016 - 2025 . . .	3.0%
Oil Fuel?	0		2026 - 2040 . . .	3.0%
		Maintenance	2005 - 2040	3.0%
		Inflation (Nominal , not used)	2005 - 2040	3.0%

* IOU = Invester Owned Utility
** POU = Publicly Owned Utility

$2,782,880 **=30-year LCC**

----------A N N U A L R E A L C A S H F L O W S----------

(Begin) Year	After Rebate First & Replace. Costs	Annual Maint. Costs	Annual Energy Costs	Annual Electric Costs	Total Annual Costs	Present Worth Factor	Present Worth of Annual Costs	Present Worth of Cumulative Costs
2011	$2,782,880	$0	$0	$0	$0	(1+i)^-n		
2011	$2,782,880	--	--	--	$2,782,880	1.00	$2,782,880	$2,782,880
2012	0	0	0	0	0	0.99	0	2,782,880
2013	0	0	0	0	0	0.98	0	2,782,880
2014	0	0	0	0	0	0.97	0	2,782,880
2015	0	0	0	0	0	0.96	0	2,782,880
2016	0	0	0	0	0	0.95	0	2,782,880
2017	0	0	0	0	0	0.94	0	2,782,880
2018	0	0	0	0	0	0.93	0	2,782,880
2019	0	0	0	0	0	0.92	0	2,782,880
2020	0	0	0	0	0	0.91	0	2,782,880
2021	0	0	0	0	0	0.91	0	2,782,880
2022	0	0	0	0	0	0.90	0	2,782,880
2023	0	0	0	0	0	0.89	0	2,782,880
2024	0	0	0	0	0	0.88	0	2,782,880
2025	0	0	0	0	0	0.87	0	2,782,880
2026	0	0	0	0	0	0.86	0	2,782,880
2027	0	0	0	0	0	0.85	0	2,782,880
2028	0	0	0	0	0	0.84	0	2,782,880
2029	0	0	0	0	0	0.84	0	2,782,880
2030	0	0	0	0	0	0.83	0	2,782,880
2031	0	0	0	0	0	0.82	0	2,782,880
2032	0	0	0	0	0	0.81	0	2,782,880
2033	0	0	0	0	0	0.80	0	2,782,880
2034	0	0	0	0	0	0.80	0	2,782,880
2035	0	0	0	0	0	0.79	0	2,782,880
2036	0	0	0	0	0	0.78	0	2,782,880
2037	0	0	0	0	0	0.77	0	2,782,880
2038	0	0	0	0	0	0.76	0	2,782,880
2039	0	0	0	0	0	0.76	0	2,782,880
Totals:	$2,782,880	$0	$0	$0	$2,782,880		**$2,782,880**	**=30-year LCC**
	1st+Repl	Maint	Fuel	Elec	Total Annual			


NPV of VMC AHU and Lighting Upgrade
Complete Project Now Vs. No Improvement
NPV ($)
Years

Directed Engineering Study cont.

SECTION 5.5 SELECTED DRAWINGS

SIEMENS

3/29/11 Revisions
4/12/11 Revisions

Hyperlink to Bottom

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 4/12/11	Design Notes:	Revision Notes:
Heating Water Upgrade (FIM 1.01-VMC)								
FIM 1.01-VMC - Existing Heating Water System - Demolition:						**Typical of: 1**		
Existing Preheat Heat Exchanger:								
Steam pressure sensor					1			
Steam control valve - 1/3					1			
Steam control valve - 2/3					1			
HW supply temp sensor					1			
HW return temp sensor					1			
HW pump start/stop					2			
HW pump status					2	Differential pressure switch		
~~Contingency Control Points - Demo:~~					~~0~~			4/12/11 Deleted
Existing Reheat Heat Exchanger:								
Steam pressure sensor					1			
Steam control valve - 1/3					1			
Steam control valve - 2/3					1			
HW supply temp sensor					1			
HW return temp sensor					1			
HW pump start/stop					3			
HW pump status					3	Differential pressure switch		
~~Contingency Control Points - Demo:~~					~~0~~			4/12/11 Deleted
Installation Note 1: Systems are located in the South Penthouse Mechanical Room.								
Installation Note 2: Remove all existing conduit, wire, junction boxes, pneumatics and control devices.								
Point totals:	0	0	0	0	20	**Total Points: 20**	20	
FIM 1.01-VMC - New Heating Water System:						**Typical of: 1**		
South Penthouse - New Preheat Heat Exchanger:								
~~Preheat Heat Exch. HX-1 steam pressure~~				~~0~~		~~Heat Exchanger HX-1~~		4/12/11 Deleted

SIEMENS

3/29/11 Revisions
4/12/11 Revisions

Hyperlink to Bottom

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 4/12/11	Design Notes:	Revision Notes:
Preheat Heat Exchanger HX-1 steam valve			1			See valve schedule		3/29/2011 Decr 2 to 1
Preheat Heat Exchanger HX-1 HW valve			1			See valve schedule		3/29/2011 Added
Preheat Heat Exch. HX-1 supply temperature				1				
Comon HW return temperature				1				
~~Preheat Heat Exch. HX-2 steam pressure~~				~~0~~		~~Heat Exchanger HX-2~~		4/12/11 Deleted
Preheat Heat Exchanger HX-2 steam valve			1			See valve schedule		3/29/2011 Decr 2 to 1
Preheat Heat Exchanger HX-2 HW valve			1			See valve schedule		3/29/2011 Added
Preheat Heat Exch. HX-2 supply temperature				1				
Comon HW return temperature				1				
HW pump start/stop	2					**Hot water Pumps HWP-1 & 2**		
HW pump status		2				Current sensing relay		
HW pump VFD speed signal			2					
HW pump VFD alarm status		2				Monitor internal contact		
~~HW pump VFD integration~~					~~0~~	~~BAS communication interface w/ VFD processor~~		4/12/11 Deleted
~~HW pump differential pressure sensor~~				~~0~~				4/12/11 Deleted
HW Loop-1 differential pressure sensor				1		Locate on Level-7 of Emergency Service Tower		3/29/2011 Added
HW Loop-2 differential pressure sensor				1		**Confirm location**		3/29/2011 Added
Basement Mechanical Room - New Preheat Heat Exchanger:								
~~Preheat Heat Exch. HX-3 steam pressure~~				~~0~~		~~Heat Exchanger HX-3~~		
Preheat Heat Exchanger HX-3 steam valve			1			See valve schedule		3/29/2011 Decr 2 to 1
Preheat Heat Exchanger HX-3 HW valve			1			See valve schedule		3/29/2011 Added
Preheat Heat Exch. HX-3 supply temperature				1				
Comon HW return temperature				1				
~~Preheat Heat Exch. HX-4 steam pressure~~				~~0~~		~~Heat Exchanger HX-4~~		
Preheat Heat Exchanger HX-4 steam valve			1			See valve schedule		3/29/2011 Decr 2 to 1
Preheat Heat Exchanger HX-4 HW valve			1			See valve schedule		3/29/2011 Added
Preheat Heat Exch. HX-4 supply temperature				1				
Comon HW return temperature				1				

SIEMENS

3/29/11 Revisions
4/12/11 Revisions

Hyperlink to Bottom

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 4/12/11	Design Notes:	Revision Notes:
HW pump start/stop	3					Hot water Pumps HWP-3, 4 & 5		
HW pump status		3				Current sensing relay		
HW pump VFD speed signal			3					
HW pump VFD alarm status		3				Monitor internal contact		
~~HW pump VFD integration~~					~~0~~	~~BAS communication interface w/ VFD processor~~		4/12/11 Deleted
~~HW pump differential pressure sensor~~				~~0~~				4/12/11 Deleted
HW Loop-3 differential pressure sensor				1		Confirm location		3/29/2011 Added
HW Loop-4 differential pressure sensor				1		Confirm location		3/29/2011 Added
HW Loop-5 differential pressure sensor				1		Confirm location		3/29/2011 Added
Logistic Note 1: Heat Exchangers HX-1 & 2 and Pumps HWP-1 & 2 will be located in the existing South Penthouse Mechanical Room.								
Logistic Note 2: Heat Exchangers HX-3 & 4 and Pumps HWP-3 - 5 will be located in the existing Basement Mechanical Room.								
Installation Note 1: Install a new PXCM control panel and UPS power supply in the South Penthouse / Wire 120vac power to PXCM.								
Installation Note 2a: Wire S. Penthouse points referenced above to the new PXCM control panel.								
Installation Note 2b: Wire Basement Mechanical Room points referenced above to the existing MBC-10 control panel.								
Installation Note 3: Wire BLN cable from the nearest existing AHU control panel.								
Installation Note 4: Wire FLN cables between the PXCM & VFD's.								
Installation Note 5: Field verify motor starter, VFD and valve locations.								
Point totals:	5	10	13	13	0	**Total Points:** 41	41	

Total Project Control Points:	61

SIEMENS

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 2/16/11	Design Notes:	General Notes:
East Penthouse Supply Fan SF-1 Replacement (FIM 3.01b-VMC)								
FIM 3.01-VMC - Lab & Radiology Dual Duct AHU (SF-1) - Demolition:						**Typical of: 1**		
Mixed Air Section:								
Outside air damper					1			
Return air damper					1			
Preheat coil valve					1			
Filter status					1			
Mixed air temperature sensor					1			
Hot Deck:								
Supply fan start/stop					1			
Supply fan status					1	Current sensing relay		
Supply fan VFD fault status					1			
Supply fan VFD speed signal					1			
Supply fan VFD integration					1			
Heating coil valve					1			
Heating coil discharge air sensor					1			
Supply air duct static pressure sensor					1			
Cold Deck:								
Supply fan start/stop					1			
Supply fan status					1	Current sensing relay		
Supply fan VFD fault status					1			
Supply fan VFD speed signal					1			
Supply fan VFD integration					1			
Freeze protection thermostat					1			
Cooling coil valve					1			
Cooling coil discharge air sensor					1			
Supply air duct static pressure sensor					1			
Exhaust Fans:								
Exhaust fan EF-12 start/stop					1	**Toilet EF**		
Exhaust fan EF-12 status					1	Current sensing relay		
Exhaust fan EF-13 start/stop					1	**Dining EF**		
Exhaust fan EF-13 status					1	Current sensing relay		
Exhaust fan EF-128 start/stop					1	**Birthing Suite EF**		
Exhaust fan EF-128 status					1	Current sensing relay		

SIEMENS

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 2/16/11	Design Notes:	General Notes:
Installation Note 1: SF-1 is located in the East Penthouse Mechanical Room .								
Installation Note 2a: Remove all existing control panels, conduit, wire, junction boxes, pneumatics and control components.								
Installation Note 2b: Retain existing MBC control panel components for potential reuse.								
Installation Note 3: Remove the existing BLN cables and patch network.								
Installation Note 4: Remove all existing 24v & 120v control power circuits and 24v transforms.								
Point totals:	**0**	**0**	**0**	**0**	**28**	**Total Points: 28**	28	
FIM 3.01-VMC - Lab & Radiology New DD Air Handling Unit (SF-1):						**Typical of: 1**		
Mixed Air Section:								
Outside air damper			1			100% Outside Air System - Confirm size	Dampers provided by McKinstry	**Act's per damper: 2**
~~Outside air damper end switch~~		~~0~~						
AHU return static pressure sensor				1				
AHU return air flow measuring station				1			AFM's provided by McKinstry	
Pre-Filter status				1		Differential pressure transducer		
Hot Deck:								
Supply fan VFD speed signal			1					
Supply fan VFD integration					1	BAS communication interface w/ VFD processor		
~~Heating coil entering air temperature sensor~~				~~0~~				
~~Heating coil entering water temp. sensor~~				~~0~~				
Heating coil valve			1			See valve schedule		
~~Heating water leaving water temp. sensor~~				~~0~~				
Heating coil discharge air temperature sensor				1				
Final-Filter status				1		Differential pressure transducer		
Discharge air smoke damper end switch		1						
Supply duct smoke detector alarm status		1				Furnished & installed by Div. 16		
Supply air flow measuring station				1			AFM's provided by McKinstry	
Supply air duct static pressure sensor				1				
Cold Deck:								
Supply fan VFD speed signal			1					
Supply fan VFD integration					1	BAS communication interface w/ VFD processor		
~~Cooling coil entering air temperature sensor~~				~~0~~				
~~Cooling coil entering water temp. sensor~~				~~0~~				
Freeze protection thermostat		1			2	2-pole: hardwire fan starter & EMCS alarm		**LTDT's per AHU: 2**
Cooling coil valve			1			See valve schedule		
~~Chilled water leaving water temp. sensor~~				~~0~~				
Cooling coil discharge air temperature sensor				1				

SIEMENS

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 2/16/11	Design Notes:	General Notes:
Final-Filter status				1		Differential pressure transducer		
Discharge air smoke damper end switch		1						
Supply duct smoke detector alarm status		1				Furnished & installed by Div. 16		
Supply air flow measuring station				1			AFM's provided by McKinstry / confirm if required	
Supply air duct static pressure sensor				1				
Exhaust Fans:								
Exhaust fan EF-12 start/stop	1					**Toilet EF**		
Exhaust fan EF-12 status		1				Current sensing relay		
Exhaust fan EF-13 start/stop	1					**Dining EF**		
Exhaust fan EF-13 status		1				Current sensing relay		
Exhaust fan EF-128 start/stop	1					**Birthing Suite EF**		
Exhaust fan EF-128 status		1				Current sensing relay		
Spare Points:	2	3	2	3			**Reference FIM-4.01 B.1.e**	
Installation Note 1: SF-4 located in the East Penthouse Mechanical Room.								
Installation Note 2: Install a new PXCM control panel and UPS power supply @ this AHU / Wire 120vac power to PXCM.								
Installation Note 3: Wire all points referenced above to the new PXCM control panel / Wire BLN cable from the existing AHU-39 control panel.								
Installation Note 4: Wire FLN cables between the PXCM & VFD's.								
Installation Note 5: Field verify motor starter, VFD, damper and valve locations.								
Point totals:	5	11	7	14	4	**Total Points:** 41	41	
FIM 3.01-VMC - Temporary Air Handling Unit:						**Typical of: 1**		
Outside air damper			1			100% Outside Air System - Confirm size	Dampers provided by McKinstry	**Act's per damper: 2**
Supply fan start/sop	1							
Supply fan status					1	BAS communication interface w/ VFD processor		
Supply fan VFD speed signal			1					
Freeze protection thermostat		1			2	2-pole: hardwire fan starter & EMCS alarm		**LTDT's per AHU: 2**
Heating coil valve			1			See valve schedule		
~~Heating coil discharge air temperature sensor~~				~~0~~				
~~Hot deck duct static pressure sensor~~				~~0~~				
Cold deck bypass air damper			1				Dampers provided by McKinstry	**Act's per damper: 2**
~~Freeze protection thermostat~~		~~0~~			~~0~~	~~2-pole: hardwire fan starter & EMCS alarm~~		~~**LTDT's per AHU: 0**~~
~~Cooling coil valve~~			~~0~~			~~See valve schedule~~		
Discharge air temperature sensor				1				
Duct static pressure sensor				1				

SIEMENS

Valley Medical Center Ficility Improvement Project

Energy Management & Control System Point Summary Sheet

Description:	Digital Outputs	Digital Inputs	Analog Outputs	Analog Inputs	Non-DDC Pt.	Remarks: 2/16/11	Design Notes:	General Notes:
Installation Note 1: The Temporary AHU will be located on the roof next to the East Penthouse Mechanical Room.								
Installation Note 2: Wire the control points to the new PXCM control panel referenced in the SF-1 description above.								
Installation Note 3: Wire all points referenced above to the PXCM control panel.								
Installation Note 4: Field verify motor starter, damper and valve locations.								
Point totals:	**1**	**1**	**4**	**2**	**3**	**Total Points: 11**	11	

Total Project Control Points: 80

Luminaire Schedule

Symbol	Qty	Label	Description	Arrangement	Lumens	LLF
	34	F1	LR6-DR1000	SINGLE	-1	1.000
	2	F4	Del Ray Big Light 4'	SINGLE	1400	0.855

Numeric Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min

Statistical Area Summary

Label	Avg	Max	Min	Avg/Min	Max/Min

LPD Area Summary

Label	Area	Total Watts	LPD

Valley Medical Center Redesign
Lobby

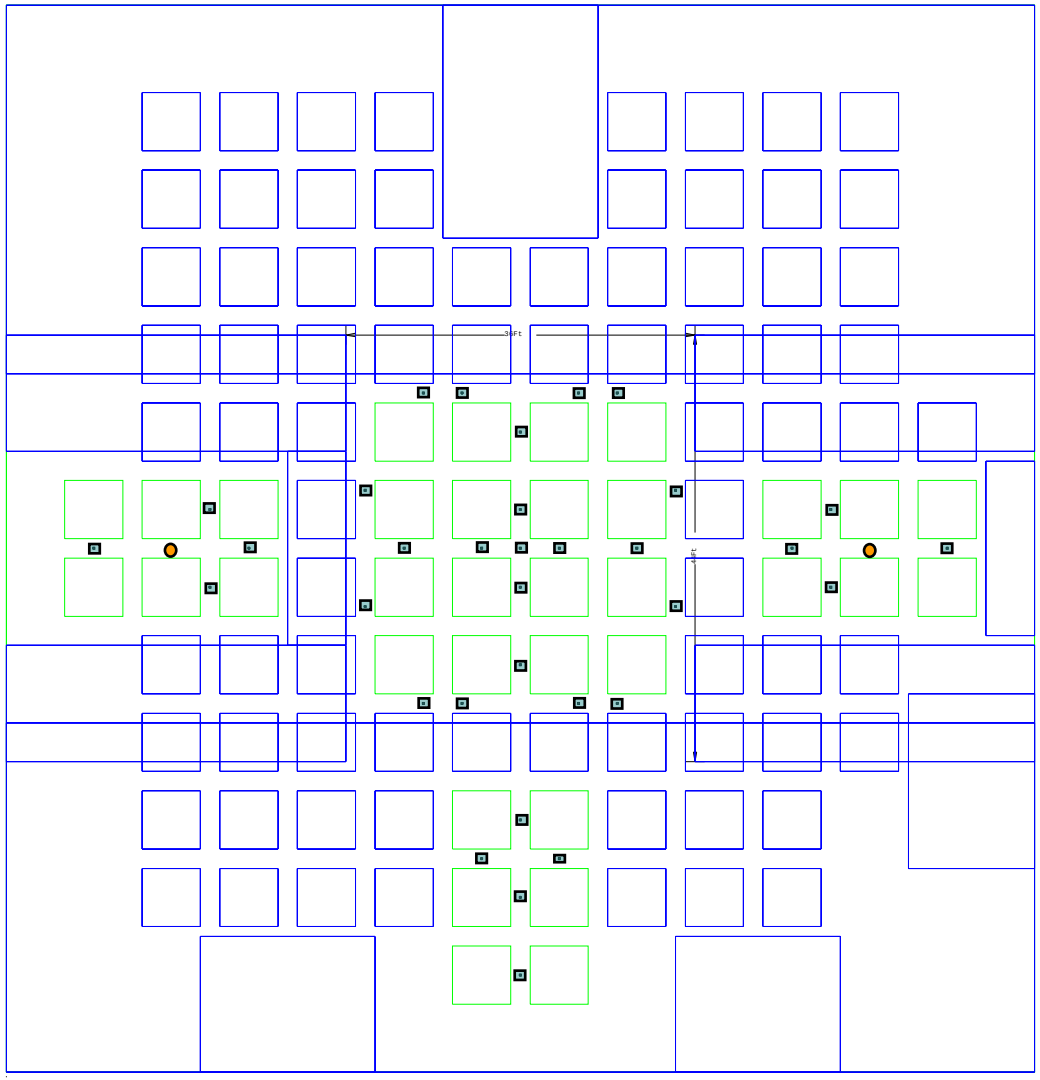
McKinstry
5005 3rd Ave. S.
Seattle, WA 98134

Luminaire Location Summary						
SeqNo	**Label**	**X**	**Y**	**Z**	**Orient**	**Tilt**
8	F1	65	54	19.5	0	0
9	F1	41	54	19.5	0	0
49	F1	53	18	19.5	0	0
50	F1	53	26	19.5	0	0
82	F1	57	54	19.5	0	0
83	F1	53	54	19.5	0	0
84	F1	49	54	19.5	0	0
85	F1	53	58	19.5	0	0
86	F1	53	50	19.5	0	0
87	F1	9	54	19.5	0	0
89	F1	81	54	19.5	0	0
91	F1	97	54	19.5	0	0
13	F1	49	22	19.5	0	0
16	F1	57	22	19.5	0	0
14	F1	53	10	19.5	0	0
105	F1	43	70	19.5	0	0
106	F1	47	70	19.5	0	0
107	F1	59	70	19.5	0	0
108	F1	63	70	19.5	0	0
109	F1	59	38	19.5	0	0
110	F1	63	38	19.5	0	0
111	F1	47	38	19.5	0	0
112	F1	43	38	19.5	0	0
113	F1	37	60	19.5	0	0
114	F1	37	48	19.5	0	0

Luminaire Location Summary						
SeqNo	**Label**	**X**	**Y**	**Z**	**Orient**	**Tilt**
115	F1	69	48	19.5	0	0
116	F1	69	60	19.5	0	0
117	F1	53	66	19.5	0	0
118	F1	53	42	19.5	0	0
92	F4	17	54	13	26.565	0
119	F1	21	58	19.5	0	0
120	F1	21	50	19.5	0	0
121	F1	25	54	19.5	0	0
122	F1	85	58	19.5	0	0
100	F4	89	54	13	225	0
61	F1	85	50	19.5	0	0

Valley Medical Center Redesign
Lobby

McKinstry
5005 3rd Ave. S.
Seattle, WA 98134

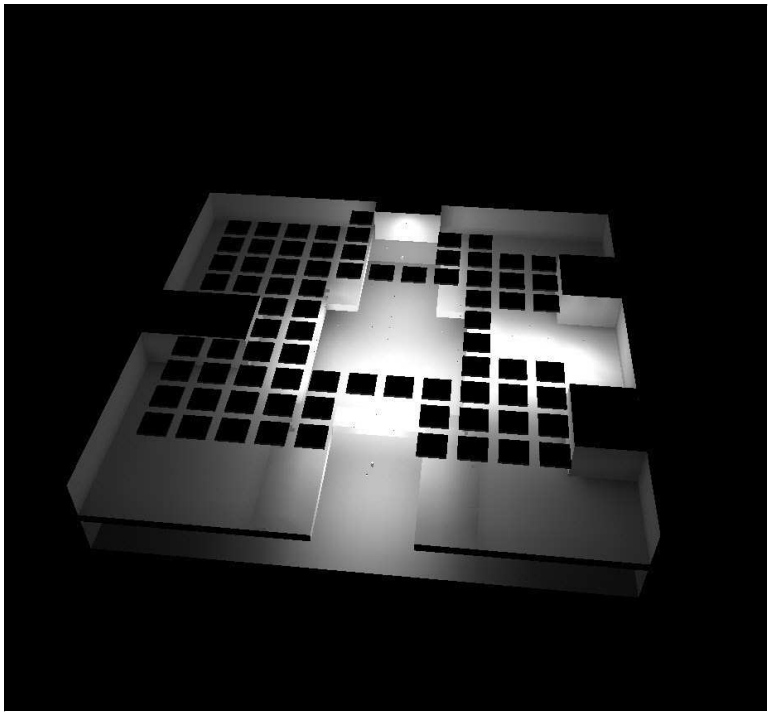


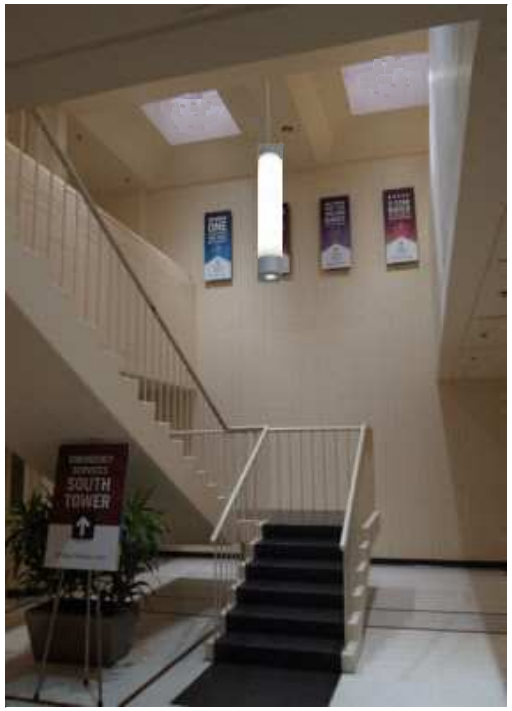
View of point by point

LEGEND

- **F1 CREE DR1000 Recessed Downlight**
- **F2 Delray 6300 Pendant Fixture**

Valley Medical Center Redesign Lobby	**McKinstry** 5005 3rd Ave. S. Seattle, WA 98134





Valley Medical Center Redesign Lobby	**McKinstry** 5005 3rd Ave. S. Seattle, WA 98134

McKinstry
For The Life Of Your Building

Directed Engineering Study cont.

SECTION 5.6 UTILITY RATES, CUT SHEETS & SUPPORT DOCS

PUGET SOUND ENERGY
The Energy To Do Great Things

Gas Summary Sheet No. S-13
Effective 04/01/2011

SUMMARY OF TOTAL CURRENT PRICES - GAS TRANSPORTATION SERVICE RATE SCHEDULE

Rates in this summary include the effect of all supplemental rate schedules except Schedule 1, Municipal Tax Adjustment, where applicable. In case of discrepancy between summary below and the rate schedules, the latter have precedence.

85T — DISTRIBUTION SYSTEM TRANSPORTATION SERVICE (INTERRUPTIBLE WITH FIRM OPTION)

Available throughout the territory served by the Company to Customers who otherwise meet all the requirements for service under sales service Rate Schedule 85.

Schedule 85T is referred to on customer bills as one of the following Rates: 85TG-C 85TG-I

BASIC CHARGE					**$ 893.87**	Per Month	SCH 85T		4/1/2011
		Next 25,000		**Next 25,000**	**Over 50,000**				
TRANS SVC COMMODITY	$	0.104910	$	0.053780	$ 0.051620	Per Therm	SCH 85T	Effective	4/1/2011
BALANCING SVC CHARGE	$	0.000700	$	0.000700	$ 0.000700	Per Therm	SCH 85T	Effective	11/1/2008
LOW INCOME PROGRAM	$	0.001570	$	0.000960	$ 0.000530	Per Therm	SCH 129	Effective	10/1/2010
TRANSPORTATION SERVICE COMMODITY	**$**	**0.107180**	**$**	**0.055440**	**$ 0.052850**				
MERGER CREDIT	**$**	**(0.000740)**	**$**	**(0.000740)**	**$ (0.000740)**	Per Therm	SCH 132	Effective	1/1/2011
TOTAL PER THERM CHARGE	$	0.106440	$	0.054700	$ 0.052110				
FIRM CONTRACT DELIVERY DEMAND CHARGE					**$ 1.14**	Per Therm	SCH 85T	Effective	4/1/2011
EXCESS VOLUME NOT BALANCED					**$ 1.00**	Per Therm	Rule 29	Effective	11/1/2008
MONTHLY BALANCING OVERRUN					**$ 2.00**	Per Therm	Rule 29	Effective	11/1/2008
					> 10% OVERRUN CHARGE				
ANNUAL MINIMUM LOAD CHARGE	Annual minimum applies - See appropriate rate schedule for details on minimum charges.								

PUGET SOUND ENERGY
The Energy To Do Great Things

Gas Summary Sheet No. S-20
Effective 06/01/2009

SUMMARY OF TOTAL CURRENT PRICES - GAS
GLOSSARY OF CHARGES

CUSTOMER CHARGE

Applied regardless of the amount of gas used and covers a portion of the costs of meter reading, billing and other related fixed costs.

DELIVERY CHARGE

This charge is for the construction, operation and maintenance of pipes, gas stations, pressure regulators and other equipment necessary for the delivery of natural gas to you.

COST OF GAS

This reflects the actual market cost of natural gas.

GAS CONSERVATION PROGRAM CHARGE

Every customer helps pay for the costs of weatherization and conservation programs. This is also known as the Gas Conservation Service Tracker, Supplemental Schedule 120

MERGER CREDIT

This rate adjustment passes through the rate credit made available following the merger completed in February 2009, Supplemental Schedule 132

NEW CUSTOMER RATE FOR FACILITIES EXTENSIONS

If you request a natural gas line extension to serve your home, depending on the costs associated with the extension, there may be an additional charge. One option is a non-refundable Qualification Payment in addition to the New Customer Rate, which is added to the residential gas rate for actual gas consumed for a period of five years. This rate is 17 cents per therm for existing residences and small commercial buildings and 11.5 cents for residences in new construction developments. (New construction developments are those that require construction of underground facilities to serve residential areas where paved streets, sidewalks and curbs do not yet exist and landscape restoration is not required.)

Line extension requests within Kittitas County are charged differently. All customers are subject to a nonrefundable Qualification Payment of $200 in addition to a New Customer Rate of 17 cents per therm, which is added to the gas rate for actual gas consumed for a minimum of seven years. Depending on the costs associated with the extension, there may be a Customer Advance payment required as well.

EFFECT OF CITY TAX

This is the effect of tax assessed on Puget Sound Energy by your city government. It is based on a percentage of your total bill.

CUSTOM MECHANICAL SOLUTIONS

SUBMITTAL

Customer:	McKinstry Co.	**Date:**	March 31, 2011
Project:	Valley Medical Center – Temporary Heating Renton, WA	**Engineer:**	McKinstry Co.

CMS, Inc. is proud to submit the following equipment for review:

Project Summary

Product	Qty	Tag(s)	Manufacturer / Model
Outdoor Air Handling Unit	1	TEMP-1	Titan Air / TAH-50.0-130 BA HW OA HRH

Craig Center
CUSTOM MECHANICAL SOLUTIONS
Main: (206) 973-3900 **Direct:** (206) 973-0242
Cell: (206) 718-3432 **E-Mail:** craig@cmswa.com

TITAN AIR INCORPORATED

UNIT SPECIFICATIONS

Title: Valley Medical Sales Rep.: Custom Mechanical Solutions

Q/N: 43061 S/N: Model: TAH-50.0-130 BA HW OA HRH Date: 3/29/11

CFM: 30,000 ESP: 2.5 Temperature Rise (°F): 60

BTU/Hr: Min. Max. 1,953,000

Heat Medium: Hot Water Coil: 180 ºF EWT, 20% Propylene, See Coil Specs.

Cool Medium: None

Function: Air Make-Up Unit Outdoor Mounted

Voltage: 460 V, 3ph., 60 Hz. Motor HP: 30 Motor FLA: 35 Unit FLA: 35.5

Heating Temp. Control Modulating Valve & Temp. Control by Others

OPTIONAL EQUIPMENT INCLUDED:

- Fresh Air Intake Hood w/ Birdscreen*
  Type: 45 Degree
- Outside Air Filter Section*
  Type: 2 in. Pleated, 30% Efficient
- Intake Damper & Actuator*
- Vibration Isolators
  Type: Blower/Motor - Neoprene
- 30" DWDI BAF Class II Blower
- Interior Unit Liner
- Insulated Unit
- G-90 Galvanized Casing & Accessories

OPTIONAL CONTROLS INCLUDED:

- Coil Freeze Protection by Others
- Door Interlocked Non-Fused Unit Disconnect
- ETL Label

SUBMITTAL USE ONLY. NOT FOR CONSTRUCTION, INSTALLATION, OR SERVICE USE.

* Denotes items shipped loose for field installation. See catalog or submittal for standard items.

APPLICATIONS FOR PRIMARY HEATING/ COOLING OR AIR MAKE-UP IN:

COMMERCIAL/RESIDENTIAL BUILDINGS
AUDITORIUMS
FACTORIES
FOUNDRIES
GARAGES
NATATORIUMS
WAREHOUSES
ETC...

- Indoor or weather proof construction.
- Optional fresh air and return air mixing chambers with mixed air temperature control, building pressure control or other options.
- Coil size and configurations optimized based upon each customer's heating/cooling medium specifications (steam pressure, entering water temperature, etc...).
- Horizontal or vertical unit configurations.
- Units are built on a design-build basis and sized accordingly (based upon coil selection, control arrangement, and other considerations).
- Solid construction, attention to details, and service considerations are representative of Titan's commitment to quality.
- Variable frequency motor drive can be adapted to Hydronic systems.

A CUSTOM SYSTEM DESIGNED AND BUILT BY EXPERIENCED PROFESSIONALS CAN BE YOUR BEST AND MOST ECONOMICAL COIL BASED HVAC SOLUTION.

TITAN's hydronic, DX, and electric coil units are designed using a conservative application of coil and blower manufacturers' design recommendations to meet a customer's specific requirements. You can be assured of proper heating/cooling and airflow without paying for an undersized or oversized "standard" unit. Call for quotations and sizing considerations.

THE HEART OF YOUR COIL BASED HVAC SYSTEM IS TESTED TO MEET INDUSTRY STANDARDS.

All hydronic and DX coils are tested and rated by the manufacturer in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 410 and certified in accordance with the ARI certification program. Electric Coils are UL Listed.

STANDARD FEATURES:

(Common to all coil units)

- ETL listed to UL 1995 standard for heating and cooling equipment.
- Blower and factory installed controls are prewired and tested. (Some field connections required)
- Basic units are fabricated from angle iron, steel channel and reinforced 16 gauge (min.) galvanized sheet steel. (TA-15 and smaller use 18 gauge min.)
- Stainless steel pitched drain pans for cooling coils.
- All units are manufactured with controls, motor and blower drives enclosed within the unit.
- Easy access, hinged and gasketed doors to allow servicing of unit components.
- Control voltage transformer(s) (when required).
- Non-Fused disconnect switch.
- 1.15 Service factor ODP blower motor.
- Adjustable motor base.
- Blower motor starter & overload protection.
- D.W.D.I. forward curved industrial type blower (s) with solid turned ground and polished shafting.
- Self aligning ball bearings.
- Variable pitch blower drive up to 30 HP.
- Lifting provisions on all units.
- Vertical units are built to accept slide - in filter sections. Integral 36" stand is also standard equipment on most unit sizes.
- Vertical units have control panel serviceable from ground level.
- G-90 Galvanized exterior.

OPTIONAL FEATURES:

(Common to all coil units)

- Fresh air and return air mixing sections with controls.
- Building pressure control with modulating fresh air and return air dampers or variable frequency drive.
- Temperature / humidity control system (see unit specific features on next page).
- Serpentine element freeze stat for hydronic coils.
- 2 spd blower motor.
- Motorized discharge or intake damper w/ safety interlock contacts.
- Filter section(s) with cleanable or disposable filters. (O.A. and R.A.)
- Intake Hood / Filter combination (1” cleanable filters.)
- Screened fresh air intake hood.
- Discharge air diffuser.
- Roof Curb.
- Service platform.
- Vibration isolation.
- Clogged filter indication light.
- Operation indication lights.
- Circuit analyzer indication lights.
- TEFC blower motor.
- Audible alarm systems.
- Unit cabinet insulation.
- Fused door interlocked disconnect.
- 7 Day time clock.
- Standard color or color matched paint.
- Other optional available upon request.

MODEL DESIGNATION:

Air Handler Models : TAH-AAA-BBB-CC-DD-EE-FFF

AAA - is the largest steam, fluid or DX coil square feet. Any number between 1 and 300. If airhandler does not include a steam, fluid or DX coil, this designator will not appear.

BBB - is blower quantity and wheel diameter and will typically be one of the following : 109, 112, 115, 118, 120, 122, 125, 127, 130, 133, 136, 139, 142, 148, 215, 218, 220, 222, 225, 227, 230, 233, 236, 239, 242, 248.

CC - designates blower type. FC - Forward Curved, BI - Backward Inclined, BA - Backward Airfoil, PN - Plenum, PG - Plug, PR - Propeller, RA - Radial Blade, TA - Tube Axial, VA - Vane Axial.

DD - can be CW - Chilled Water, DX - Direct Expansion Coil, HW - Hot Water Coil, ST - Steam Coil, EL - Electric Coil, EV - Evaporative Cooler, FP - Flat Plate Heat Recovery, RR - Rotary Energy Recovery. Multiple items may be designated in succession.

EE - can be AR - Mixed outside air & recirculated air, OA - 100% outside air, RA - 100% recirculated air.

FF - HRH, HRD, HRV, HLH, HLD, HLV, VRH, VRV, VDRH, VLH, VLV, VDLH.

STEAM COIL UNITS:

- Feature Jet Tube Distributing Coils with steam supply and condensate return connections on the same end of the coil. This tube within a tube construction offers superior freeze resistance.
- Free Floating steam coil core.
- Factory installed face & bypass dampers available.
- Integral face & bypass dampers available.

HOT WATER COIL UNITS:

- Standard coils feature vents and drains.
- Temperature controlled by modulating face and bypass dampers (factory installed and tested) or modulating hot water valve.
- Integral face & bypass dampers available.

CHILLED WATER COIL UNITS:

- Standard coils feature vents and drains.
- Units available with humidity control capability (reheat coil following cooling coil).
- Stainless steel condensate drain pan.

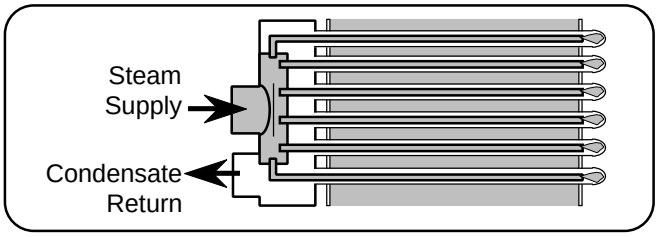
DIRECT EXPANSION (DX) COIL UNITS:

- Coils are counterflow circuited and equipped with pressure type distributors.
- Stainless steel condensate drain pan.
- Units available with humidity control capability (reheat following cooling coil).
- Evaporator coils available in normal, face, row, or interlaced control coil circuiting.
- Special coils available for ammonia refrigerant systems.

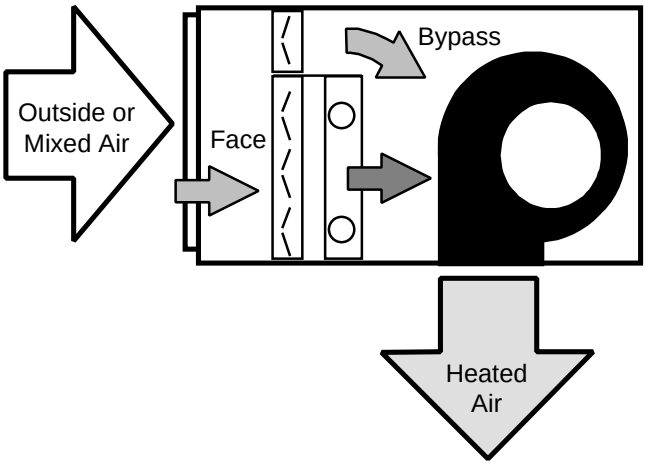
ELECTRIC COIL UNITS:

- Coil manufacturer supplied integral controls include: 1) Dual over temperature protection, 2) Over current protection, 3) Loss of airflow protection, 4) Contactors, 5) Door disconnect.
- Coil watt density is properly matched with air velocity.
- High grade nickel-chrome heating elements available upon request.
- Electronic room or discharge temperature control of up to 8 stages is available.
- SCR also available.

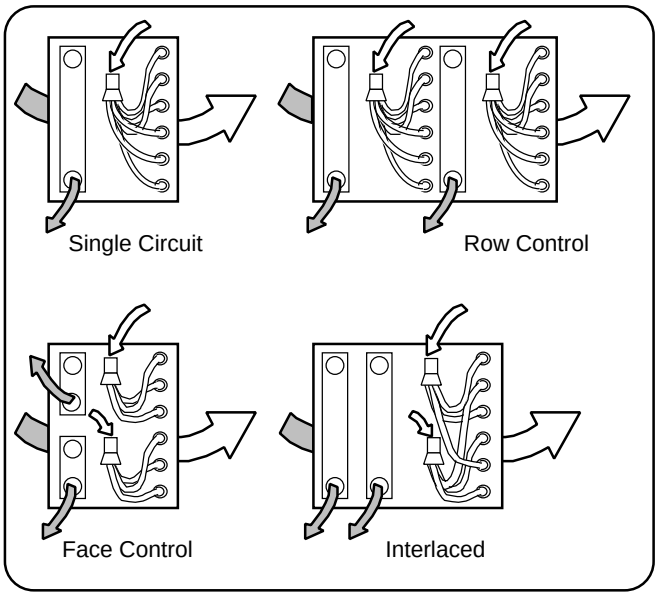
JET TUBE DISTRIBUTING COIL

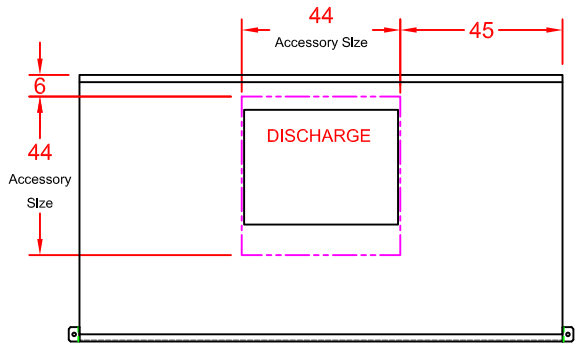


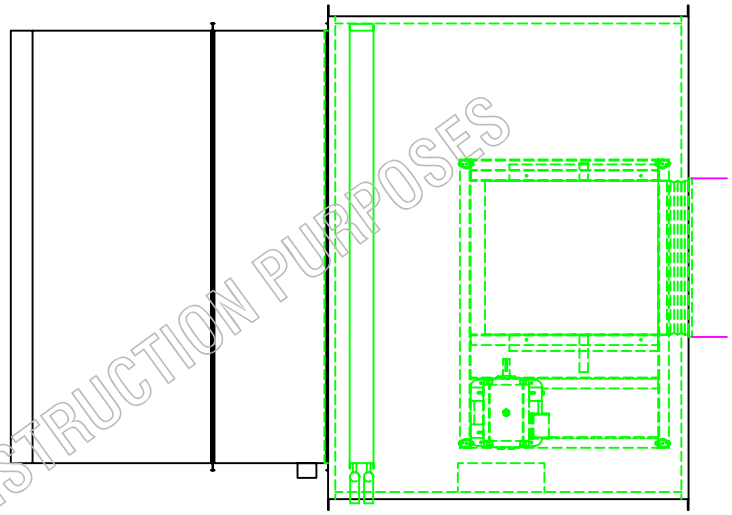
FACE AND BYPASS DAMPER CONFIGURATION



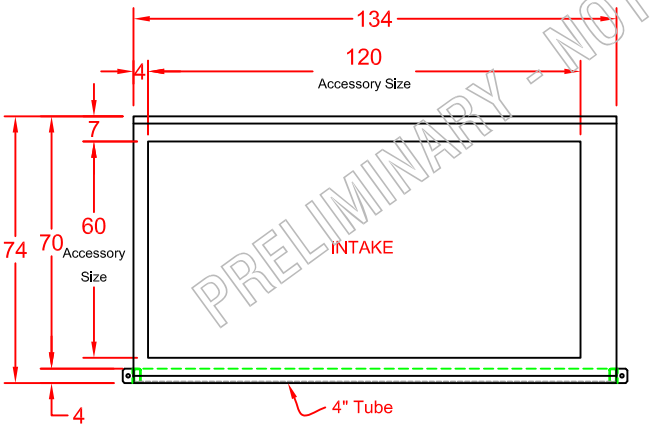
EVAPORATOR COOLING COIL CIRCUITINGS

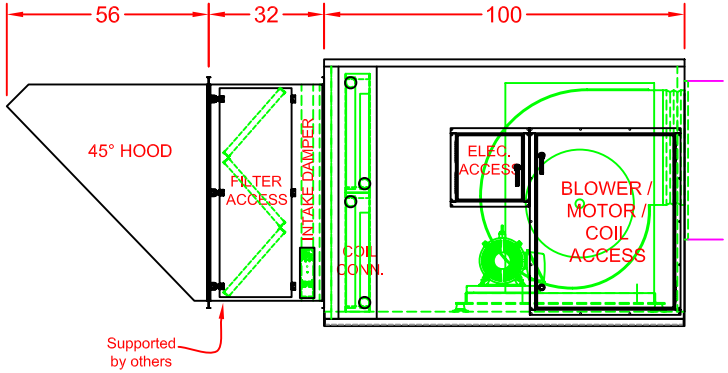






PLAN VIEW





SERVICE SIDE

PRELIMINARY - NOT FOR CONSTRUCTION PURPOSES

NOTES:
- UNIT DOORS: 1)20"w x 20"h, 1)40"w x 50"h
- ACCESSORIES ARE LARGER THAN OPENINGS & SUPPORTED BY OTHERS
- 45°INTAKE HOOD: 120"w x 60"h x 56"
- INTAKE FILTER/DAMPER SECTION: 120"w x 60"h x 43"
  15) 24 x 24 x 2 Pleated 30% Filters
- GH 30-AFDW BLOWER
- VIBRATION ISOLATION: Blower & Motor, Neoprene
- INSULATED & LINED
- G-90 GALVANIZED CASING & ACCESSORIES

TITAN AIR INCORPORATED	NOTICE: CONFIDENTIAL PROPERTY OF TITAN AIR INCORPORATED. INFORMATION CONTAINED ON THIS DRAWING IS CONFIDENTIAL IN NATURE, IT MAY NOT BE REPRODUCED OR RELEASED WITHOUT PRIOR WRITTEN CONSENT OF TITAN AIR INCORPORATED.	QUOTE NUMBER: 43061	DRAWING NAME: DESCRIPTION: TAH-130 BI HW OA HRH	JOB NAME: Valley Medical	DRAWN BY: JON HAGENESS	SCALE: 1 = 54	SHEET #: 1 OF 1
		SERIAL NUMBER: N/A		REP. NAME: CMS	DRAWN DATE: 08-26-10	DRAWING NUMBER: ----	ISSUE #: 00

GREENHECK
Building Value in Air.

Printed Date: 3/29/2011
Job: Q43061
Product Type: Fan
Mark: Q43061

AFDW Series 21 Airfoil Double Width

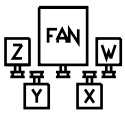
Tag Q43061

ENGINEERING DATA

Approx. Fan Weight (lb)	Class	Max. T Motor Frame Size	WR2 (lb-ft2)
846	II	405	139

**Weight does NOT include motor, drives, or accessories.

Motor Location
Y



Drive Type
Constant

CONFIGURATION

Arrangement	Rotation	Discharge Position	Material Type
3	CW	TH	Steel

INSTALLATION

Inlet Conditions	Outlet Conditions
Standard	Standard

STANDARD CONSTRUCTION FEATURES

HOUSING: Series 21 class I and II fans feature Perma-Lock construction on sizes 18-49 and continuously welded steel housing on sizes 54-73 and all class III fans • Unpunched outlet flange standard on class I and II sizes 33-73, all class III fans, and all downblast fans (DB) • All structural parts phosphatized and coated with Permatector

BEARINGS, SHAFT, AND WHEEL: Heavy duty, self-aligning ball or roller pillow block bearings • Polished, solid steel shafts • Fully welded centrifugal wheel

Structural or Inertia Base, required for this arrangement.

SELECTED OPTIONS & ACCESSORIES

Steel Base, Permatector, Rubber Mount w/ 1/4" Defl., Base Factory Mntd
Permatector Coating on Steel Components
Motor Slide Base
Class B Motor Insulation or Greater
Drive Service Factor of 1.5 - Standard
VFD Rated Motor, Meets NEMA MG-1 Standard, S.F. is 1.0
Housing is not sealed for outdoor use
NEMA Premium Efficient Motor - meets NEMA Table 12-12

MOTOR SPECS

Size (hp)	RPM	V/C/P	Enclosure	Frame Size
30	1725	460/60/3	ODP	286

PERFORMANCE (Elevation ft = 0, Airstream Temperature F = 70, Start Up Temperature F = 70) Drive Loss (%) 3

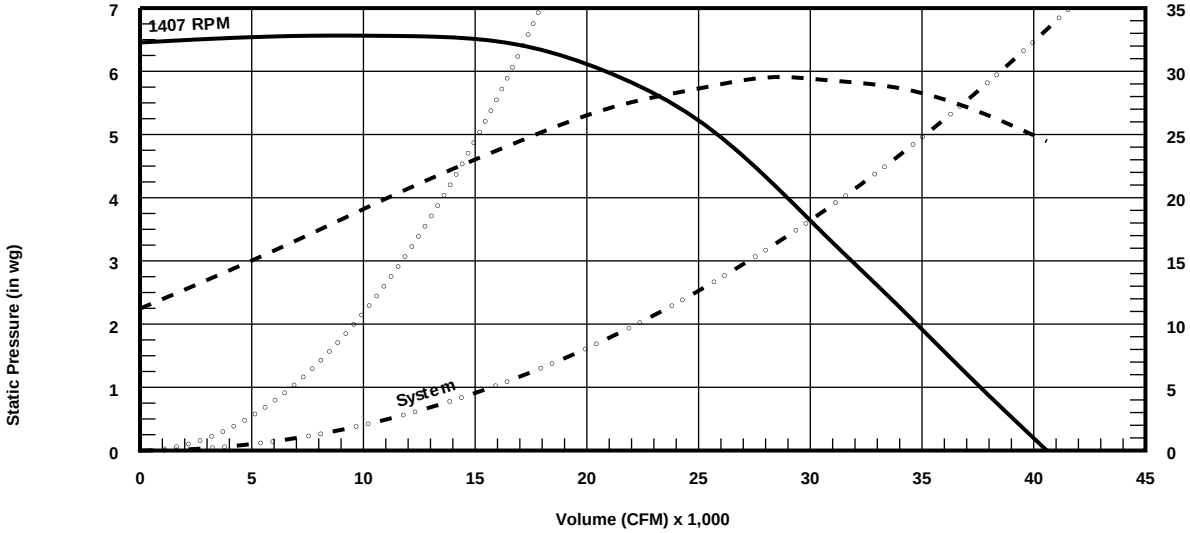
Qty	Model	Volume (CFM)	SP (in wg)	TS (ft/min)	OV (ft/min)	FRPM	Max Class FRPM	Operating Power (hp)	SE%
1	30-AFDW-21	30,000	3.64	11,051	3,222	1,407	1,757	29.39	60

SOUND

Inlet / Outlet Sound Power by Octave Band								LwA	dBA
63	125	250	500	1000	2000	4000	8000		
100 / 103	96 / 98	103 / 98	94 / 94	92 / 91	91 / 88	84 / 82	79 / 76	98 / 96	87 / 85

LwA - A weighted sound power level, based on ANSI S1.4.
dBA - A weighted sound pressure level, based on 11.5 dB attenuation per octave band at 5.0 ft.

dBA levels are not licensed by AMCA International.



RPM Curve
System Curve
Brake Power Curve
Do not select to the left of this surge curve

amca CERTIFIED RATINGS SOUND AND AIR PERFORMANCE AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

TITAN AIR INCORPORATED

STATIC PRESSURE DROPS

CFM	30000	STATIC
ESP		2.5
Unit	TAH-50.0-130 BA HW OA HRH	0.5
Hood		0.14
O.A. Filter(s)	1" Cleanable	0
	2" Cleanable	0
	2" Throw Away	0
	2" Pleated 30% Efficient	0.43
	Linked Panel (1" Rack)	0
	Other	0
Intake Damper		0.07
Discharge Damper		0
Discharge Diffuser		0
Misc. Static Drop		0
		0
TOTAL STATIC	30000	3.64
R.A. Filters	1" Cleanable	
	2" Cleanable	
	2" Throw Away	
	2" Pleated 30% Efficient	
	Linked Panel (1" Rack)	
	Other	

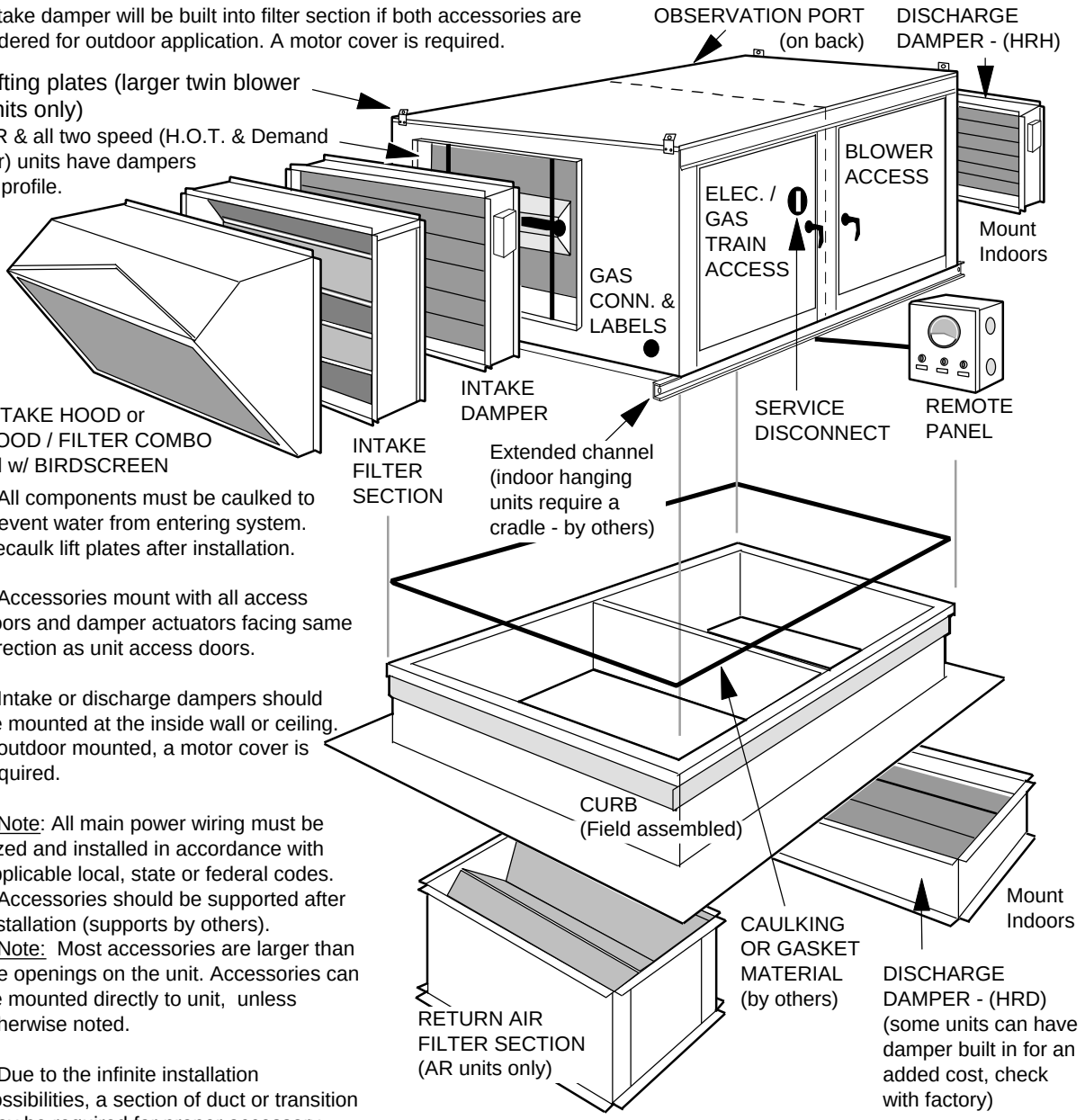
"TA" SERIES UNIT / ACCESSORY INFO.

rev. 01-04

Intake damper will be built into filter section if both accessories are ordered for outdoor application. A motor cover is required.

Lifting plates (larger twin blower units only)

AR & all two speed (H.O.T. & Demand Air) units have dampers in profile.



All components must be caulked to prevent water from entering system. Recaulk lift plates after installation.

Accessories mount with all access doors and damper actuators facing same direction as unit access doors.

Intake or discharge dampers should be mounted at the inside wall or ceiling. If outdoor mounted, a motor cover is required.

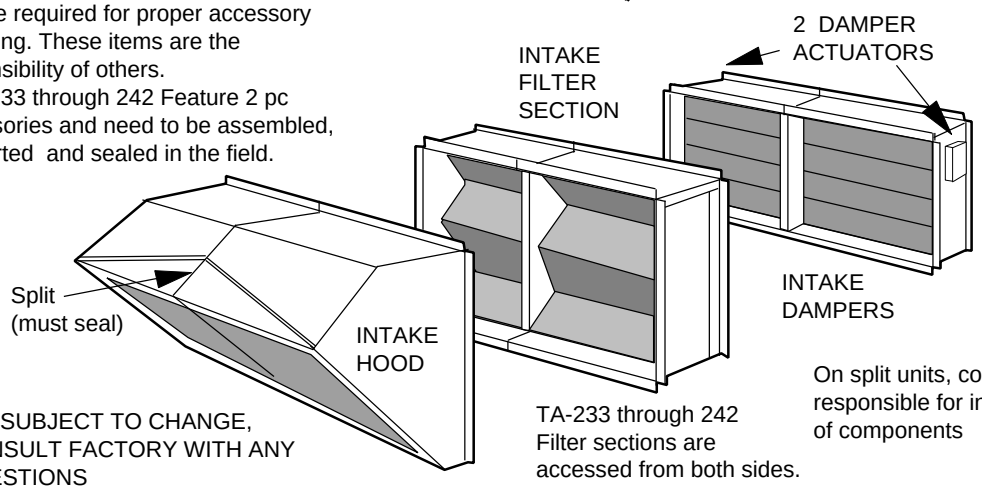
Note: All main power wiring must be sized and installed in accordance with applicable local, state or federal codes.

Accessories should be supported after installation (supports by others).

Note: Most accessories are larger than the openings on the unit. Accessories can be mounted directly to unit, unless otherwise noted.

Due to the infinite installation possibilities, a section of duct or transition may be required for proper accessory mounting. These items are the responsibility of others.

TA-233 through 242 Feature 2 pc accessories and need to be assembled, supported and sealed in the field.



On split units, contractor is responsible for interconnection of components

TA-233 through 242 Filter sections are accessed from both sides.

ALL SUBJECT TO CHANGE, CONSULT FACTORY WITH ANY QUESTIONS

TITAN AIR INCORPORATED

SEQUENCE OF OPERATION

HOT WATER COIL UNIT WITH MODULATING WATER VALVE (BY OTHERS) & DISCHARGE TEMPERATURE CONTROL

SUMMER MODE:

1. Summer/Off/Winter (S.O.W.) switch in summer position.
2. Damper (optional intake or discharge) will open.
3. Damper interlock switch closes, energizing the supply fan motor starter.

WINTER MODE:

1. S.O.W switch in the winter position.
2. Damper (optional intake or discharge) will open.
3. Damper interlock switch closes, energizing the supply fan motor starter.
4. Low temperature safety LTS-1 (optional) will shut the unit down after 3 minutes of operation with discharge air temperatures below its set point.
5. Hot water modulating valve control (by others) will be energized and modulate the hot water valve to control the discharge temperature.

UNIT LEGEND SHEET / GENERAL PARTS LIST

TITAN AIR INCORPORATED

Model: TAH-50.0-130 BA HW OA HRH

S/N:

Abbr.	Specification	#	Description
DM-1	Belimo AFB 24-S us	1	Intake Damper Motor
FU-2	600VAC - Class CC Time Delay: 0.3 Amp	2	Trans. Primary Fuses
MT-1	see motor specs. on right side of page.	1	Blower Motor
ST-1	Eaton XTCE040D00T, XTOE045DCS & XTCEXFBG20	1	Starter, OL & Aux.
SW-1	ABB OT63F3, OHB65J6, OXP6X265	1	Equipment Disconnect
SW-2	AB 800FP-SM32, -ALPX20	1	Summer-Off-Winter Switch
SW-5	Carlingswitch 111-16-73	1	Blower Service Switch
SW-6	Carlingswitch 111-16-73	1	Heat Service Switch
TR-1	Honeywell AT150F1030	1	Control Transformer
	By Blower Mfg.	4	Vibration Isolators
	Rae Corp. 58W30X120-7-2-W-F-R	2	Hot Water Coil

Abbr.	Description/Spec.	#

REMOTE PANEL(S)

ASE 6 x 6 x 4	1

MOTOR & BLOWER & DRIVE ASSEMBLY

Motor: 30 hp, 460 V 3ph. ODP 35 fla, 286T frame 1750 rpm (By Blower Mfg.)	
Blower: GH 30-AFDW-21	1
P.B. Bearings: By Blower Mfg.	2
Motor Sheave: By Blower Mfg.	1
Bore: By Blower Mfg. Turns Open: By Blower Mfg.	
Blower Sheave: By Blower Mfg	1
RPM: 1407 Bushing: By Blower Mfg.	
Belts: By Blower Mfg.	2
Coupling:	na

SCHEMATIC SYMBOLS

- ### Unit Control Panel Terminal
- ## Remote Panel Terminal
- # Component Terminal
- Terminal in Others Panel
- ## R Wiring to Remote (Others)
- Field Wiring (by Others)
- Jumper Wire
- Wire Connection
- * Optional Part (see Legend)

Terminal no.'s 1 to 99 designate 120 volt; no.'s 100+ designate low volt wiring (run in shielded cable). Ground unit according to N.E.C. CAUTION: Open disconnect switch before servicing unit.

Rating Sheet

TITAN AIR, INC.

13901 16TH STREET / OSSEO, WI 547580000
Phone # - 7155972050 / Fax # - 7155973620
Kyle Kittelson

Customer: TITAN AIR INC **Job: Q43061**
Quote Number: 1000078 **Item #: ?**

58W30X120-7-2-W-F-R (SCFM)

No. Coils:	2	Coil Type:	Water - Heating
Fin Height (In.):	30	Fin Material:	Aluminum
Fin Length (In.):	120	Fin Thickness (In.):	0.008
Air Flow (per Coil) (CFM):	15000 (30000 Total)	Tube Material:	Copper
Air Velocity (fpm):	600	Tube Thickness (In.):	0.025
EDB (°F):	20	Casing Material:	GALV
EWT (°F):	180	Fluid Type:	PG
Fluid Temp. Drop (°F):	20	% Glycol:	20
Circuiting:	Full		
FPI:	7		
Rows:	2		

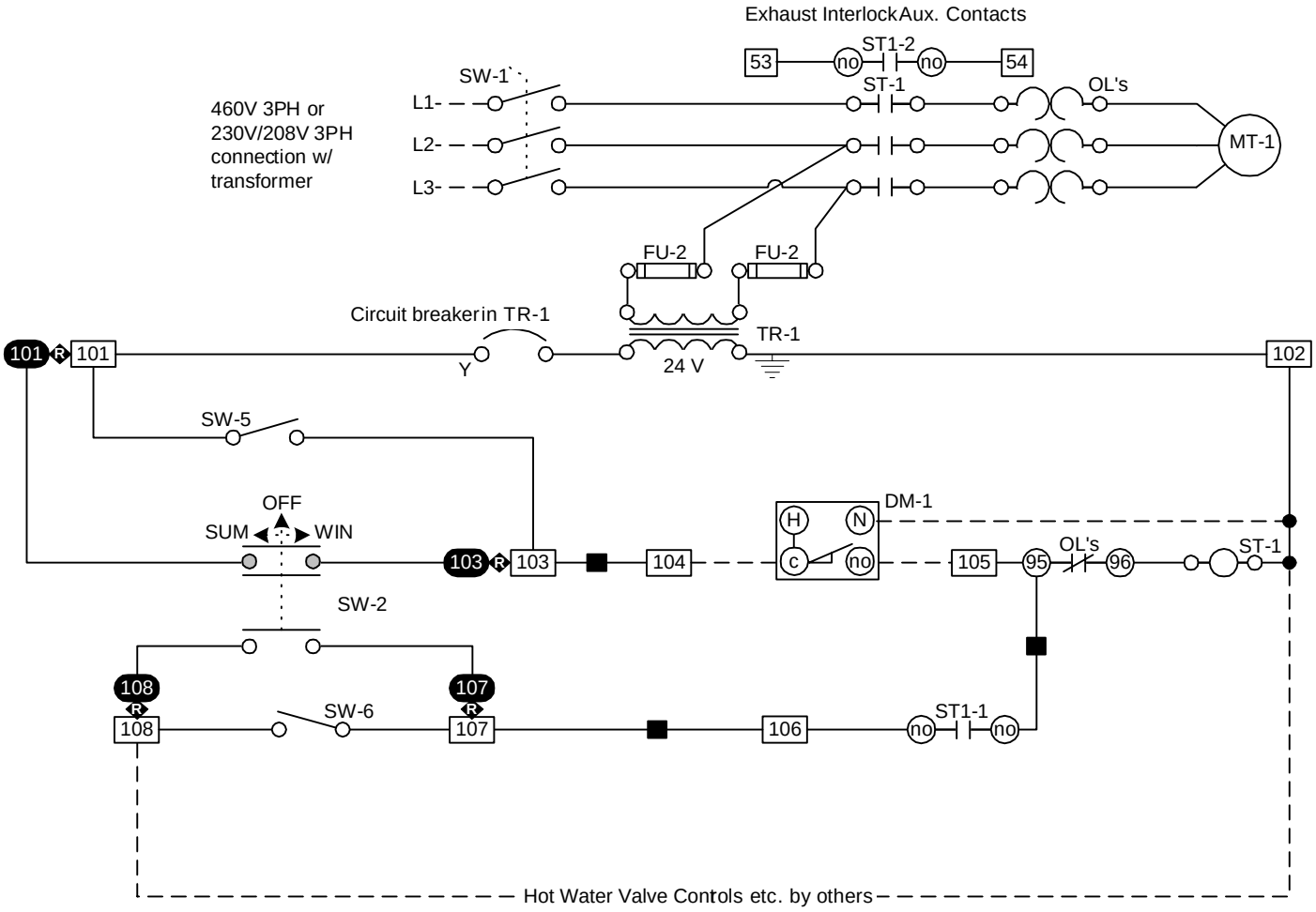
	Per Coil	Total All Coils
LDB (°F):	80.6	
Total Heat (BTUH):	Sen. Coil Only	
Sensible. Heat (BTUH):	986,043	1,972,086
LWT (°F):	160.0	
Liquid Flow (gpm):	103.6	207.3
Fluid Press. Drop (Feet):	9.78	
Tube Velocity (fps):	5.96	
Number of Circuits :	20	
Air Pressure Drop (in W.G.):	0.15	
Connection Size (In.):	2.5	
Approximate Fluid Volume (Gal) :	6.1	12.2

Approximate Shipping Weight: 195 lbs. Est. Dry Weight (uncrated each)

Date Printed - 3/29/2011 using Program Version : 2.17.2011.1/2011.1.13

We reserve the right to change or revise specifications and product design in connection with any feature of our products. Such changes do not entitle the buyer to corresponding changes, improvements, additions, or replacements for equipment previously sold or shipped.

TITAN AIR INCORPORATED	HOT WATER COIL UNIT w/ MOD VALVE TEMP CONTROL BY OTHERS	JOB: Valley Medical	SERIAL NUMBER: Q43061	
			DATE: 3/29/2011	DRAWN BY: KK



Low voltage wiring must be run in shielded cable.

See Legend Sheet for symbol description. (R ## = unit to remote wiring)

q43061 hot water amu 24v temp control by others.vsd

CUSTOM MECHANICAL SOLUTIONS

SUBMITTAL

Customer:	McKinstry Co.	**Date:**	April 11, 2011
Project:	Valley Medical Center AHU Replacement Renton, WA	**Engineer:**	CDI Engineers Inc.

CMS, Inc. is proud to submit the following equipment for review:

Project Summary

Product	Qty	Tag(s)	Manufacturer / Model
Custom Air Handling Units	1	SF-1	Haakon Airpak

Craig Center
CUSTOM MECHANICAL SOLUTIONS
Main: (206) 973-3900 **Direct:** (206) 973-0242
Cell: (206) 718-3432 **E-Mail:** craig@cmswa.com

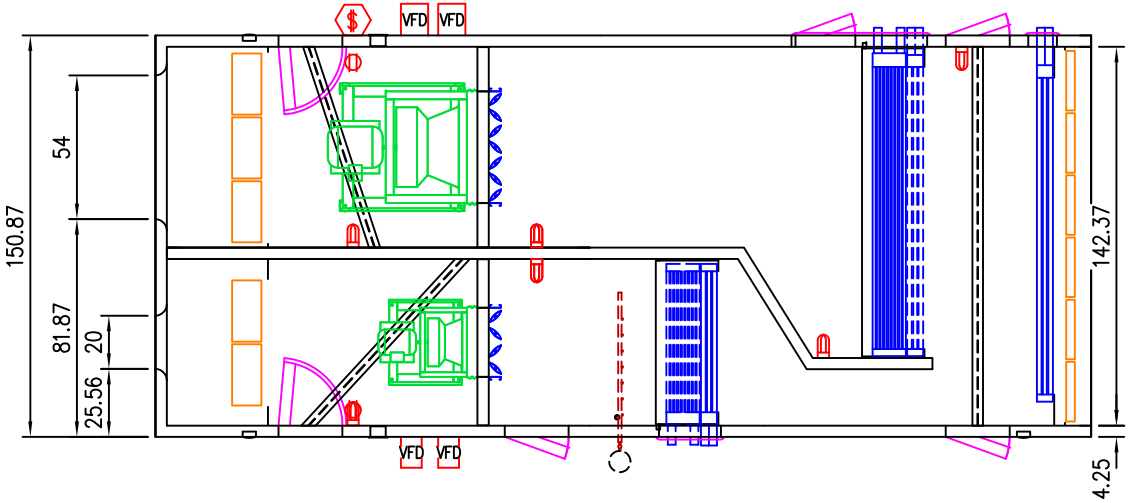
Options / Accessories:

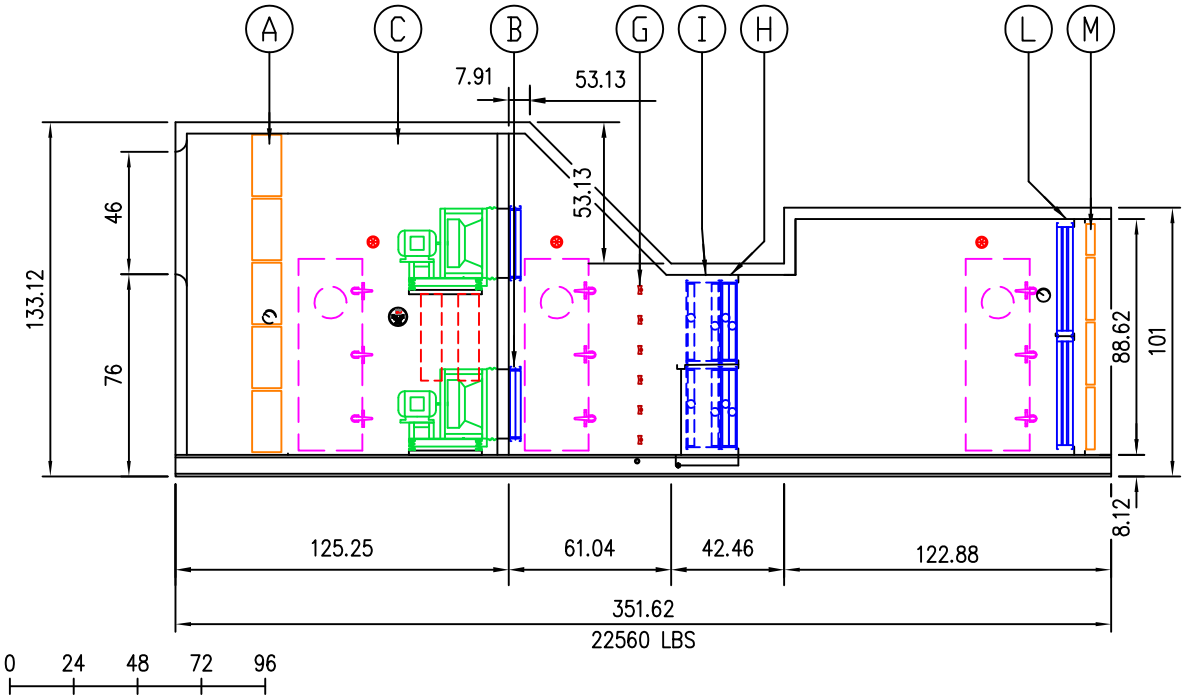
- Tag(s): SF-1
- Field Constructed “Kit” Unit
- Factory Supervision of Unit Reassembly
- 4" Double Wall Construction
- Welded Stainless Steel Floor
- 30,000 CFM Cold Deck Air Tunnel
- 11,000 CFM Hot Deck Air Tunnel
- Pre-Heat, Chilled Water, & Hot Water Coils
- Additional Rack for Future Heating Coil in Cold Deck
- Additional Rack for Future Cooling Coil in Hot Deck
- Pre-Heat Coils Designed for Lift-Out Removal Through Access Door
- Gasketed Split Coils for Pre-Heat Removal (includes 4 sets spare gaskets)
- Space Allocated for Future Humidifier Grid
- Direct Drive Plenum Fans
- Internal Spring Isolation
- Bellmouth Supply Duct Connections
- Fan Airflow Monitors
- Motor Removal I-Beam with Trolley
- ABB Variable Frequency Drives with Disconnect (one VFD per fan)
- Fan Isolation Dampers
- TAMCO Low Leak Aluminum Airfoil Dampers
- Stainless Steel Drain Pans
- 2", MERV 8 Pre-Filters
- 12", MERV 14 Final Filters
- Double Wall Access Doors with Stainless Piano Hinge
- Marine Lights & Service Outlets (Wired to Separate 120V Disconnect)
- Field Leak Test

NOTES:

1. Excluding: Installation/Reassembly, Start-Up, Labor Warranty, Disconnects, Controls, Actuators, Spares, Reconnecting Split Sections, Drive Changes, VFDs, Storage or Staging, Curbs.
2. Haakon is providing field supervision of reassembly only. Field reassembly will take approximately 5 days with two competent sheet metal workers (5 days X 8 hours X 2 workers = 80 Man hours).
3. CONTRACTOR IS RESPONSIBLE FOR DETERMINING COIL PULL, PIPING, ACCESS, ELECTRICAL, AND DRAIN CONNECTION SIDES. UNITS WILL SHIP AS SUBMITTED UNLESS DIRECTED OTHERWISE.

SF-1





(L) PREHEAT COIL
TYPE : 2 ROW
SIZES : 2 @ 39 X 119
CONN : LEFT PULL : DNSTREAM
VEL : 466 FPM

(M) FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 357 FPM
TYPE : 4" (MERV 8) Farr 30/30
SIZES : 18 @ 24 X 24 6 @ 24 X 12

UNIT MOUNTING
The unit is designed to be mounted on a concrete pad.

Note : Calculated unit weights are shipping weights and do not reflect operating conditions

ELEVATION VIEW
SHOWS HOT DECK

(A) HD FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 275 FPM
TYPE : 12" (MERV 14) Farr Riga-Flo 200 PH style
SIZES : 10 @ 24 X 24

(B) FAN INLET DAMPER : OPPOSED BLADES
MAKE : T.A. Morrison 1000
SIZE : 2 @ 28 X 28

(C) FAN : 2 @ 18" EPFN SW, 67% Width, Arrangement-4 HOT DECK SF

	PRESENT	FUTURE
AIR FLOW :	5500 CFM	7700 CFM
T.S.P. :	7 in wc	3.43 in wc
RPM (Class) :	3149 (III)	3438 (III)

MOTOR : 15 HP, ODP Prem-Eff, 460/3/60
RPM : 3500 (GROUNDED SHAFT)
ISOLATORS : OS DEF : 1 in

(D) CD FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 500 FPM
TYPE : 12" (MERV 14) Farr Riga-Flo 200 PH style
SIZES : 15 @ 24 X 24

(E) FAN INLET DAMPER : OPPOSED BLADES
MAKE : T.A. Morrison 1000
SIZE : 2 @ 44 X 44

(F) FAN : 2 @ 30" EPFN SW, 90% Width, Arrangement-4 COLD DECK SF

	PRESENT	FUTURE
AIR FLOW :	15000 CFM	21000 CFM
T.S.P. :	7 in wc	3.43 in wc
RPM (Class) :	1685 (III)	1706 (III)

MOTOR : 30 HP, ODP Prem-Eff, 460/3/60
RPM : 1750 (GROUNDED SHAFT)
ISOLATORS : OS DEF : 2 in

(G) STEAM HUMIDIFIER - FUTURE

(H) HEATING COIL
TYPE : 2 ROW
SIZES : 2 @ 30 X 53
CONN : RIGHT PULL : RIGHT
DRAIN : RIGHT VEL : 499 FPM

(I) COOLING COIL - FUTURE
TYPE : 8 ROW
SIZES : 2 @ 30 X 53
CONN : RIGHT PULL : RIGHT
DRAIN : RIGHT VEL : 499 FPM

(J) PREHEAT COIL - FUTURE
TYPE : 2 ROW
SIZES : 2 @ 40.5 X 106
CONN : LEFT PULL : LEFT
DRAIN : LEFT VEL : 504 FPM

(K) COOLING COIL
TYPE : 8 ROW
SIZES : 2 @ 40.5 X 106
CONN : LEFT PULL : LEFT
DRAIN : LEFT VEL : 504 FPM

SDG VER: Apr 4 2011

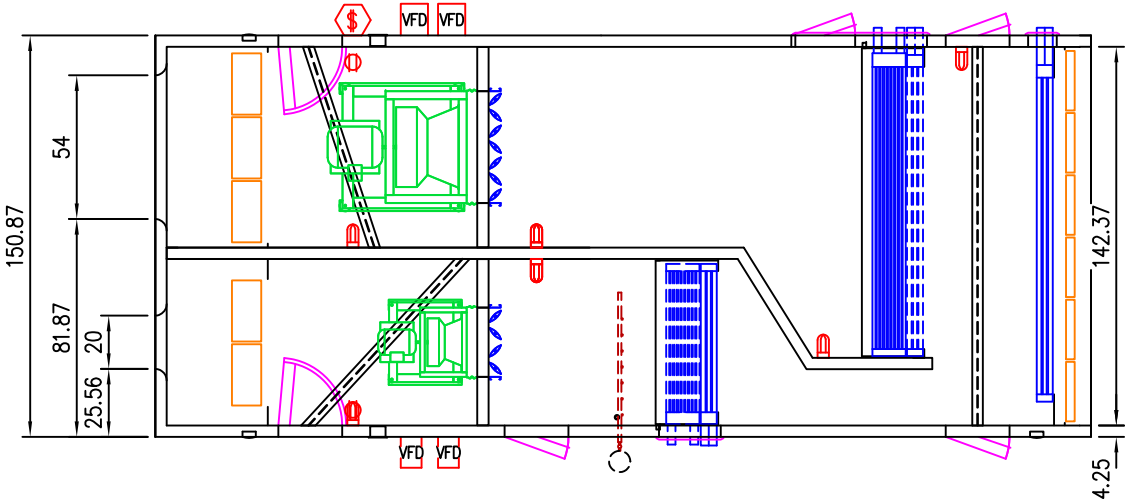
PROJECT VMC - AHU REPLACEMENT

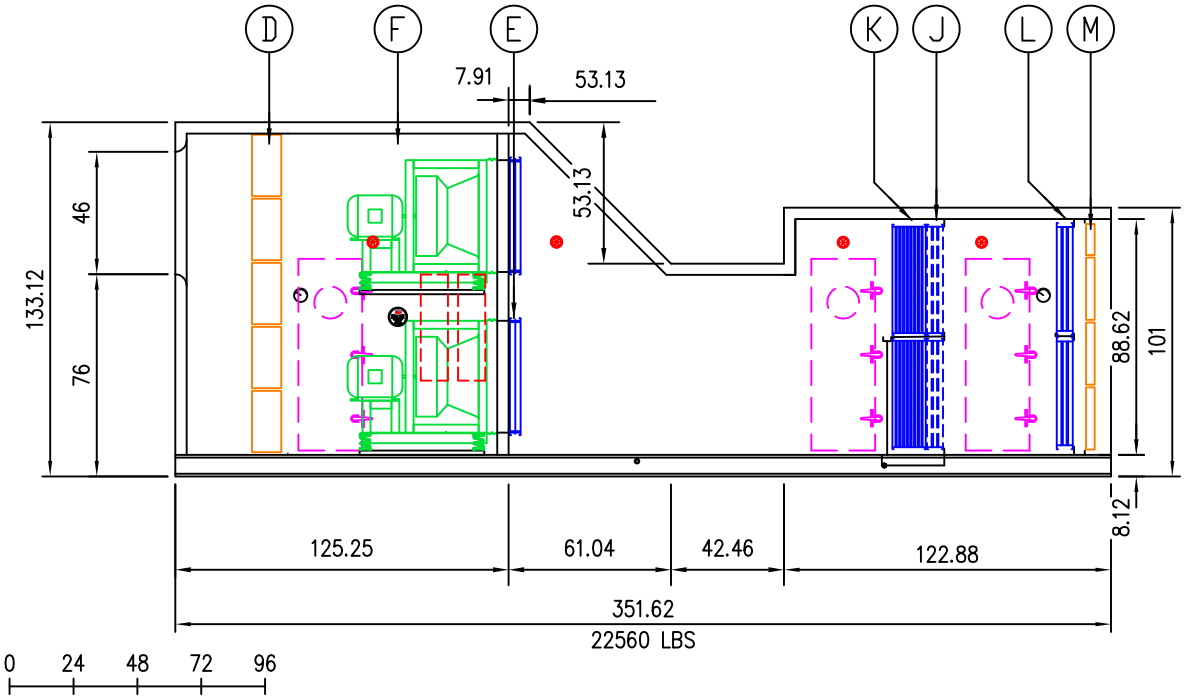
OPENINGS AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS. RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES.

JOB NO.	5873	DRAWN BY	DL	DWG NO.	5873U01SD01	ACCESS SIDE	RIGHT	DWG UNITS	IN
TAG	AHU-EP-01	DATE	APR 11/11	TYPE	INDOOR	16:23		SCALE	N.T.S.

SALES OFFICE CUSTOM MECHANICAL SOLUTIONS
SALES ENGINEER CRAIG CENTER

HAAKON INDUSTRIES
11851 DYKE ROAD, RICHMOND, B.C. CANADA V7A 4X8





(L) PREHEAT COIL
TYPE : 2 ROW
SIZES : 2 @ 39 X 119
CONN : LEFT PULL : DNSTREAM
VEL : 466 FPM

(M) FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 357 FPM
TYPE : 4" (MERV 8) Farr 30/30
SIZES : 18 @ 24 X 24 6 @ 24 X 12

UNIT MOUNTING
The unit is designed to be mounted on a concrete pad.

Note : Calculated unit weights are shipping weights and do not reflect operating conditions

ELEVATION VIEW
SHOWS COLD DECK

(A) HD FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 275 FPM
TYPE : 12" (MERV 14) Farr Riga-Flo 200 PH style
SIZES : 10 @ 24 X 24

(B) FAN INLET DAMPER : OPPOSED BLADES
MAKE : T.A. Morrison 1000
SIZE : 2 @ 28 X 28

(C) FAN : 2 @ 18" EPFN SW, 67% Width, Arrangement-4 HOT DECK SF

	PRESENT	FUTURE
AIR FLOW :	5500 CFM	7700 CFM
T.S.P. :	7 in wc	3.43 in wc
RPM (Class) :	3149 (III)	3438 (III)

MOTOR : 15 HP, ODP Prem-Eff, 460/3/60
RPM : 3500 (GROUNDED SHAFT)
ISOLATORS : OS DEF : 1 in

(D) CD FILTERS : LIFT-OUT UPSTREAM
VELOCITY : 500 FPM
TYPE : 12" (MERV 14) Farr Riga-Flo 200 PH style
SIZES : 15 @ 24 X 24

(E) FAN INLET DAMPER : OPPOSED BLADES
MAKE : T.A. Morrison 1000
SIZE : 2 @ 44 X 44

(F) FAN : 2 @ 30" EPFN SW, 90% Width, Arrangement-4 COLD DECK SF

	PRESENT	FUTURE
AIR FLOW :	15000 CFM	21000 CFM
T.S.P. :	7 in wc	3.43 in wc
RPM (Class) :	1685 (III)	1706 (III)

MOTOR : 30 HP, ODP Prem-Eff, 460/3/60
RPM : 1750 (GROUNDED SHAFT)
ISOLATORS : OS DEF : 2 in

(G) STEAM HUMIDIFIER - FUTURE

(H) HEATING COIL
TYPE : 2 ROW
SIZES : 2 @ 30 X 53
CONN : RIGHT PULL : RIGHT
DRAIN : RIGHT VEL : 499 FPM

(I) COOLING COIL - FUTURE
TYPE : 8 ROW
SIZES : 2 @ 30 X 53
CONN : RIGHT PULL : RIGHT
DRAIN : RIGHT VEL : 499 FPM

(J) PREHEAT COIL - FUTURE
TYPE : 2 ROW
SIZES : 2 @ 40.5 X 106
CONN : LEFT PULL : LEFT
DRAIN : LEFT VEL : 504 FPM

(K) COOLING COIL
TYPE : 8 ROW
SIZES : 2 @ 40.5 X 106
CONN : LEFT PULL : LEFT
DRAIN : LEFT VEL : 504 FPM

SDG VER: Apr 4 2011

PROJECT

VMC - AHU REPLACEMENT

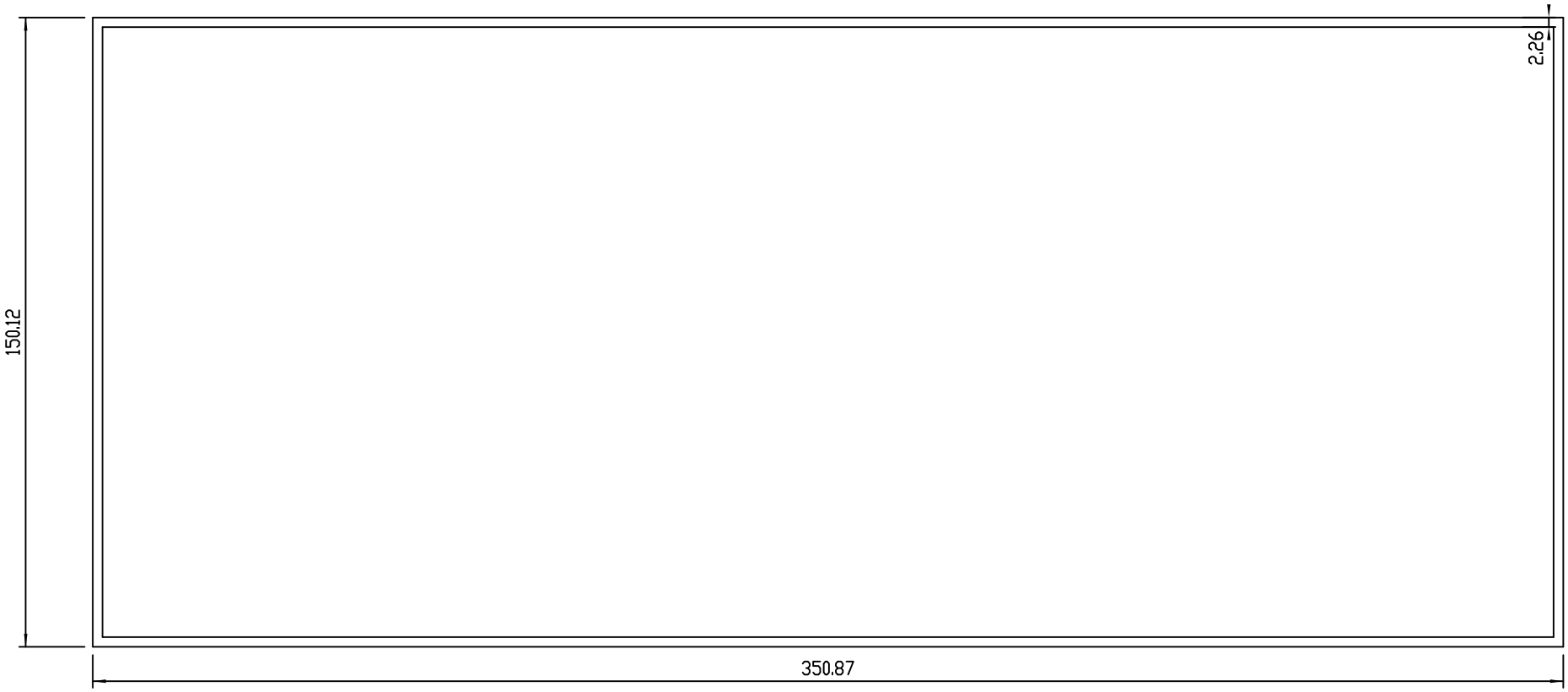
OPENINGS AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS. RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES.

JOB NO.	5873	DRAWN BY	DL	DWG NO.	5873U01SD02	ACCESS SIDE	RIGHT	DWG UNITS	IN
TAG	AHU-EP-01	DATE	APR 11/11	TYPE	INDOOR	16:23		SCALE	N.T.S.

SALES OFFICE CUSTOM MECHANICAL SOLUTIONS
SALES ENGINEER CRAIG CENTER

HAAKON INDUSTRIES
11851 DYKE ROAD, RICHMOND, B.C. CANADA V7A 4X8

FOOT PRINT DIAGRAM - outline is base channel



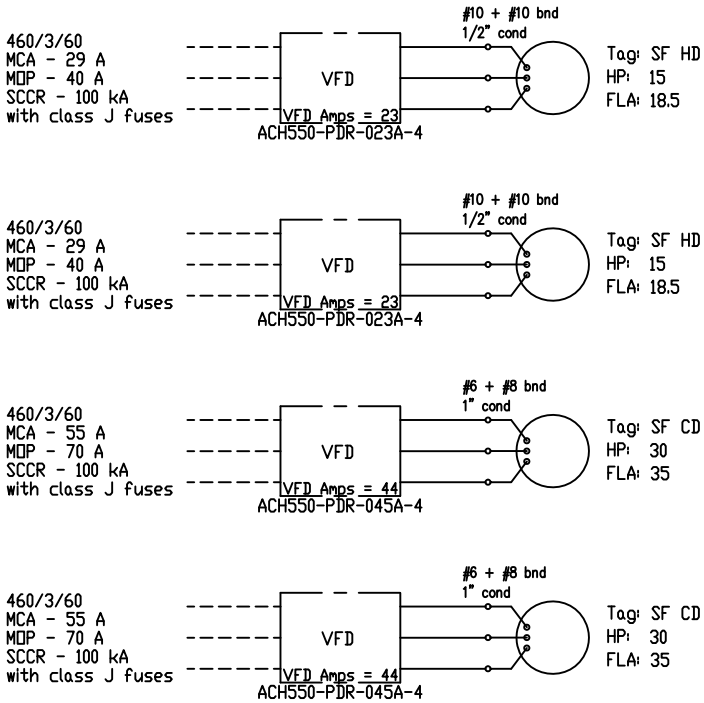
0 24 48 72 96

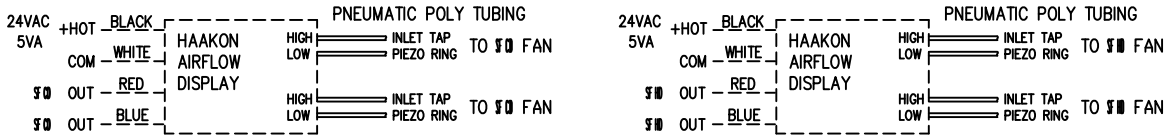
SDG VER: Apr 4 2011

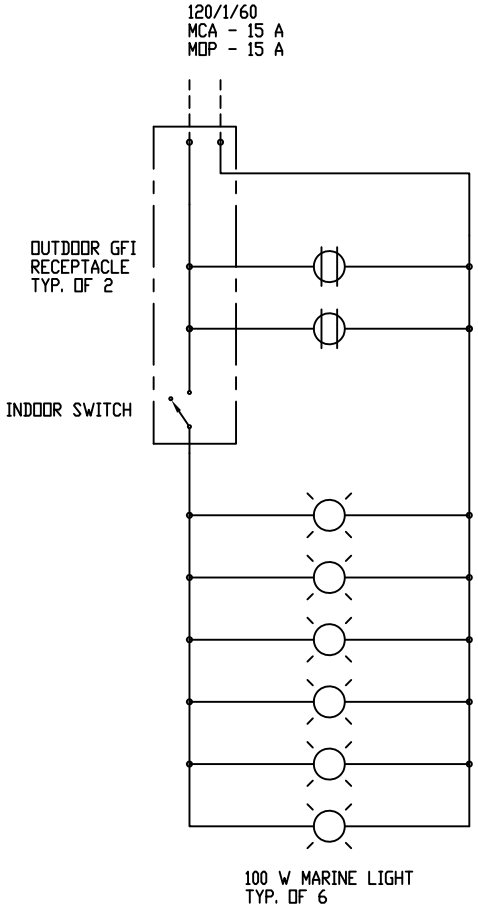
PROJECT	VMC – AHU REPLACEMENT							OPENINGS AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS. RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES.	
JOB NO.	5873	DRAWN BY	DL	DWG NO.	5873U01FP01	ACCESS SIDE	RIGHT	DWG UNITS	IN
TAG	AHU-EP-01	DATE	APR 11/11	TYPE	INDOOR	16:23		SCALE	N.T.S.

SALES OFFICE: CUSTOM MECHANICAL SOLUTIONS
SALES ENGINEER: CRAIG CENTER

HAAKON INDUSTRIES
11851 DYKE ROAD, RICHMOND, B.C. CANADA V7A 4X8







NOTE:

The customer is responsible for obtaining the local inspection authority having jurisdiction to approve the installation.

Because this is a field built-up kit unit, we are unable to put our regular ETL label on this unit. But the motors and each electrical component, wiring, conduit and fitting supplied is certification labeled and sized to meet the code requirements.

MOTOR LOADS ARE PRELIMINARY

——— WIRING BY HAAKON

- - - - - WIRING BY OTHERS

PROJECT	VMC – AHU REPLACEMENT		
JOB NO. 5873	DRAWN BY DL	DWG NO. 5873U01CS01	CERTIFICATION: NONE
TAG AHU-EP-01	DATE APR 8/11	UNIT: INDOOR, NEMA3R INSIDE	CONDUIT: ALRIGID

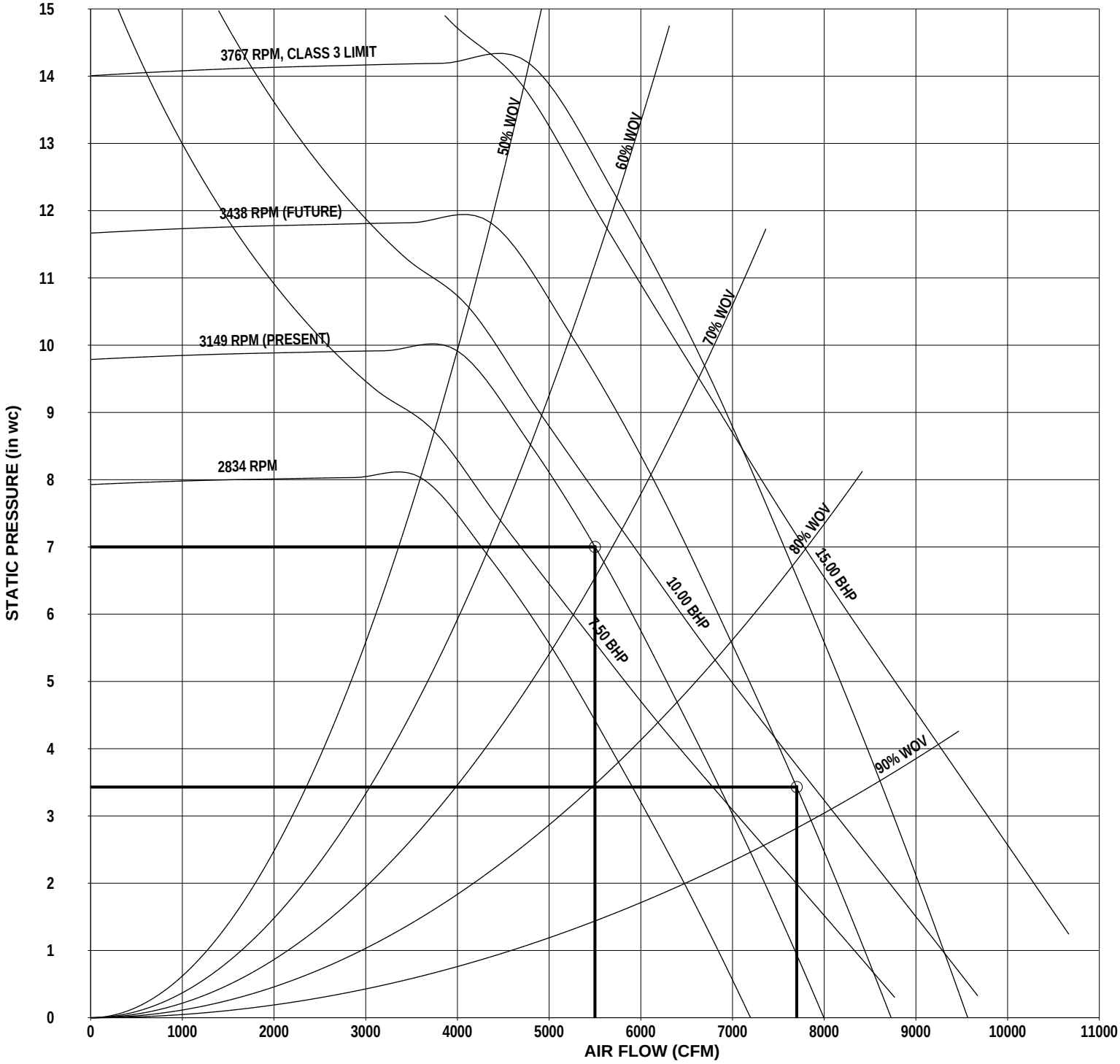
REVISIONS

NO	DATE	BY
1		
2		
3		

HAAKON INDUSTRIES
11851 DYKE ROAD, RICHMOND, B.C. CANADA V7A 4X8

AHU-EP-01SF HD

HOT DECK FANS



FAN SELECTION:

Model 182EPFN, CLASS III
Type :
Width :0.67

OPERATING CONDITIONS:

Required Air Flow : 5500 CFM
Static Pressure : 7 in wc
Future:
Required Air Flow : 7700 CFM
Static Pressure : 3.43 in wc
Site Elevation : SEA LEVEL

PERFORMANCE

Total Static :	7 in wc
Fan RPM :	3149
Brake HP @ Op. Cond.:	9.07
Static Efficiency :	67%
Future:	
Total Static :	3.43 in wc
Fan RPM :	3438
Brake HP @ Op. Cond.:	9.54
Static Efficiency :	44%

SOUND POWER (Inlet/Outlet)

Octave Band	1	2	3	4	5	6	7	8
	89	89	96	101	95	93	89	83
	89	89	96	101	95	93	89	83
Future:								
	93	93	97	105	99	97	95	91
	93	93	97	105	99	97	95	91

Motor Inertia Load : 6 WRsqrd
Inlet Veocity : 2652 FPM
Tip Speed : 15045 FPM

BLADE PASSAGE FREQ 472 Hz

MOTOR DATA:

Rated HP :	15
Frame Size :	215T
Nominal RPM :	3500
Electrical Power :	460/3/60
Enclosure Type :	ODP
Max Inertial Load	0 WRsqrd

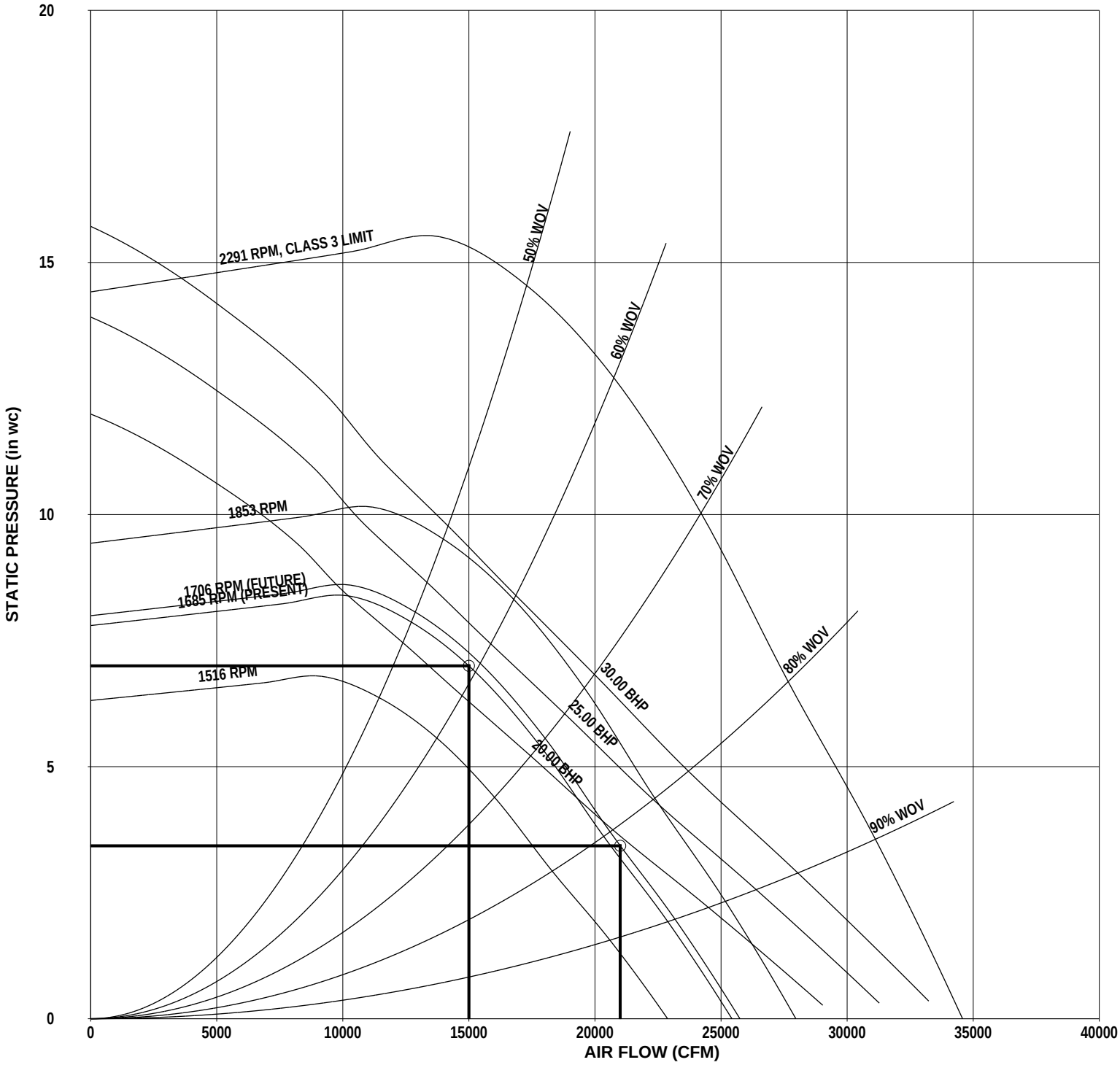
PROJECT: VMC - AHU REPLACEMENT

DRAWN BY	DL	JOB NO.	5873	DWG NO	5873DT10
DATE	2011-04-08	UNITS	IMPERIAL	REVISION	

HAAKON INDUSTRIES

AHU-EP-01SF CD

COLD DECK FANS



FAN SELECTION:

Model 300EPFN, CLASS III
Type :
Width :0.9

OPERATING CONDITIONS:

Required Air Flow : 15000 CFM
Static Pressure : 7 in wc
Future:
Required Air Flow : 21000 CFM
Static Pressure : 3.43 in wc
Site Elevation : SEA LEVEL

PERFORMANCE

Total Static :	7 in wc
Fan RPM :	1685
Brake HP @ Op. Cond.:	22.25
Static Efficiency :	74%
Future:	
Total Static :	3.43 in wc
Fan RPM :	1706
Brake HP @ Op. Cond.:	19.28
Static Efficiency :	59%

SOUND POWER (Inlet/Outlet)

Octave Band

1	2	3	4	5	6	7	8
91	93	100	102	91	88	84	75
91	93	100	102	91	88	84	75
Future:							
88	91	101	104	95	92	87	77
88	91	101	104	95	92	87	77

Motor Inertia Load : 182 WRsqrd
Inlet Veocity : 2750 FPM
Tip Speed : 13234 FPM

BLADE PASSAGE FREQ: 253 Hz

MOTOR DATA:

Rated HP :	30
Frame Size :	286T
Nominal RPM :	1750
Electrical Power :	460/3/60
Enclosure Type :	ODP
Max Inertial Load	0 WRsqrd

PROJECT: VMC - AHU REPLACEMENT

DRAWN BY	DL	JOB NO.	5873	DWG NO	5873DT11
DATE	2011-04-08	UNITS	IMPERIAL	REVISION	

HAAKON INDUSTRIES

AEROFIN Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: HOT DECK
CUSTOMER:
P.O. #:

Date: 4/11/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-6.0-20-53.00-2	239	

DRAWING
Special Drawing Req'd
CIRCUIT
1/4
TOTAL LIST

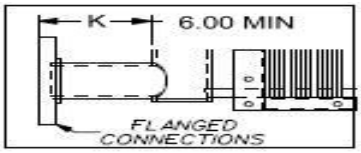
COMPANY INFORMATION

Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

TUBING	
OD	.625
Wall	0.020
Material	Copper
Joints	Brazed
Turbulators	No
Orifices	No
Belled Ends	No
FINS	
Fin Type	Aluminum Wave
Fin Thickness	0.0075
SolderCoated	No

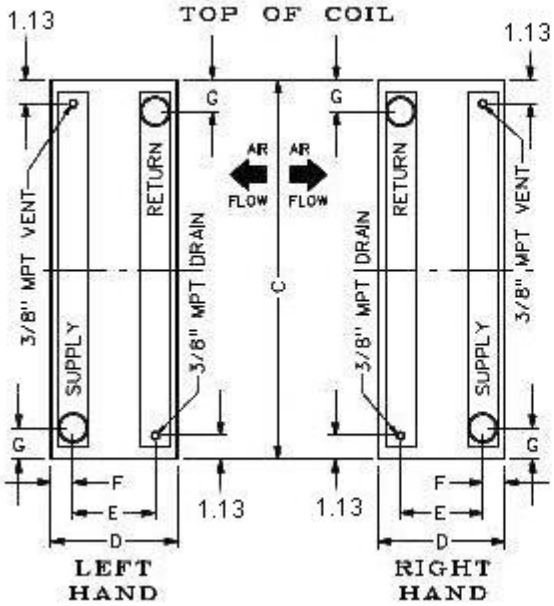
CASING	
Casing Material	Stainless Stl
Casing Leg ("L")	3/4" Leg
Mounting Holes	Yes
HEADER	
Header Schedule	
Header Matl	Carbon Stl

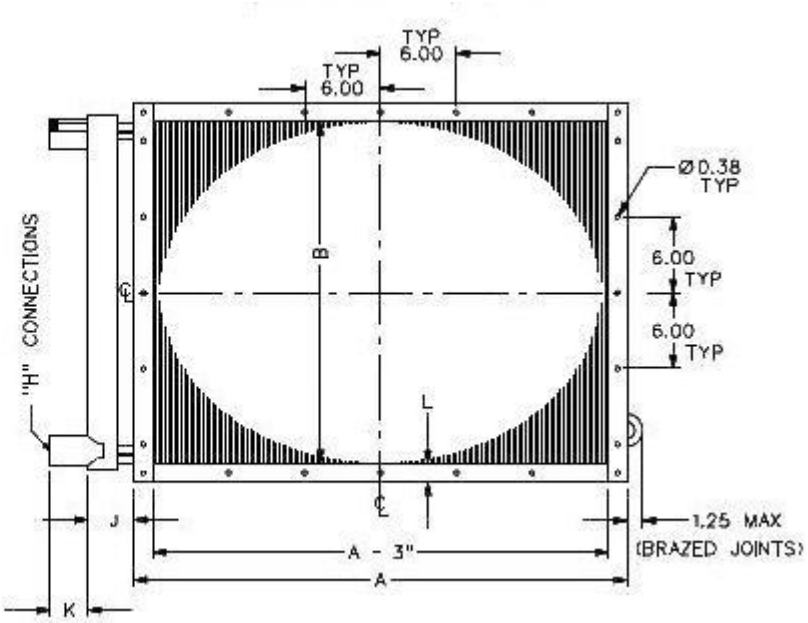
CONNECTIONS	
Connection Type	Victaulic
Flange Class	
Flange Type	
Conn Size("H")	2.00
Conn. Length	8.00



ORIENTATION	
AirFlow Dir.	Horizontal
Hand	Left
ADDITIONAL FEATURES	
Actuator(s)	No
ASME	No
Coating	No
Hydro Test	No
Spray Guard	No

ITEM	A	B	C	D	E	F	G	H	J	K	L
1	56.00	30.00	31.50	0.00	0.00	0.00	1.75	2.00	3.50	8.00	0.75
2											
3											
4											





CONSTRUCTION NOTES:

1. HORIZONTAL & VERTICAL AIR FLOW.
2. COIL HAND MUST BE SPECIFIED.
3. BRAZED JOINTS ONLY.
4. COILS FOR VERTICAL AIR FLOW ARE BUILT RIGHT HAND, PIPE FOR COUNTER FLOW.
5. IF CONN. RADIUS (ACTUAL) EXCEEDS "F" DIM. - HEADER WILL PROTRUDE PAST COIL CASINGS.

COMMENTS:

AEROFIN Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: HOT DECK
CUSTOMER:
P.O. #:

Date: 4/11/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-6.0-20-53.00-2	239	

DRAWING
Special Drawing Req'd

CIRCUIT
1/4

TOTAL LIST

COMPANY INFORMATION
Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

PERFORMANCE		
Pressure	29.92	IN HG
Elevation	Sea Level	FT
Airflow	11,400.00	SCFM
System Face Area	22.10	FT^2
Standard Face Velocity	516.23	FPM
Entering Dry Bulb Temp	42.00	°F
Entering Wet Bulb Temp	41.00	°F
Leaving Dry Bulb Temp	90.00	°F
Leaving Wet Bulb Temp	61.60	°F
Outside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$
Sensible Heat Load	591.12	MBH
Total Heat Load	598.30	MBH
LOSSES		
Air Friction	0.20	IN H2O
Pressure Drop	17.31	FT H2O

Water		
Flow Rate	61.88	GPM
Entering Temp	180.00	°F
Leaving Temp	160.00	°F
Tube Velocity	6.57	FPS
Inside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$

Notes & Warnings:

100 Oversized connection specified.
51 Outside the scope of AHRI standard 410.
46 Total surface not used. Reduce gpm, rows, or fin series.

AEROFIN Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: COLD DECK
CUSTOMER:
P.O. #:

Date: 4/11/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-10.0-27-106.00-8	1,792	

DRAWING
CA-W-109
CIRCUIT
1-1/3
TOTAL LIST

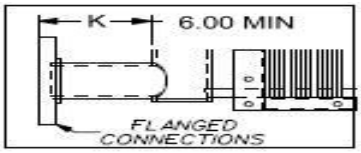
COMPANY INFORMATION

Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

TUBING	
OD	.625
Wall	0.020
Material	Copper
Joints	Brazed
Turbulators	No
Orifices	No
Belled Ends	No
FINS	
Fin Type	Aluminum Wave
Fin Thickness	0.0075
SolderCoated	No

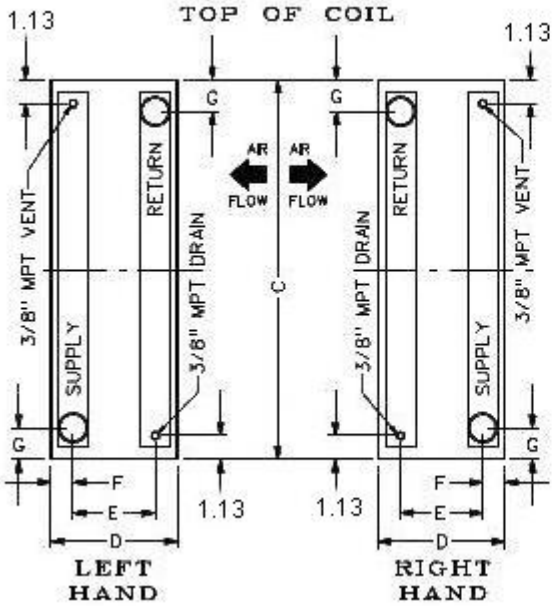
CASING	
Casing Material	Stainless Stl
Casing Leg ("L")	3/4" Leg
Mounting Holes	Yes
HEADER	
Header Schedule	
Header Matl	Carbon Stl

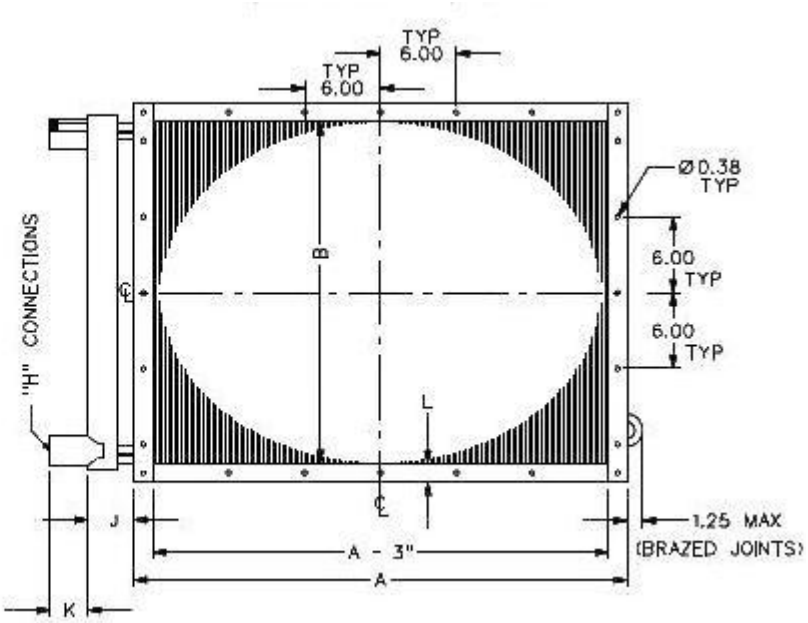
CONNECTIONS	
Connection Type	Victaulic
Flange Class	
Flange Type	
Conn Size("H")	3.00
Conn. Length	8.00



ORIENTATION	
AirFlow Dir.	Horizontal
Hand	Right
ADDITIONAL FEATURES	
Actuator(s)	No
ASME	No
Coating	No
Hydro Test	No
Spray Guard	No

ITEM	A	B	C	D	E	F	G	H	J	K	L
1	109.00	40.50	42.00	12.50	7.80	2.35	2.31	3.00	4.19	8.00	0.75
2											
3											
4											





CONSTRUCTION NOTES:

1. HORIZONTAL & VERTICAL AIR FLOW.
2. COIL HAND MUST BE SPECIFIED.
3. BRAZED JOINTS ONLY.
4. COILS FOR VERTICAL AIR FLOW ARE BUILT RIGHT HAND, PIPE FOR COUNTER FLOW.
5. IF CONN. RADIUS (ACTUAL) EXCEEDS "F" DIM. - HEADER WILL PROTRUDE PAST COIL CASINGS.

COMMENTS:

AEROFIN Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: COLD DECK
CUSTOMER:
P.O. #:

Date: 4/11/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-10.0-27-106.00-8	1,792	

DRAWING
CA-W-109
CIRCUIT
1-1/3
TOTAL LIST

COMPANY INFORMATION

Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

PERFORMANCE		
Pressure	29.92	IN HG
Elevation	Sea Level	FT
Airflow	30,000.00	SCFM
System Face Area	59.60	FT^2
Standard Face Velocity	503.14	FPM
Entering Dry Bulb Temp	89.00	°F
Entering Wet Bulb Temp	69.00	°F
Leaving Dry Bulb Temp	50.00	°F
Leaving Wet Bulb Temp	50.00	°F
Outside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$
Sensible Heat Load	1,264.06	MBH
Total Heat Load	1,715.32	MBH
LOSSES		
Air Friction	1.22	IN H2O
Pressure Drop	16.00	FT H2O

Water		
Flow Rate	285.90	GPM
Entering Temp	44.00	°F
Leaving Temp	56.00	°F
Tube Velocity	4.40	FPS
Inside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$

Notes & Warnings:

100 Oversized connection specified.
56 Rated in accordance with AHRI Standard 410.

AEROFIN
Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: HRC COIL / PRE HEAT
CUSTOMER:
P.O. #:

Date: 3/31/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-6.0-26-119.00-2	612	

DRAWING
CA-W-100
CIRCUIT
Full
TOTAL LIST

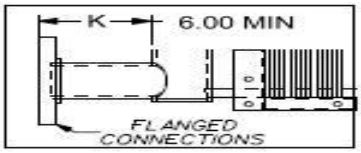
COMPANY INFORMATION

Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

TUBING	
OD	.625
Wall	0.020
Material	Copper
Joints	Brazed
Turbulators	No
Orifices	No
Belled Ends	No
FINS	
Fin Type	Aluminum Wave
Fin Thickness	0.0075
SolderCoated	No

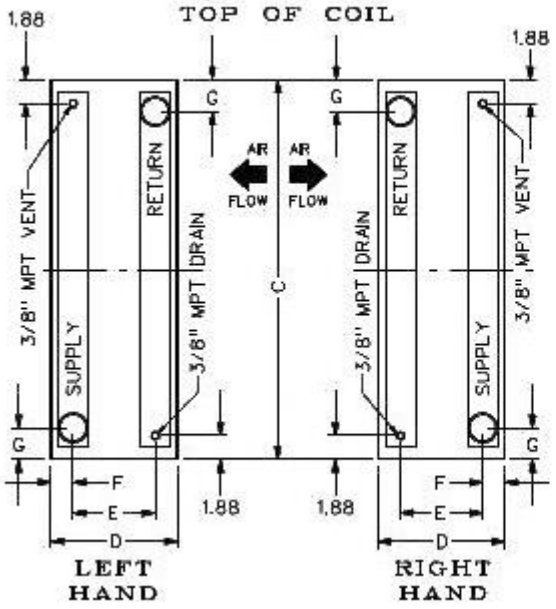
CASING	
Casing Material	Stainless Stl
Casing Leg ("L")	1-1/2" Leg
Mounting Holes	Yes
HEADER	
Header Schedule	
Header Matl	Carbon Stl

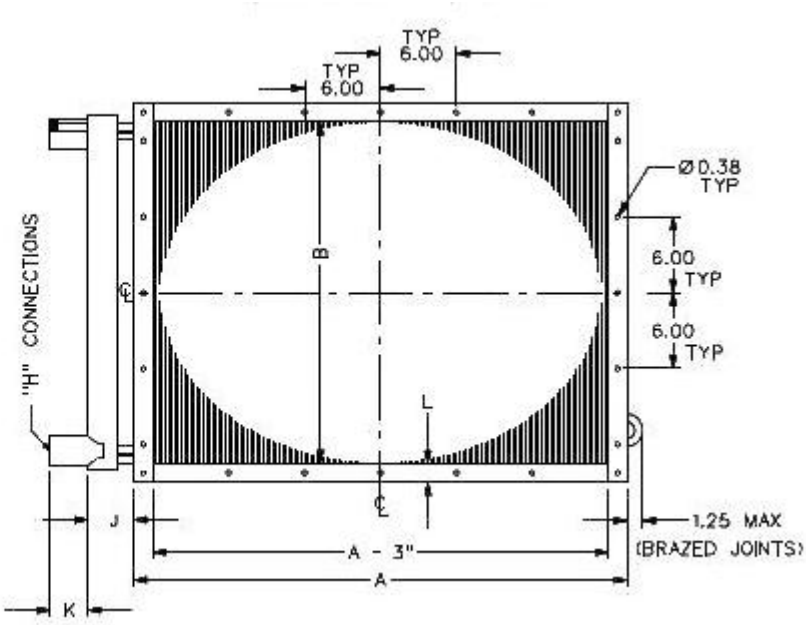
CONNECTIONS	
Connection Type	Victaulic
Flange Class	
Flange Type	
Conn Size("H")	2.50
Conn. Length	3.00



ORIENTATION	
AirFlow Dir.	Horizontal
Hand	Right
ADDITIONAL FEATURES	
Actuator(s)	No
ASME	No
Coating	No
Hydro Test	No
Spray Guard	No

ITEM	A	B	C	D	E	F	G	H	J	K	L
1	122.00	39.00	42.00	6.00	2.96	1.52	2.75	2.50	3.75	3.00	1.50
2											
3											
4											





CONSTRUCTION NOTES:

1. HORIZONTAL AIR FLOW ONLY.
2. COIL HAND MUST BE SPECIFIED.
3. 2 ROW (1/2 & 1/3 CIRCUITS) & 3 ROW (1/2 CIRCUIT) COILS MUST BE DRAINED THRU BOTTOM OF BOTH HEADERS.
4. BRAZED JOINTS ONLY.
5. IF CONN. RADIUS (ACTUAL) EXCEEDS "F" DIM. - HEADER WILL PROTRUDE PAST COIL CASINGS.

COMMENTS:

AEROFIN Heat Transfer Products
P.O. Box 10819
Lynchburg, VA 24506

JOB NAME: VALLEY MED HRC
QUOTE NO:
SYSTEM ID: HRC COIL / PRE HEAT
CUSTOMER:
P.O. #:

Date: 3/31/2011

ITEM	QTY	COIL-FPI-TF-FL-ROWS	DRY WGT. (LBS.)	LIST
1	2	W-6.0-26-119.00-2	612	

DRAWING
CA-W-100
CIRCUIT
Full
TOTAL LIST

COMPANY INFORMATION

Custom Mechanical Solutions
2517 Eastlake Ave East
Suite 200
Seattle,WA 98074
Phone 2069373900

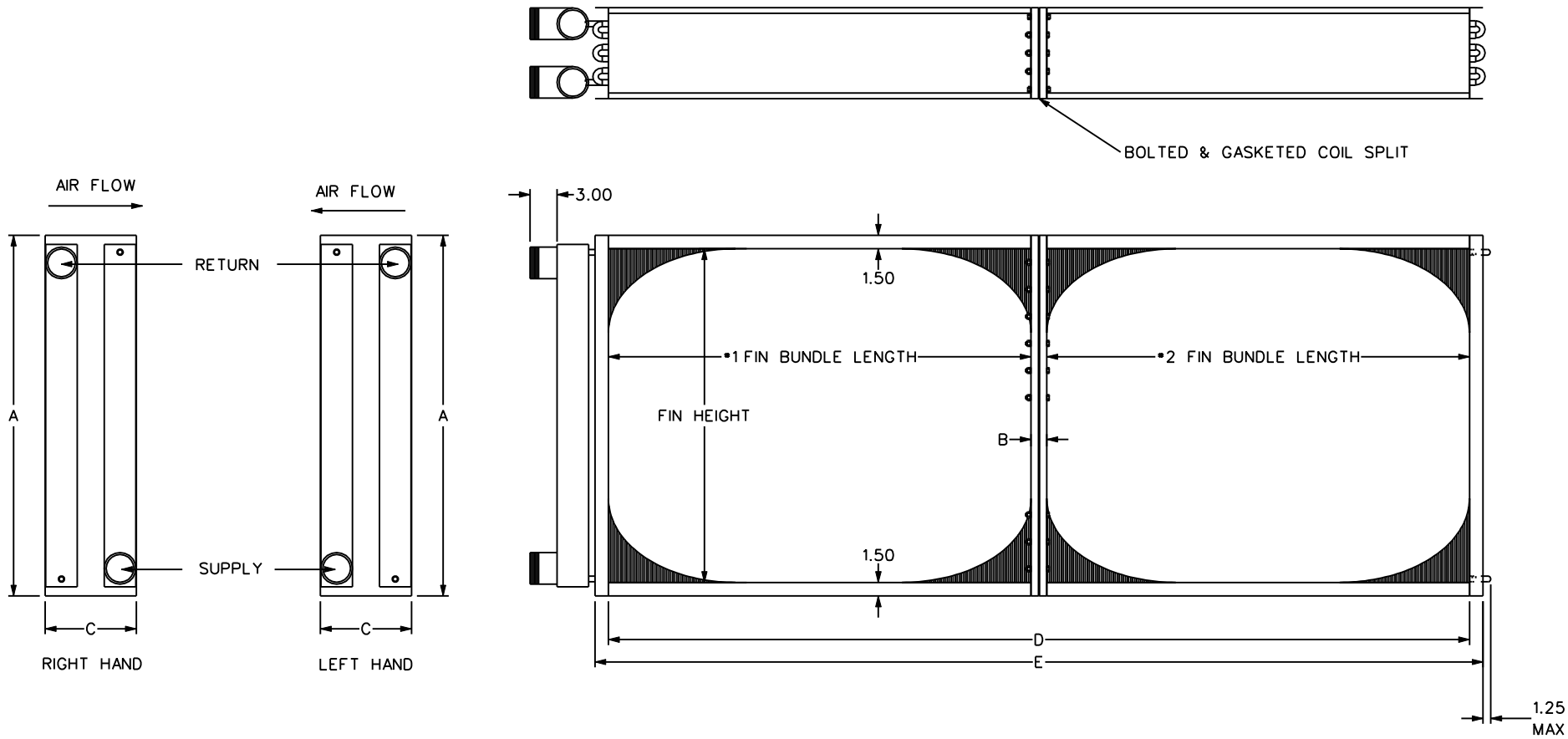
PERFORMANCE		
Pressure	29.92	IN HG
Elevation	Sea Level	FT
Airflow	30,000.00	SCFM
System Face Area	64.50	FT^2
Standard Face Velocity	465.42	FPM
Entering Dry Bulb Temp	20.00	°F
Entering Wet Bulb Temp	19.00	°F
Leaving Dry Bulb Temp	55.00	°F
Leaving Wet Bulb Temp	40.00	°F
Outside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$
Sensible Heat Load	1,132.81	MBH
Total Heat Load	1,140.53	MBH
LOSSES		
Air Friction	0.15	IN H2O
Pressure Drop	2.09	FT H2O

Water		
Flow Rate	117.95	GPM
Entering Temp	180.00	°F
Leaving Temp	160.00	°F
Tube Velocity	2.41	FPS
Inside Surface Fouling	0.00	$HR \cdot FT^2 \cdot °F/BTU$

Notes & Warnings:

51 Outside the scope of AHRI standard 410.
46 Total surface not used. Reduce gpm, rows, or fin series.

HRC / PRE-HEAT COIL ONLY



A = FINNED HEIGHT + 3.00"
B = 1.625" (APPROXIMATE)
C = TBD (BASED ON THE NUMBER OF ROWS)
D = #1 FIN BUNDLE LENGTH + #2 FIN BUNDLE LENGTH + B
E = D + 3.00"

NOTES:
1. DIMENSIONS ARE APPROXIMATE. OTHER DIMENSIONS TO BE DETERMINED.
2. NOT TO SCALE.
3. COIL TESTED AND SHIPPED AS ONE PIECE.
4. SPARE GASKET(S) SHIPPED LOOSE TO BE USED UPON INSTALLATION IF NECESSARY.

TOLERANCE
1. CONNECTION & HEADER LOCATIONS = ± .250
2. CASING DIMENSIONS = ± .125
(ALL DIMENSIONS ARE IN INCHES)

NO	REVISION	DATE	DR	ENG
A	CHECKED	8-18-09	RAM	

ENERGY FLOW by AEROFIN

TITLE: TYPE "W" COIL
SPECIAL TWO SECTION COIL
HORIZONTAL AIRFLOW

DWG.NO. SPLIT-FIT

VARIABLE FREQUENCY DRIVES

ABB
ACH550 SERIES
ADJUSTABLE SPEED AC DRIVES
SUBMITTAL

JOB #: 5873

JOB NAME: VMC - AHU Replacement

QTY	UNIT TAG	HP	OUTPUT AMPS	MODEL	DIMENSION DRAWING	POWER DRAWING	CONNECTION DRAWING
2	AHU-EP-01 RF	15	623	ACH550-PDR-023A-4	3AUA000008218	PD00R016PW-A	PCPDR014CC-A
2	AHU-EP-01 SF	30	44	ACH550-PDR-045A-4	3AUA000008220	PD00R016PW-A	PCPDR014CC-A

All of the above include the following:

- Voltage: 460/3/60
- Short circuit current rating: 100kA, 600V Max with Class J Fuses
- Input Disconnect Switch
- Drive Input Fuses
- 5% Input Line Impedance with Input Line Reactors
- EMI / RFI Filter
- Nema 1 Enclosure

ACH550 Product Overview

Description

The ACH550 series is a microprocessor based Pulse Width Modulated (PWM) adjustable speed AC drive. The ACH550 drive takes advantage of sophisticated microprocessor control and advanced IGBT power switching technology to deliver high-performance control of AC motors for a wide range of HVAC applications.

With drives ranging from 1 to 550 HP, the ACH550 series features a universal full graphic interface that “speaks” to the operator in plain English phrases, greatly simplifying set-up, operation, and fault diagnosis. The ACH550 is also programmable in fourteen other languages.

Each ACH550 drive comes equipped with an extensive library of pre-programmed HVAC application macros which, at a touch of a button, allow rapid configuration of inputs, outputs, and performance parameters for specific HVAC applications to maximize convenience and minimize start-up time. The ACH550 series can handle the most demanding commercial applications in an efficient, dependable, and economic manner.

ACH550 Standard Features

- UL, cUL labeled and CE marked
- EMI/RFI Filter (1st Environment, Restricted Distribution)
- Start-Up Assistants
- Maintenance Assistants
- Diagnostic Assistants
- Real Time Clock
  - Includes Day, Date and Time
- Operator Panel Parameter Backup (read/write)
- Full Graphic and Multilingual Display for Operator Control, Parameter Set-Up and Operating
  - Data Display:
    - Output Frequency (Hz)
    - Speed (RPM)
    - Motor Current
    - Calculated % Motor Torque
    - Calculated Motor Power (kW)
    - DC Bus Voltage
    - Output Voltage
    - Heatsink Temperature
    - Elapsed Time Meter (reset-able)
    - KWh (reset-able)
    - Input / Output Terminal Monitor
    - PID Actual Value (Feedback) & Error
    - Fault Text
    - Warning Text
    - Three (3) Scalable Process Variable Displays
    - User Definable Engineering Units
- Two (2) Programmable Analog Inputs
- Six (6) Programmable Digital Inputs
- Two (2) Programmable Analog Outputs
- Up to six (6) Programmable Relay Outputs (Three (3) Standard)
- Adjustable Filters on Analog Inputs and Outputs
- Mathematical Functions on Analog Reference Signals
- All Control Inputs Isolated from Ground and Power
- Four (4) Resident Serial Communication Protocols
  - Johnson Controls N2
  - Siemens Building Technologies FLN (P1)
  - Modbus RTU
  - BACnet (MS/TP)
- Input Speed Signals
  - Current 0 (4) to 20 mA
  - Voltage 0 (2) to 10 VDC
  - Increase/Decrease Reference Contacts (Floating Point)
  - Serial Communications
- Start/Stop
  - 2 Wire (Dry Contact Closure)
  - 3 Wire (Momentary Contact)
  - Application of Input Power
  - Application of Reference Signal (PID Sleep/Wake-Up)
  - Serial Communications
- Start Functions
  - Ramp
  - Flying Start
  - Premagnetization on Start
  - Automatic Torque Boost
  - Automatic Torque Boost with Flying Start
  - Auto Restart (Reset) – Customer Selectable and Adjustable
- Stop Functions
  - Ramp or Coast to Stop
  - Emergency Stop
  - DC Braking / Hold at Stop
  - Flux Braking
- Accel/Decel
  - Two (2) sets of Independently Ramps
  - Linear or Adjustable ‘S’ Curve Accel/Decel Ramps
- HVAC Specific Application Macros
- Separate Safeties (2) and Run Permissive Inputs
- Damper Control
- Override Input (Fire Mode)
- Timer Functions
  - Four (4) Daily Start/Stop Time Periods
  - Four (4) Weekly Start/Stop Time Periods
  - Four Timers for Collecting Time Periods and Overrides
- Seven (7) Preset Speeds
- Supervision Functions
- Adjustable Current Limit
- Electronic Reverse
- Automatic Extended Power Loss Ride Through (Selectable)
- Programmable Maximum Frequency to 500 Hz
- PID Control
  - Two (2) Integral Independent Programmable PID Setpoint Controllers (Process and External)
  - External Selection between Two (2) Sets of Process
    - PID Controller Parameters
  - PID Sleep/Wake-Up
- Motor Control Features
  - Scalar (V/Hz) and Vector Modes of Motor Control
  - V/Hz Shapes
    - Linear
    - Squared
  - Energy Optimization
  - IR Compensation
  - Slip Compensation
  - Three (3) Critical Frequency Lockout Bands
- Preprogrammed Protection Circuits
  - Overcurrent
  - Short Circuit
  - Ground Fault
  - Overvoltage
  - Undervoltage
    - Input Phase Loss
  - Output Device (IGBT) Overtemperature
  - Adjustable Current Limit Regulator
  - UL508C approved Electronic Motor Overload (I^2T)
- Programmable Fault Functions for Protection Include
  - Loss of Analog Input
  - Panel Loss
  - External Fault
  - Motor Thermal Protection
  - Stall
  - Underload
  - Motor Phase Loss
  - Ground Fault
- 5% Input Impedance
  - Equivalent 5% Impedance with Internal Reactor(s)
  - Patented Swinging Choke Design for Superior Harmonic Mitigation (R1 to R4)

OPTIONAL FEATURES

- 3 Relay Extension Module (OREL-01)
- 115/230 V Digital input Interface Card (OHDI-01)
- Fieldbus Adapter Modules
  - LonWorks
  - Profibus
  - Ethernet
- DriveWindow Light Start-up, Operation, Programming and Diagnostic Tool
- Fan Replacement Kit

ACH550 Specifications

Input Connection

Input Voltage (U_1)..... 208/220/230/240 VAC 3-phase +/-10%
208/220/230/240 VAC 1-phase +/-10%
380/400/415/440/460/480 VAC 3-phase +/-10%
500/600 VAC 3-phase +/-10%
Frequency: ..... 48 - 63 Hz
Line Limitations: ..... Max +/-3% of nominal phase to phase input voltage
Fundamental Power Factor (cos φ): ..... 0.98 at nominal load
Connection: ..... U_1, V_1, W_1 (U_1, V_1, 1-phase)
Output (Motor) Connection
Output Voltage: ..... 0 to U_1, 3-phase symmetrical, U_2 at the field weakening point
Output Frequency: ..... -500 to 500 Hz
Frequency Resolution: ..... 0.01 Hz
Continuous Output Current:
Variable Torque: ..... 1.0 * I_{2N} (Nominal rated output current, Variable Torque)
Short Term Overload Capacity:
Variable Torque: ..... 1.1 * I_{2N}, (1 min/10 min)
Peak Overload Capacity:
Variable Torque: ..... 1.35 * I_{2N}, (2 sec/1 min)
Base Motor Frequency Range: ..... 10 to 500 Hz
Switching Frequency: ..... 1, 4, 8 or 12 kHz
Acceleration Time: ..... 0.1 to 1800 s
Deceleration Time: ..... 0.1 to 1800 s
Efficiency: ..... 0.98 at nominal power level
Short Circuit Withstand Rating: ..... 100,000 AIC (UL) w/o fuses
Connection: ..... U_2, V_2, W_2
Enclosure
Style: ..... UL (NEMA) Type 1, Type 12, or Type 3R
UL Plenum Rated Type 1, Type 12
Agency Approval
Listing and Compliance:..... UL, cUL, CE

Ambient Conditions, Operation

Air Temperature: ..... 0^0 to 40^0C (32^0 to 104^0F), above 40^0C the maximum output current is de-rated 1% for every additional 1^0C (up to 50^0C (122^0F)) maximum limit.
Relative Humidity: ..... 5 to 95%, no condensation allowed, maximum relative humidity is 60% in the presence of corrosive gasses
Contamination Levels:
IEC:..... 60721-3-1, 60721-3-2 and 60721-3-3
Chemical Gasses:..... 3C1 and 3C2
Solid Particles: 3S2
Installation Site Altitude:..... 0 to 1000 m (3300 ft) above sea level. At sites over 1000 m (3300 ft) above sea level, the maximum power is de-rated 1% for every additional 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or representative for further information
Vibration:..... Max 3.0 mm (0.12 in) 2 to 9 Hz, Max 10 m/s^2 (33 ft/s^2) 9 to 200 Hz sinusoidal

Ambient Conditions, Storage (in Protective Shipping Package)

Air Temperature:.....-40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity:.....Less than 95%, no condensation allowed
Vibration Tested to (IEC 60068-2-6):.....In accordance with ISTA 1A and 1B specifications
Bump Tested to (IEC 60068-2-29):.....Max 100 m/s^2 (330 ft/s^2) 11 ms (Tested 500 times each axis, each pole; 3000 times total)

Ambient Conditions, Transportation (in Protective Shipping Package)

Air Temperature:..... -40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity:.....Less than 95%, no condensation allowed
Atmospheric Pressure:.....60 to 106 kPa (8.7 to 15.4 PSI)
Vibration Tested to (IEC 60068-2-6):.....Max 3.0 mm (0.14 in) 2 to 9 Hz, Max 15 m/s^2 (49 ft/s^2) 9 to 200 Hz sinusoidal
Bump Tested to (IEC 60068-2-29):.....Max 100 m/s^2 (330 ft/s^2) 11 ms (Tested 500 times each axis, each pole; 3000 times total)
Shock Tested to (IEC 60068-2-27)
R1: 76 cm (30 in) R2: 61 cm (24 in) R3: 46 cm (18 in) R4: 31 cm (12 in) R5 & 6: 25 cm (10 in)

ACH550 Specifications (continued)

Cooling Information

Cooling Method: ..... Integral fan(s)
Power Loss: ..... Approximately 3% of rated power

Analog Inputs

Quantity ..... Two (2) programmable
Voltage Reference: ..... 0 (2) to 10 V, 250kOhm, single ended
Current Reference: ..... 0 (4) to 20 mA, 100Ohm, single ended
Potentiometer: ..... 10 VDC, 10 mA (1K to 10KOhms)
Input Updating Time ..... 8 ms
Terminal Block Size ..... 2.3mm^2 / 14AWG

Reference Power Supply

Reference Voltage ..... +10 VDC, 1% at 25^{0}C (77^{0}F)
Maximum Load ..... 10 mA
Applicable Potentiometer ..... 1 kOhm to 10 kOhm
Terminal Block Size ..... 2.3mm^2 / 14AWG

Analog Outputs

Quantity ..... Two (2) programmable current outputs
Signal Level ..... 0 (4) to 20 mA
Accuracy ..... +/- 1% full scale range at 25^{0}C (77^{0}F)
Maximum Load Impedance ..... 500 Ohms
Output Updating Time ..... 2 ms
Terminal Block Size ..... 2.3mm^2 / 14AWG

Digital Inputs

Quantity ..... Six (6) programmable digital inputs
Isolation ..... Isolated as one group
Signal Level ..... 24 VDC, (10V Logic 0)
Input Current ..... 15 mA at 24 VDC
Input Updating Time: ..... 4 ms
Terminal Block Size ..... 2.3mm^2 / 14AWG

Internal Power Supply

Primary Use ..... Internal supply for digital inputs
Voltage: ..... +24 VDC, max 250 mA
Maximum Current: ..... 250 mA
Protection: ..... Short circuit protected

Relay Outputs

Quantity ..... Three (3) programmable relay (Form C) outputs
Switching Capacity: ..... 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC
Max Continuous Current: ..... 2A RMS
Contact Material: ..... Silver Cadmium Oxide (AgCdO)
Isolation Test Voltage ..... 4 kVAC, 1 minute
Output Updating Time ..... 12 ms
Terminal Block Size ..... 2.3mm^2 / 14AWG

Protections

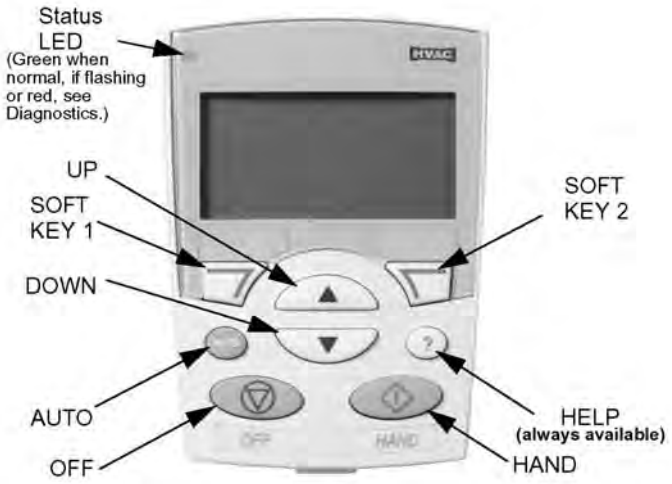
Single Phase ..... Protected (input & output)
Overcurrent Trip Limit: ..... 3.5 x I_{2N} instantaneous
Adjustable Current Regulation Limit: ..... 1.1 x I_{2N} (RMS) max.
Overvoltage Trip Limit: ..... 1.30 x U_N
Undervoltage Trip Limit: ..... 0.65 x U_N
Overtemperature (Heatsink): ..... +115°C (+239°F)
Auxiliary Voltage: ..... Short Circuit Protected
Ground Fault: ..... Protected
Short Circuit: ..... Protected
Microprocessor fault: ..... Protected
Motor Stall Protection: ..... Protected
Motor Overtemperature Protection (I^2t): ..... Protected
Input Power Loss of Phase: ..... Protected
Loss of Reference: ..... Protected
Short Circuit Current Rating: ..... 100,000 RMS symmetrical Amperes
Input Line Impedance: ..... Swinging choke 5% equivalent R1-R6, 3% equivalent R8

U_1 = Input Voltage
U_2 = Output Voltage
P_N = Power – Normal Duty (HP)
U_N = Nominal Motor Voltage
f_N = Nominal Motor Frequency
I_{2N} = Nominal Motor Current – Normal Duty

Specifications are subject to change without notice. Please consult the factory when specifications are critical.

ACH550 Control Panel

The ACH550 Control Panel is a multifunction control panel with full graphic LCD display and multiple language capability. The control panel can be connected to and detached from the ACH550 at any time. The panel can be used to upload and copy parameters to other ACH550 drives.



Run Indication and Shaft Direction

Control Panel Display	Significance
Rotating arrow (clockwise or counterclockwise)	Drive is running and at set point Shaft direction is forward or reverse
Rotating arrow blinking	Drive is operating but not at setpoint
Stationary arrow	Drive is stopped

LED Indicators

The green LED indicates that the power is on and the drive is operating normally. The red LED indicates a fault. A blinking green LED indicates an alarm condition. A blinking red LED indicates a fault that requires power to be cycled off and on to reset the drive.

Fault Indications

The ACH550 Control Panel can display over 20 alarm and fault messages. The last fault and previous faults (1 to 9) are retained in memory. The last fault and previous faults (1 & 2) also record important diagnostic information to assist in troubleshooting. Most faults can be reset by pressing the RESET key (Soft Key 1).

Parameters

Application specific parameters are immediately accessible through a selection of start-up “Assistants”. A complete list of parameters is also available grouped by function in approximately 33 menu groups. One of the basic menu functions can be used to display the complete list of changed parameters.

Real Time Clock

The Operator Control Panel includes a real time clock which provides Day, Date and Time information, displayed in a choice of formats. The real time clock has a 10 year battery back up and provides time and date stamping of drive faults and other events. The clock is also used by the ACH550s internal timer functions, providing an integral time clock for start/stop control as well
as other control operations.

Control Modes

When the HAND key is pressed, the drive starts and pressing the UP/DOWN keys can modify the reference frequency. The HAND (keypad) control mode is indicated.

When the OFF key is pressed, the drive stops and the OFF control mode is indicated.

When the AUTO key is pressed, the AUTO control mode is indicated. The drive can be started and stopped using whichever remote start/stop command has been configured, a contact closure applied to the start/stop input, a serial communication command or a process feedback signal. In AUTO mode the drive speed is typically controlled by the external speed reference input or by the PID controller.

If the HAND key is pressed while the drive is running in the AUTO control mode, the drive continues to run without changing speed, but ceases to respond to external input or PID speed reference changes. (Bumpless transfer) Pressing the UP/DOWN keys can modify the reference frequency.

If the AUTO key is pressed while the drive is running in the HAND control mode and an external start command is present, the drive continues to run and follows the acceleration or deceleration control ramp to the speed set by the external input or PID speed reference. (Bumpless transfer)

Cable Connections

Terminal	Description	Note
U1, V1, W1	3~ power supply input	Use of 1~ supply requires 50% derate of output current and is applicable for 208 to 240 VAC operation only.
PE / GND	Protective Ground	Follow local rules for cable size.
U2, V2, W2	Power output to motor	
Uc+, Uc-	DC bus	
X1 1 to 18	Control Wiring	Low voltage control – Use shielded cable
X1 19 to 27	Control Wiring	Low voltage or 115VAC
X1 28 to 32	Serial Communications	Use shielded cable

Follow local codes for cable size. To avoid electromagnetic interference, use separate metallic conduits for input power wiring, motor wiring, control and communications wiring. Keep these four classes of wiring separated in situations where the wiring is not enclosed in metallic conduit. Also, keep 115VAC control wiring separated from low voltage control wiring and power wiring.

Use shielded cable for control wiring.

Ampacity is based on the use of 60 °C rated power cable up to 100 Amps (75 °C over 100 Amps).

Refer to the included tables for current ratings, fuse recommendations and maximum wire size capacities and tightening torques for the terminals. The ACH550 is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 480 V maximum. The ACH550 has an electronic motor protection feature that complies with the requirements of the National Electric Code (NEC). When this feature is selected and properly adjusted. Additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations.

For CE installation requirements, see ABB publication CE-US-02 “CE Council Directives and Variable Speed Drives.” Contact your local ABB representative for specific IEC installation instructions.

ACH550 Control Terminals - Main I/O Terminal X1

X1	Identification	Description	
1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)	
2	AI 1	Analog input channel 1, programmable. Resolution 0.1 % accuracy ±1 %. Default: 0 (4) - 20 mA (R_i = 500 Ω) (J1:AI1 ON) 0 (2) - 10 V (R_i = 200 kΩ) (J1:AI1 OFF) External reference	
3	AGND	Analog input common. (Connected internally to chassis ground through 1 M Ω)	
4	10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2 %.	
5	AI 2	Analog input channel 2, programmable. Resolution 0.1 % accuracy ±1 %. Default: 0 (4) - 20 mA (R_i = 500 Ω) (J1:AI2 ON) 0 (2) - 10 V (R_i = 200 k Ω) (J1:AI2 OFF) PID Feedback	
6	AGND	Analog input common. (Connected internally to chassis ground through 1 M Ω)	
7	AO1	Analog output channel 1, programmable. Default: 0 (4) - 20 mA (load < 500 Ω) Output frequency	
8	AO2	Analog output channel 2, programmable. Default: 0 (4) - 20 mA (load < 500 Ω) Output current	
9	AGND	Analog output common. Connected internally to chassis ground through 1 M Ω)	
10	24 V	Auxiliary voltage output 24 V DC / 250 mA (Reference to AGND). Short circuit protected.	
11	GND	Common for digital input (DI) return signals.	
12	DCOM	Digital input circuit common for all digital inputs (DIs).	
DI Configuration		To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1:10) or by an external 12-24 V source of either polarity.	
13	DI 1	AUTO mode Start/Stop: Activation starts the drive	
14	DI 2	Not used	
15	DI 3	Constant speed 1: Activation selects constant speed 1	
16	DI 4	Start enable 1: Deactivation stops the drive.	
17	DI 5	Not used	
18	DI 6	Not used	
19	RO1C	Common	Relay output 1, programmable (Default: Ready - 19 connected to 21). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
20	RO1A	Normally Closed (NC)	
21	RO1B	Normally Open (NO)	
22	RO2C	Common	Relay output 2, programmable (Default: Running - 22 connected to 24). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
23	RO2A	Normally Closed (NC)	
24	RO2B	Normally Open (NO)	
25	RO3C	Common	Relay output 3, programmable (Default: Fault(-1) - 25 connected to 27). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
26	RO3A	Normally Closed (NC)	
27	RO3B	Normally Open (NO)	
28	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	
29	B	RS-485 Serial Communications Positive input connection	
30	A	RS-485 Serial Communications Negative input connection	
31	AGND	Analog input common. (Connected internally to chassis ground through 1 M Ω.)	
32	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	

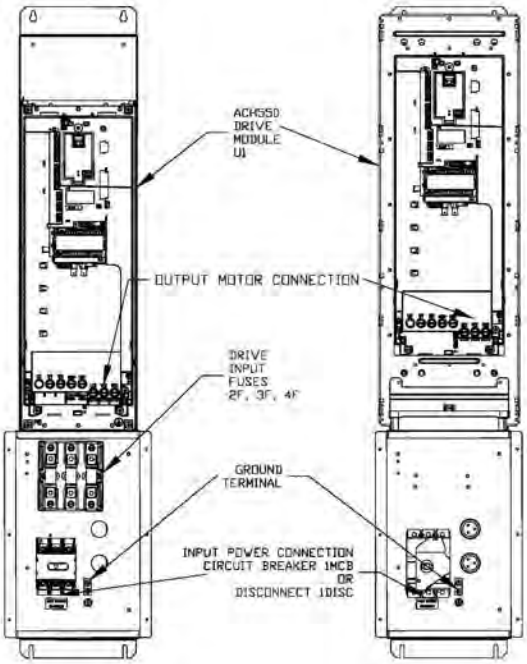
Notes: Digital input impedance 1.5 k Use multi-strand wire, size range: 20-16 AWG (0.5-1.5 mm^2) For fail-safe reasons, the Fault (-1) Relay signals a “Fault”, when the ACH550 is powered down.

Drive Pack Standard Features

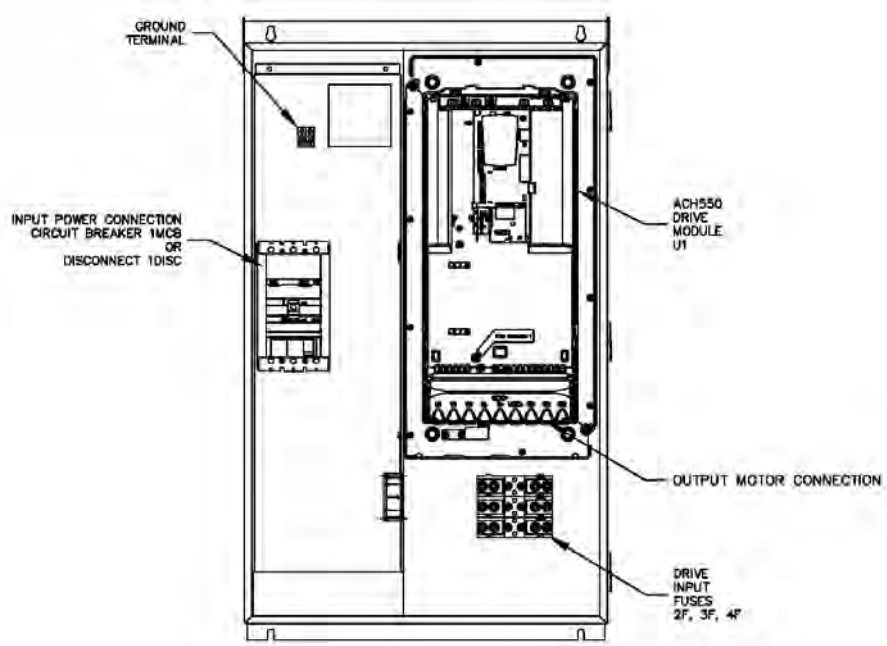
The ACH500 Drive Pack is and ACH550 Variable Frequency Drive enclosed with either an input disconnect switch and fast acting fuses (ACH550-PDR) or an input circuit breaker (ACH550-PCR). The ACH550 Drive Pack provides a door-mounted input disconnect operator (padlockable in the OFF position), electronic motor overload protection, local operator keypad with graphics display, and provisions for external control connections.

Cable Connections

The following illustrations show the ACH550 Drive Pack cable connection points for the various enclosure styles. The illustrations indicate the location of input and output power connections as well as equipment and motor grounding connection points. At least three separate metallic conduits are required, one for input power, one for output power to the motor and one for control signals.



Vertical Wall Mount Drive Pack Internal Views



Standard Wall Mount Drive Pack Internal View

Terminal Sizes

The following tables list power and motor cable terminal sizes for connections to an input circuit breaker or disconnect switch, a motor terminal block and ground lugs. The tables also list the torque that should be applied when tightening the terminals. Maximum recommended wire size capacity of the control terminals is #14, torque to 4 in/lbs.

208 VOLT DRIVES

Model	**Maximum Wire Size Capacity of Power Terminals**			
ACH-550-PxR-	Circuit Breaker	Disconnect Switch	Motor Terminal Block	Ground Lugs
04A6-2	# 10 35 in-lbs	# 10 7 in-lbs	# 10 12 in-lbs	# 10 40 in-lbs
06A6-2				
07A5-2				
012A-2				
017A-2				
024A-2	# 6 45 in-lbs	# 8 7 in-lbs	# 6 12 in-lbs	# 6 35 in-lbs
031A-2				
046A-2	# 3 50 in-lbs	# 4 18 in-lbs	# 3 24 in-lbs	# 3 50 in-lbs
059A-2				
075A-2	# 1 (50 in-lbs)	# 1 (55in-lbs)	# 1 (48 in-lbs)	# 2 50 in-lbs
088A-2	350 MCM 274 in-lbs	# 1/0 (70 in-lbs)	# 1/0 70 in-lbs	
114A-2		300 MCM 275 in-lbs		
143A-2			350 MCM 360 in-lbs	3 x # 3/0 250 in-lbs
178A-2				
221A-2	2 x 250 MCM 274 in-lbs	2 x 250 MCM 274 in-lbs		
248A-2				

460 VOLT DRIVES

Model	**Maximum Wire Size Capacity of Power Terminals**			
ACH-550-PxR-	Circuit Breaker	Disconnect Switch	Motor Terminal Block	Ground Lugs
03A3-4	# 10 35 in-lbs	# 10 7 in-lbs	# 10 12 in-lbs	# 10 35 in-lbs
04A1-4				
06A9-4				
08A8-4				
012A-4				
015A-4	# 6 45 in-lbs	# 8 62 in-lbs	# 6 12 in-lbs	# 6 35 in-lbs
023A-4				
031A-4	# 3 50 in-lbs		# 3 24 in-lbs	# 3 50 in-lbs
038A-4		# 4 18 in-lbs		
045A-4				
059A-4	# 1 50 in-lbs		# 1 50 in-lbs	# 1 50 in-lbs
072A-4		# 1 (55 in-lbs)		
078A-4		# 1/0 (62 in-lbs)		
097A-4	350 MCM 274 in-lbs	# 1/0 (70 in-lbs)	# 1/0 (48 in-lbs)	3 x # 3/0 250 in-lbs
125A-4		300 MCM 275 in-lbs	# 2/0 (132 in-lbs)	
157A-4			350 MCM 360 in-lbs)	
180A-4				
246A-4	2 x 250 MCM 274 in-lbs	2 x 250 MCM 275 in-lbs		

600 VOLT DRIVES

<table>
<tr><th>Model</th><th colspan="4">Maximum Wire Size Capacity of Power Terminals</th></tr>
<tr><td>ACH-550-PxR-</td><td>Circuit Breaker</td><td>Disconnect Switch</td><td>Motor Terminal Block</td><td>Ground Lugs</td></tr>
<tr><td>02A7-6</td><td rowspan="6">#6
62 in-lbs</td><td rowspan="8">#8
7 in-lbs</td><td rowspan="6">#6
30 in-lbs</td><td rowspan="6">#6
35 in-lbs</td></tr>
<tr><td>03A9-6</td></tr>
<tr><td>06A1-6</td></tr>
<tr><td>09A0-6</td></tr>
<tr><td>011A-6</td></tr>
<tr><td>017A-6</td></tr>
<tr><td>022A-6</td><td rowspan="2">#3
62 in-lbs</td><td rowspan="2">#3
24 in-lbs</td><td rowspan="2">#3
50 in-lbs</td></tr>
<tr><td>027A-6</td></tr>
<tr><td>032A-6</td><td rowspan="4">#1
62 in-lbs</td><td rowspan="2">#4
18 in-lbs</td><td rowspan="4">#1
48 in-lbs</td><td rowspan="4">#2
50 in-lbs</td></tr>
<tr><td>041A-6</td></tr>
<tr><td>052A-6</td><td>#1 (55 in-lbs)</td></tr>
<tr><td>062A-6</td><td>#1 (62 in-lbs)</td></tr>
<tr><td>077A-6</td><td rowspan="4">350 MCM
274 in-lbs</td><td rowspan="2">#1/0
70 in-lbs</td><td rowspan="4">350 MCM
360 in-lbs</td><td rowspan="4">3 x #3/0
250 in-lbs</td></tr>
<tr><td>099A-6</td></tr>
<tr><td>125A-6</td><td rowspan="2">300 MCM
275 in-lbs</td></tr>
<tr><td>144A-6</td></tr>
</table>

Branch Circuit Protection

Input power is connected to the ACH550 with E-Clipse Bypass through a door interlocked disconnect switch or circuit breaker. Neither of these inputs are fused. The branch circuit that provides power to the ACH550 with E-Clipse Bypass must include appropriate motor branch circuit protective devices to provide short circuit and ground fault protection for the motor in the bypass mode.

Drive input fuses are provided to disconnect the drive from power in the event that a component fails in the drive's power circuitry. Since fast-acting fuses are provided, the branch circuit protection will not clear when the drive input fuses blow. If the drive input fuses blow, the motor can be switched to Bypass without replacing fuses or resetting a circuit breaker. Replacement drive input fuse specifications are listed in the following tables. Fuses from other manufacturers can be used if they meet the ratings given in the table. The fuses recommended in the table are UL recognized.

208 VOLT DRIVES

<table>
<tr><th>Model</th><th colspan="2">Drive Input Fuse Ratings</th></tr>
<tr><td>ACH-550-BxR-</td><td>Amps (600V)</td><td>Bussmann Type</td></tr>
<tr><td>04A6-2</td><td>15</td><td>KTK-R-15</td></tr>
<tr><td>06A6-2</td><td>15</td><td>KTK-R-15</td></tr>
<tr><td>07A5-2</td><td>15</td><td>KTK-R-15</td></tr>
<tr><td>012A-2</td><td>15</td><td>KTK-R-15</td></tr>
<tr><td>017A-2</td><td>30</td><td>KTK-R-30</td></tr>
<tr><td>024A-2</td><td>30</td><td>KTK-R-30</td></tr>
<tr><td>031A-2</td><td>60</td><td>JJS-60</td></tr>
<tr><td>046A-2</td><td>100</td><td>JJS-100</td></tr>
<tr><td>059A-2</td><td>100</td><td>JJS-100</td></tr>
<tr><td>075A-2</td><td>100</td><td>JJS-100</td></tr>
<tr><td>088A-2</td><td>200</td><td rowspan="3">170M1370
or
170M2617</td></tr>
<tr><td>114A-2</td><td>200</td></tr>
<tr><td>143A-2</td><td>200</td></tr>
<tr><td>178A-2</td><td>315</td><td rowspan="3">170M1372
or
170M2619</td></tr>
<tr><td>221A-2</td><td>315</td></tr>
<tr><td>248A-2</td><td>315</td></tr>
</table>

460 VOLT DRIVES

Model	Drive Input Fuse Ratings	
ACH-550-BxR-	Amps (600V)	Bussmann Type
03A3-4	15	KTK-R-15
04A1-4	15	KTK-R-15
06A9-4	15	KTK-R-15
08A8-4	15	KTK-R-15
012A-4	15	KTK-R-15
015A-4	30	KTK-R-30
023A-4	30	KTK-R-30
031A-4	60	JJS-60
038A-4	60	JJS-60
045A-4	60	JJS-60
059A-4	100	JJS-100
072A-4	100	JJS-100
078A-4	100	JJS-100
097A-4	200	170M1370 or 170M2617
125A-4	200	
157A-4	200	
180A-4	315	170M1372 or 170M2619
246A-4	315	

600 VOLT DRIVES

Model	Drive Input Fuse Ratings	
ACH-550-BxR-	Amps (600V)	Bussmann Type
02A7-6	30	KTK-R-30
03A9-6	30	KTK-R-30
06A1-6	30	KTK-R-30
09A0-6	30	KTK-R-30
011A-6	30	KTK-R-30
017A-6	30	KTK-R-30
022A-6	60	JJS-60
027A-6	60	JJS-60
032A-6	100	JJS-100
041A-6	100	JJS-100
052A-6	100	JJS-100
062A-6	100	JJS-100
077A-6	200	170M1370 or 170M2617
099A-6	200	
125A-6	200	
144A-6	200	

Heat Dissipation Requirements

ACH550 drives are self-cooled. The cooling air entering the drive must be clean and free from corrosive materials. The table below gives the heat dissipated into the hot air exhausted from the drives. If the drives are installed in a confined space, the heat must be removed from the area by ventilation or air conditioning equipment.

208 VOLT DRIVES

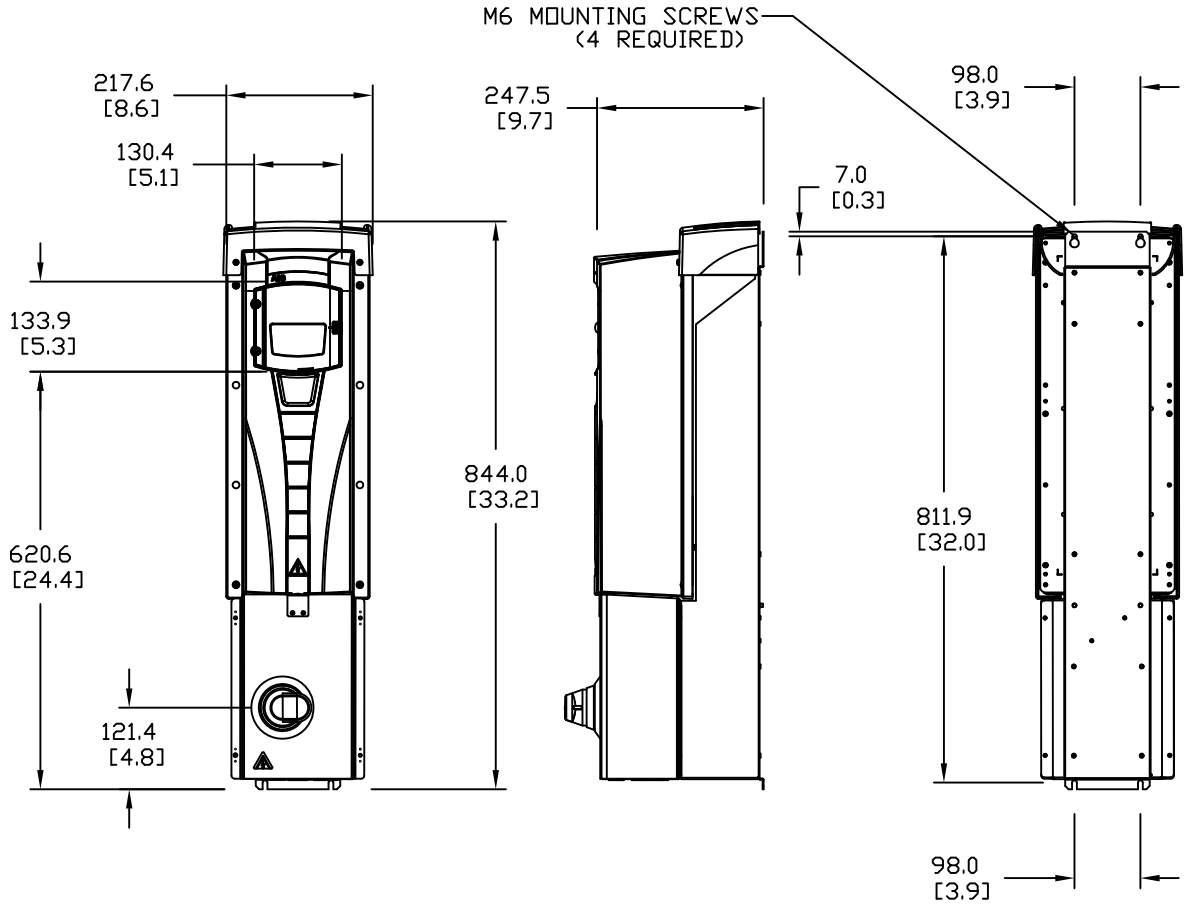
Heat Dissipation & Airflow Requirements				
Model	**Power Losses**		**Airflow**	
ACH-550-PxR-	Watts	BTU/Hr	M^3/hr	CFM
04A6-2	55	189	44	26
06A6-2	73	249	44	26
07A5-2	81	276	44	26
012A-2	116	404	44	26
017A-2	161	551	44	26
024A-2	227	776	88	52
031A-2	285	373	88	52
046A-2	420	1434	134	79
059A-2	536	1829	134	79
075A-2	671	2290	280	165
088A-2	786	2685	280	165
114A-2	1014	3463	280	165
143A-2	1268	4431	405	238
178A-2	1575	5379	405	238
221A-2	1952	6666	405	238

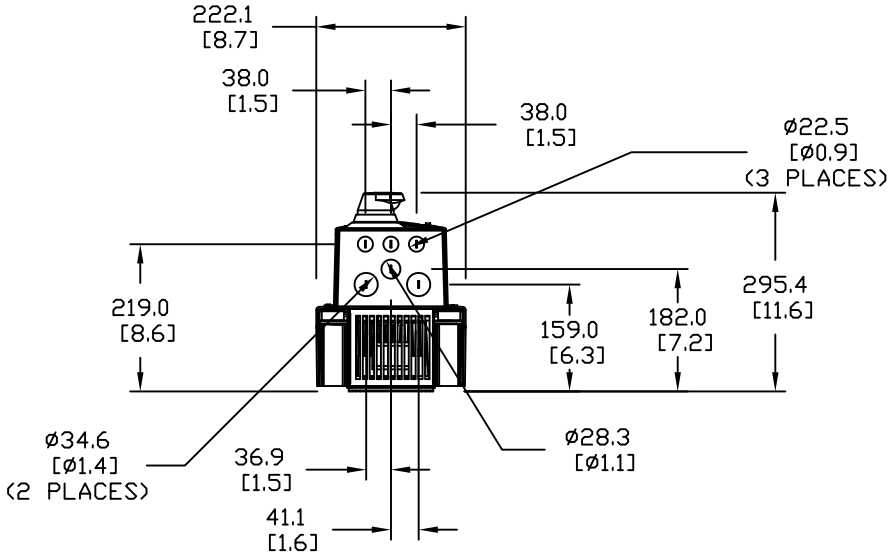
460 VOLT DRIVES

Heat Dissipation & Airflow Requirements				
Model	**Power Losses**		**Airflow**	
ACH-550-PxR-	Watts	BTU/Hr	M^3/hr	CFM
03A3-4	40	137	44	26
04A1-4	52	177	44	26
06A9-4	97	331	44	26
08A8-4	127	433	44	26
012A-4	172	587	44	26
015A-4	232	792	88	52
023A-4	337	1150	88	52
031A-4	457	1560	134	79
038A-4	562	1918	134	79
045A-4	667	2276	134	79
059A-4	907	3096	280	165
072A-4	1120	3820	280	165
078A-4	1295	4420	280	165
097A-4	1440	4915	280	165
125A-4	1940	6621	168	99
157A-4	2310	7884	405	238
180A-4	2810	9590	405	238
246A-4	3850	13000	300	540

600 VOLT DRIVES

Heat Dissipation & Airflow Requirements				
Model	**Power Losses**		**Airflow**	
ACH-550-PxR-	Watts	BTU/Hr	M^3/hr	CFM
02A7-6	46	157	88	52
03A9-6	68	232	88	52
06A1-6	124	423	88	52
09A0-6	170	581	88	52
011A-6	232	792	88	52
017A-6	337	1150	88	52
022A-6	457	1560	134	79
027A-6	562	1918	134	79
032A-6	667	2256	280	165
041A-6	907	3096	280	165
052A-6	1120	3820	280	165
062A-6	1295	4420	280	165
077A-6	1504	5136	405	238
099A-6	1821	6219	405	238
125A-6	2442	8339	405	238
144A-6	2813	9607	405	238





BOTTOM VIEW

NOTES
1. DIMENSIONS SHOWN ARE IN MM [INCHES].
2. PRODUCT WEIGHT: 21 kg [47 lbs.].

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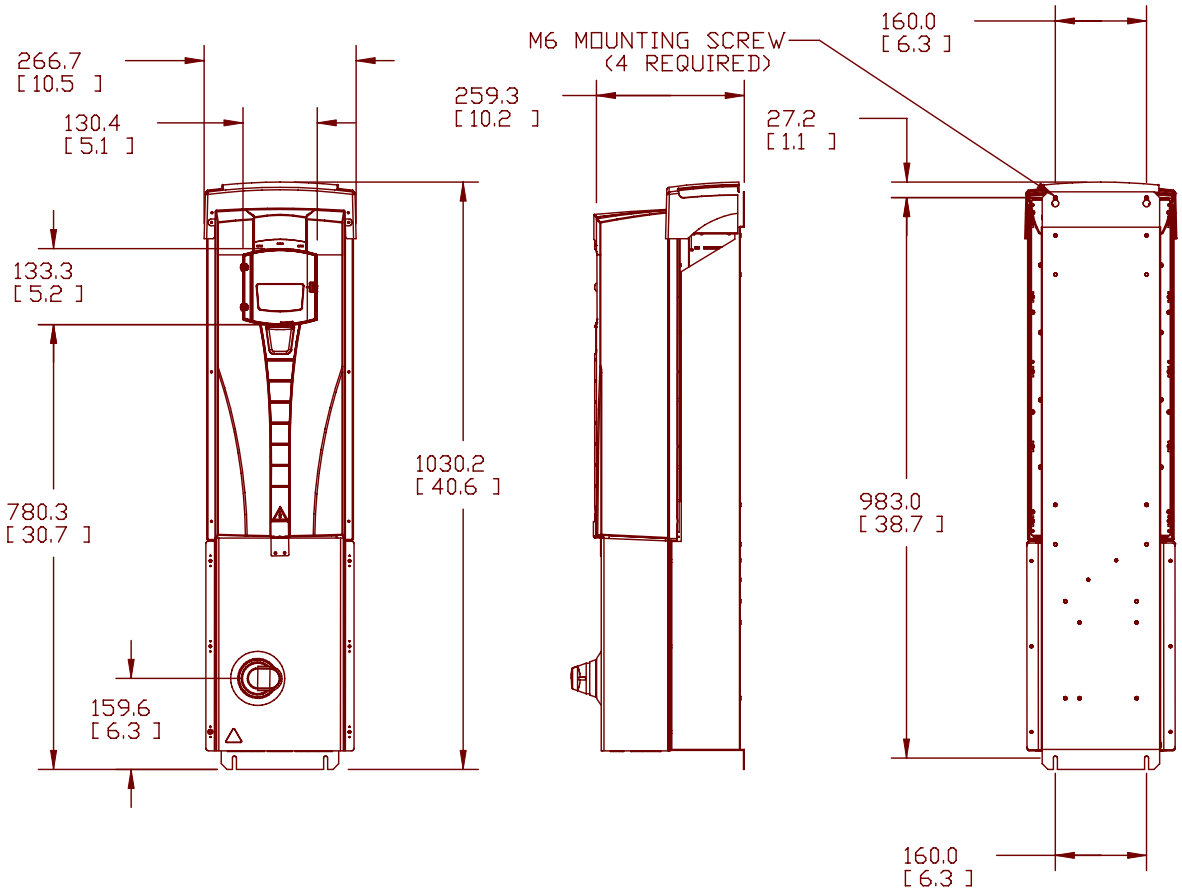
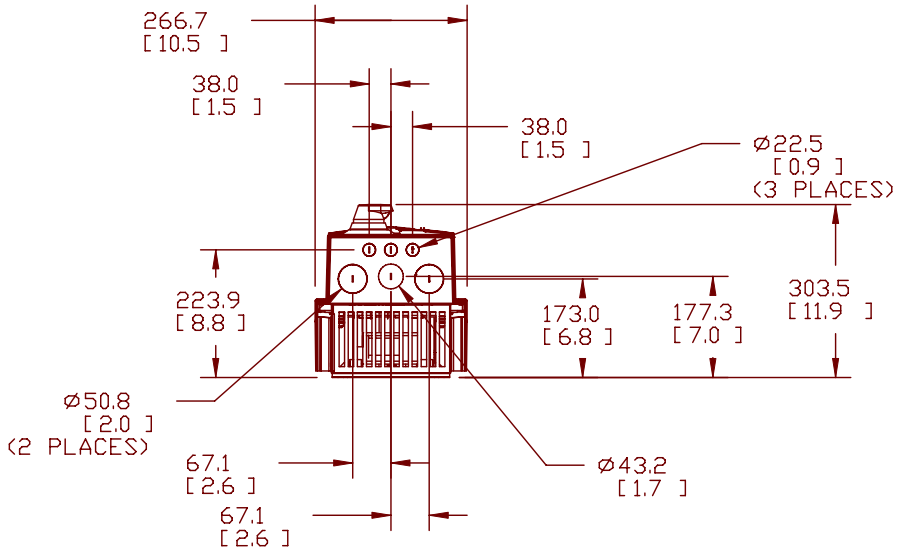
ECO # 500000142134	Rev. descr. Added inches to dimensions on sheet 2.						
Prep.	USINY/ 20050	D.Varble	9/25/09	Title DIMENSION DRAWING 550 DRIVE W/INPUT DISCONNECT UL TYPE 12, R2			Cont. sh. -
Appr.	USINY/ 20050	J.Brenner	9/25/09				
Resp. dept.	USINY/ 45069	20050	6/21/04				
ABB Automation and Drives				Document number 3AUA0000008218	Lang. EN	Rev. ind. E	Sheet 2





BOTTOM VIEW

NOTES
1. DIMENSIONS SHOWN ARE IN MM [INCHES].
2. PRODUCT WEIGHT: 47 kg [103 lbs.].

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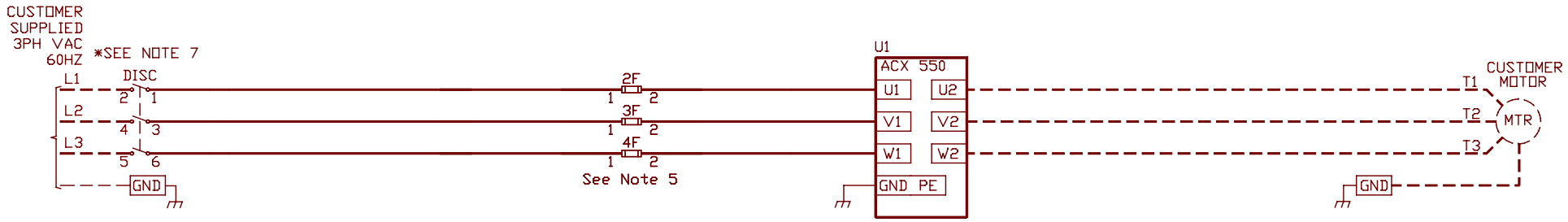
ECO # 10001342	Rev. descr SEE ECN 10001342				
Prep. USINY/ 45069	D.CRAWLEY	03/30/05	Title DIMENSION DRAWING 550, DRIVE W/INPUT OPTION UL TYPE 12. R3		Cont. sh./ No. of sh. --
Appr. USINY/ 45069	R.GONIA	03/30/05			
Resp. dept USINY/ 45069		06/21/04			
ABB Automation and Drives			Document number 3AUA0000008220	Lang.	Rev. ind. C / Sheet 2

F-3BUAD980502-d, rev. 0, 2-25-00



NOTES:

1. PROGRAMMING:
   DRIVE MACRO = HVAC DEFAULT.
2. DASH LINES INDICATE CUSTOMER INSTALLED DEVICES AND WIRING
3. COPPER WIRE RATED FOR 60°C INSULATION IF RATED LESS THAN 100A OR 75°C IF RATED 100A OR MORE MUST BE USED.
4. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND TIGHTENING TORQUE VALUES.
5. FUSE RATING LABEL IS NEAR DEVICE.
6. CUSTOMER REQUIRED TO PROVIDE BRANCH CIRCUIT PROTECTION AND DISCONNECT MEANS PER NEC AND LOCAL CODE.
7. SHORT CIRCUIT CURRENT: 100kA RMS SYMMETRICAL 480V MAXIMUM.

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F-3BUA0980502-M, rev. 0 8-21-03

Rev	Description	Date	Appd
B	SEE ECN 10002745	01/18/08	DC

Based On

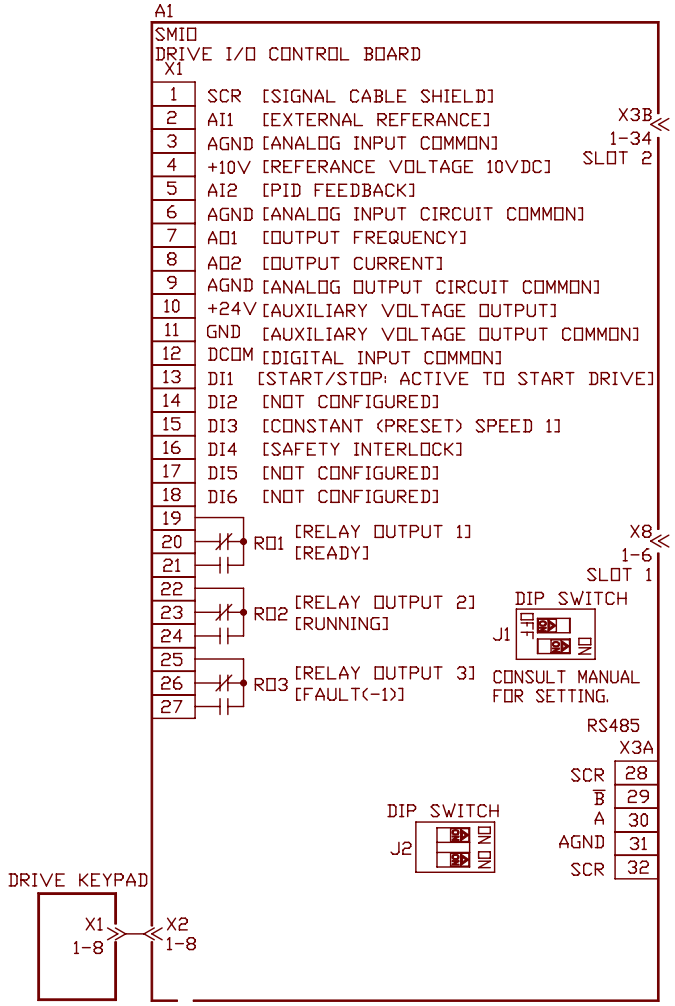
Description: ACX550 Power Wiring Diagram

Project Name: ACH550 DRIVE SWITCH & FUSES Options:

Approved: D.Truettner
Checked: J.Brenner
Prepared: Sch Gen

ABB Inc.
Resp. dept: AJ
Date: 9/19/2007

Reference number: PD00R016PW-A
Document number: 3AUA0000014954
Sheet: A
Cont.: B



NOTES:

1. APPLICATION MACRO: HVAC DEFAULT. CONSULT USER'S MANUAL FOR OTHER MACRO DEFAULT CONTROL SIGNALS.
2. CONSULT USER'S MANUAL FOR I/O RATINGS.

4. COPPER WIRE RATED FOR 60°C INSULATION IF RATED LESS THAN 100A OR 75°C IF RATED 100A OR MORE MUST BE USED.
5. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND TIGHTENING TORQUE VALUES.
6. CUSTOMER REQUIRED TO PROVIDE BRANCH CIRCUIT PROTECTION AND DISCONNECT MEANS PER NEC AND LOCAL CODE.

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F-3BUA0980502-M, rev. 0 8-21-03

Rev	Description	Date	Appd
B	SEE ECN 10002745	01/18/08	DC

Based On

Description: ACX550 Control Wiring Diagram

Project Name: ACH550 DRIVE
Options:

Approved: D.Truettner
Checked: J.Brenner
Prepared: Sch Gen

ABB Inc.
Resp. dept: AJ
Date: 9/19/2007

Reference number: PCPDR014CC-A
Document number: 3AUA0000014954
Sheet: B
Cont.: -

LITHONIA LIGHTING®

Catalog Number	
Notes	Type

FEATURES & SPECIFICATIONS

INTENDED USE — General illumination for rough service (vandal-resistant) applications. Ideal for areas that require higher levels of protection from physical assault, while providing proper illumination for safety or security. **Certain airborne contaminants can diminish integrity of acrylic. Click here for Acrylic Environmental Compatibility table for suitable uses.**

CONSTRUCTION — Housing - Constructed from one-piece die-cast aluminum. Three threaded 1/2" NPS plugs allow conduit entry, or the housing can be mounted over the outlet box.

Gasket - One-piece silicone perimeter lens gasket and closed-cell neoprene housing gasket help to seal out moisture and contaminants.

FINISH — Post-painted after fabrication in dark bronze polyester powder coat. Additional colors available.

OPTICAL SYSTEM — Lens - Clear prismatic, UV-stabilized, polycarbonate lens, nominal thickness .125" (1/8"). Prism optics provide uniformity with maximum spacing-to-mounting height ratios. Lens secured by either stainless steel tamper-resistant Torx® T-20 or standard stainless steel slotted hex-head screws (four of each included).

ELECTRICAL SYSTEM — Ballast - Electronic, Class P, High Power Factor multi-volt, THD <10% with a starting temperature of 0°F. Exceptions are 7TT, 22DTT and 28DTT Electromagnetic ballasts, 120V only.

Socket - Thermoplastic socket(s)

Lamp - 35K lamp(s) included unless specified L/LP.

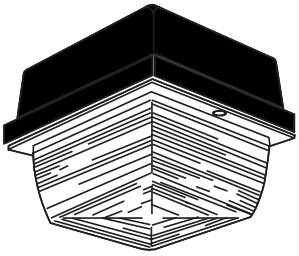
INSTALLATION — Unit may be ceiling or wall mounted. For maximum vandal-resistance, mount unit to structure through four mounting holes provided.

LISTING — UL Listed (standard). CSA Certified (see Options). UL listed for wet locations for wall mount or in covered ceiling applications.

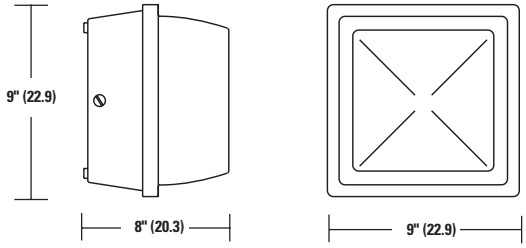
NOTE: Specifications subject to change without notice.

Rough Service Fixture

VR3C



COMPACT FLUORESCENT
Ceiling / Wall Mounted



All dimensions are inches (centimeters).

ORDERING INFORMATION

Example: **VR3C 42TRT 120 GMF LPI**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number.

VR3C

Series

VR3C

Wattage

2/7TT	Two 7W twin-tube lamps[1]
2/9TT	Two 9W twin-tube lamps[1]
13DTT	One 13W double twin-tube lamp
2/13DTT	Two 13W double twin-tube lamps
18DTT	One 18W double twin-tube lamp
2/18DTT	Two 18W double twin-tube lamps
22DTT	One 22W double twin-tube lamp[1,2]
2/22DTT	Two 22W double twin-tube lamps[1,2]
26DTT	One 26W double twin-tube lamp
2/26DTT	Two 26W double twin-tube lamps
28DTT	One 28W double twin-tube lamp[1,2]
26TRT	One 26W triple-tube lamp
2/26TRT	Two 26W triple-tube lamps
32TRT	One 32W triple-tube lamp
42TRT	One 42W triple-tube lamp

Lens

(Blank)	Clear prismatic
WP	White polycarbonate

Voltage

120
277
347
MVOLT[3]

Options

Shipped installed in fixture

ADEZ	Advance mark X electronic dimming ballast[4]
DMHZ	Lutron Hi-Lume electronic dimming ballast[4,5]
DS	Dual switching
EC	Emergency circuit (Incandescent - 25W Max.)[1,4]
GLR	Internal fast-blow fusing[7]
GMF	Internal slow-blow fusing[7]
IR	Internal reflector
NL	Night-light (Incandescent - 7W Max.)[1,6]
PE	Photoelectric cell[7]
CSA	CSA Certified

Shipped separately[8]

FV3C	Steel vertical external visor

Lamp[9]

LPI	Lamp(s) included (standard)
L/LP	Less lamp(s)

NOTES:
1 120V only.
2 2-pin 15mm lamp.
3 Multi-volt electronic ballast (for DTT and TRT lamps) capable of operating on any line voltage between 120 and 277 volt.
4 Available with 2DTT and all TRT lamps.
5 Not available with 42TRT.
6 Lamp by others.
7 Must specify voltage. Not available with MVOLT.
8 For aluminum visor, add **AL** (Example: **FV3C AL**).
9 Lamp(s) included unless specified L/LP.

Accessories

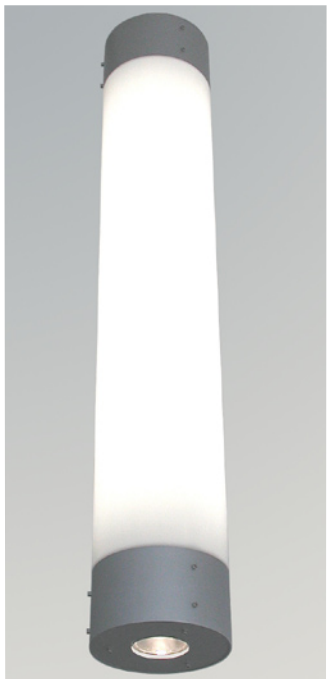
Order as separate catalog numbers.

RK1 T20BIT	Hex-base driver bit, Torx TX20, for tamper-resistant screws with center reject pin.
RK1 T20DRV	Torx TX20 screwdriver for use with tamper-resistant screws with center reject pin.

BIG LIGHT OPAL CYLINDER WITH DOWNLIGHT

DELRAY LIGHTING INCORPORATED

6300



BIG LIGHT PENDANT CYLINDER

Canopy mounts to standard J-box. Extruded aluminum center tube is a lamp holder and electronic ballast housing, ballast removes from bottom. Extruded aluminum top and bottom cylinder is 1/4" thick with aluminum cover plates and has a silver powder coat finish. Top plate will mount to rigid stem or aircraft cable. Mounting option and length of suspension must be specified, see back page for details. Fixtures use three T8 lamps wrapped by a seamless cylindrical Acrylic diffuser. See order info for downlight options. Separate switch leg for downlight is standard. PAR lamps are replaceable without removing cover. Dimming ballasts available for 32W and 17W lamps only. U.L. listed for damp locations.

TYPE: F3

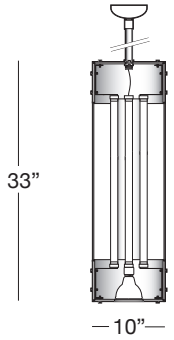
PROJECT: VMC

ORDER NUMBER: 6332-2-BLC-105

6332	2	BLC	105	None
Model#	**Voltage**	**Mount**	**Length**	**Option**
	1–120V **2**–277V	**BLA**–Pipe **BLC**–Cable	In Inches	**D3**–Dimming

Example:

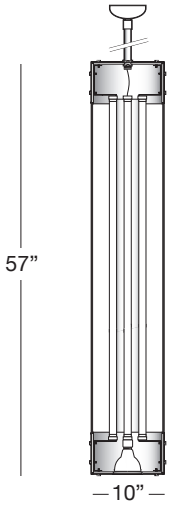
6320.	2.	BLA.	96	D3



6301
Three 17W T8 lamps, with one 75W PAR30S. *120V only.*

6321
Three 17W T8 lamps, with one 39W Metal Halide PAR30.

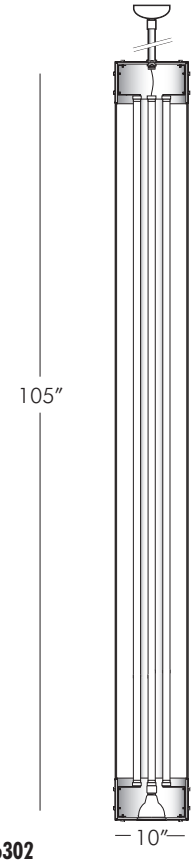
6331
Three 17W T8 lamps, with no downlight.



6300
Three 32W T8 lamps, with one 75W PAR30S. *120V only.*

6320
Three 32W T8 lamps, with one 39W Metal Halide PAR30.

6330
Three 32W T8 lamps, with no downlight.



6302
Three 59W T8 lamps, with one 75W PAR30S. *120V only.*

6322
Three 59W T8 lamps, with one 39W Metal Halide PAR30.

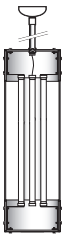
6332
Three 59W single pin T8 lamps, with no downlight.

BURBANK,
CALIFORNIA,
91505
WWW.
DELRAY
LIGHTING.
COM

DEC 2008

3-17 WATT

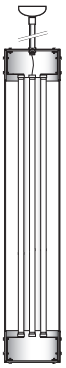
3-17W T8



6331
3-17W T8
G13 Base
Total lumens: 4200 mean
Total luminaire efficiency: 57.3%

3-32 WATT

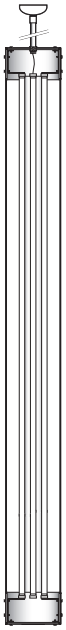
3-32W T8



6330
3-32W T8
G13 Base
Total lumens: 8850 mean
Total luminaire efficiency: 57.4%

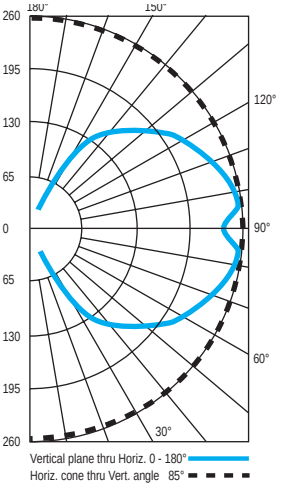
3-59 WATT

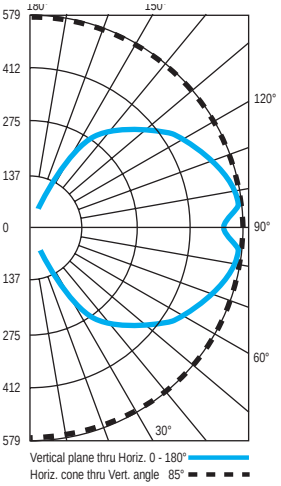
3-59W T8

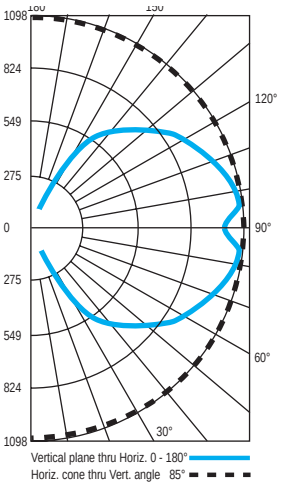


6332
3-59W T8
Fa8 Base
Total lumens: 17700 mean
Total luminaire efficiency: 57.3%

CP DISTRIBUTION







COEFFICIENTS OF UTILIZATION

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

MOUNTING OPTIONS

PIPE MOUNT

Order **BLA** mount for 1/2" pipe. Length must be specified. Includes ball aligner canopy rated for 75 lbs. and mounts to standard J-boxes.

CABLE MOUNT

Order **BLC** mount for any length, must be specified. 3/32" stainless steel aircraft cable adjusts with push button cable grippers for easy field adjustment. Not for use in windy areas.

DIMMING BALLAST

D3 Advance Mark X
- Wattage: 3-17 or 3-32
- Voltage: 120 or 277 (must be specified)
- Range: 5–100%
- Control wires: none
- Dimmers: standard incandescent

ACRYLIC DIFFUSER CLEANING

Warning: Do not clean with ammonia based cleaners (e.g. Windex®). Use only water or cleaners specifically formulated for cleaning plastics.

EB1L17B

QUICKTRONIC® T8 Instant Start UNIVERSAL VOLTAGE

High Efficiency Series — *Low Ballast Factor*

Lamp/Ballast Guide

32W T8 - OCTRON®
QHE ISL SC Models
- 1-lamp QHE1x32T8/UNV
- 2-lamp QHE2x32T8/UNV
- 3-lamp QHE3x32T8/UNV
- 4-lamp QHE4x32T8/UNV

Also operates:
FBO32, FBO31, FO25, FBO24, FO17, FBO16, FO30/SS (30W), FBO30/SS (30W), FBO29/SS (29W), FO28/SS (28W) & FO25/SS (25W)

FO40T8 operation:
1 lamp on 2L ballast
2 lamps on 3L ballast
3 lamps on 4L ballast

Note: FO40T8 0°F Starting Temp.

Key System Features

- High Efficiency Systems over 90% efficient
- **Over 100 LPW (lumens/watt)** with OCTRON SUPERSAVER® lamps
- **Lowest power T8 I.S. Systems**
- Universal voltage (120-277)
- Small Can enclosure size
- 30-50% Energy savings
- -20°F (-29°C) min. starting temp. for OCTRON lamps
- 60°F (16°C) min. starting temperature with OCTRON SUPERSAVER lamps
- <10% THD
- Virtually eliminates lamp flicker

Application Information

SYLVANIA QUICKTRONIC High Efficiency
is ideally suited for:
- Any applications where the lowest power T8 systems are needed for **maximum energy savings**
- Energy Retrofits
- Commercial & Retail
- Hospitality & Institutional
- New Construction

SYLVANIA QUICKTRONIC High Efficiency (QHE) energy-saving electronic T8 ballasts save up to 6% over standard electronic ballasts without compromising light output or lamp life. The added energy savings also provides for a quicker payback. QHE ballasts also meet the most demanding utility rebate standards.

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates OCTRON T8 lamps with maximum efficacy and high lumen output, and provides **30-50% energy savings** when compared to F40T12 magnetic systems.

Small can enclosure allows for low profile fixture design. Small size also provides transportation, inventory and ergonomic benefits.

This product is also offered in new banded packaging and pallet packs.

SYLVANIA QUICKTRONIC High Efficiency (QHE) is also covered by our QUICK 60+® warranty, the first and most comprehensive lamp & ballast system warranty in the industry.

Parallel circuitry is utilized to keep the remaining lamps lit if one or more should go out.

System Information

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by half.

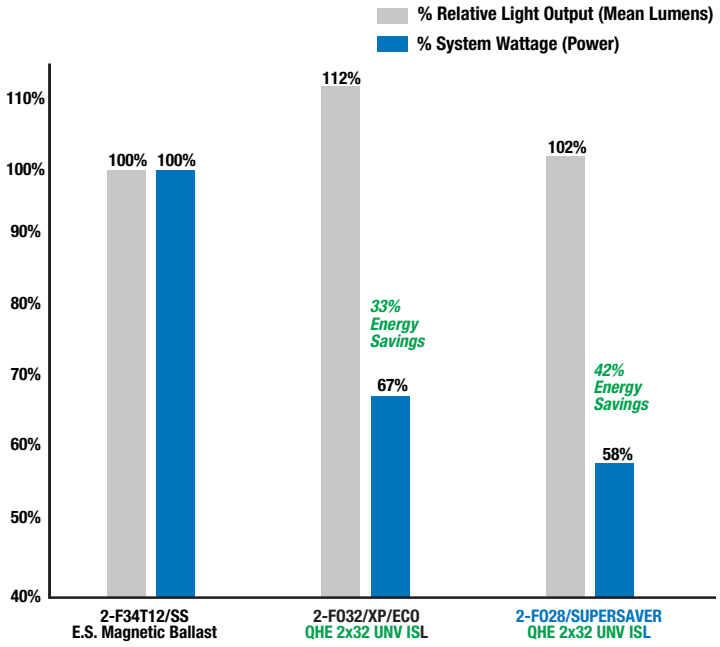
SYLVANIA QUICKTRONIC High Efficiency (QHE) uses instant start operation to provide the highest system efficacy and to assure low temperature starting capability. Instant start also provides for maximum remote wiring distances.

SYLVANIA QUICKTRONIC High Efficiency (QHE) electronic ballasts have very low harmonic distortion (<10% THD) for high system performance.

Ballast operates at >42kHz to reduce potential interference with infrared control systems.

A complete OSRAM SYLVANIA System Performance Guide showing performance characteristics for all combinations of lamps and ballasts is available upon request.

System Type (2-lamp)	Input Wattage	Initial Lumens	System LPW	Mean Lumens	Energy Savings
F34T12 - E.S. Magnetic Ballast	72	4660	65	3960	Baseline
FO32/XP - QHE2x32T8/UNV ISL-SC	**48**	**4680**	**98**	**4445**	**33%**
FO28/SS - QHE2x32T8/UNV ISL-SC	**42**	**4250**	**101**	**4040**	**42%**



SEE THE WORLD IN A NEW LIGHT SYLVANIA

Low Ballast Factor

T8 Instant Start UNV VOLTAGE

High Efficiency Systems

<10% THD High Efficiency Electronic T8 Fluorescent Systems (Low Ballast Factor)

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
49861	QHE 1X32T8/UNV ISL-SC	120-277	0.21/0.09	F032/XP	3000	1	0.78	2340	25	94
			0.20/0.09	F030/SS	2850	1	0.78	2220	24	93
			0.19/0.08	**F028/SS**	**2725**	**1**	**0.78**	**2125**	**22**	**97**
			0.17/0.08	F025/SS	2475	1	0.78	1930	20	97
49863	QHE 2X32T8/UNV ISL-SC	120-277	0.41/0.18	F032/XP	3000	2	0.78	4680	48	98
			0.38/0.16	F030/SS	2850	2	0.78	4445	45	99
			0.35/0.15	**F028/SS**	**2725**	**2**	**0.78**	**4250**	**42**	**101**
			0.32/0.14	F025/SS	2475	2	0.78	3860	37	104
49865	QHE 3X32T8/UNV ISL-SC	120-277	0.61/0.27	F032/XP	3000	3	0.78	7020	71	99
			0.58/0.25	F030/SS	2850	3	0.78	6670	68	98
			0.53/0.23	**F028/SS**	**2725**	**3**	**0.78**	**6380**	**63**	**101**
			0.48/0.21	F025/SS	2475	3	0.78	5790	55	105
49867	QHE 4X32T8/UNV ISL-SC	120-277	0.80/0.35	F032/XP	3000	4	0.78	9360	95	99
			0.75/0.32	F030/SS	2850	4	0.78	8890	89	100
			0.71/0.31	**F028/SS**	**2725**	**4**	**0.78**	**8500**	**84**	**101**
			0.62/0.27	F025/SS	2475	4	0.78	7720	74	104

Products listed above are 10 packs.

840 PC Pallet Packs

49862 QHE1x32T8/UNV-ISL-SC-PAL
49864 QHE2x32T8/UNV-ISL-SC-PAL
49866 QHE3x32T8/UNV-ISL-SC-PAL
49868 QHE4x32T8/UNV-ISL-SC-PAL

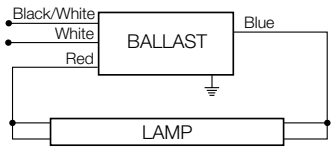
10 PC Banded Packs

49837 QHE1x32T8/UNV-ISL-SC-B
49838 QHE2x32T8/UNV-ISL-SC-B
49839 QHE3x32T8/UNV-ISL-SC-B
49840 QHE4x32T8/UNV-ISL-SC-B

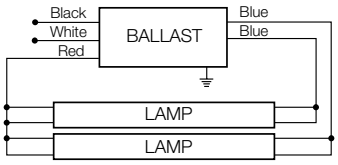
Performance Guide

Data based upon SYLVANIA OCTRON® XP™ lamps shown. QUICKTRONIC QHE Instant Start ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications.

QHE Instant Start ballasts will operate F17, F25 and F32 (and the U-Bend equivalent) T8 lamps. Complete performance data is available in the QUICKSYSTEMS section of the SYLVANIA Electronic Ballast Catalog.

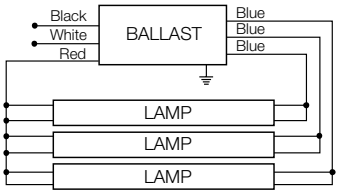


QUICKTRONIC 1x32



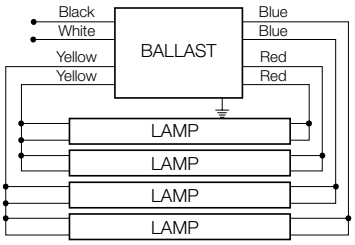
Note: For one lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 2x32



Note: For two lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 3x32



Note: For three lamp application, cap any unused blue lead. Insulate to 600 volts.

QUICKTRONIC 4x32

Specifications[1]

Starting Method: Instant Start
Ballast Factor: 0.78
Circuit Type: Parallel
Lamp Frequency: > 40KHz
Lamp CCF: Less than 1.7
Starting Temp: [1]
-20°F for OCTRON T8 lamps;
60°F for SUPERSAVER® T8 lamps
0°F for F040T8
Input Frequency: 50/60 Hz
Low THD: < 10%
Power Factor: > 98%
Voltage Range: 108-305V

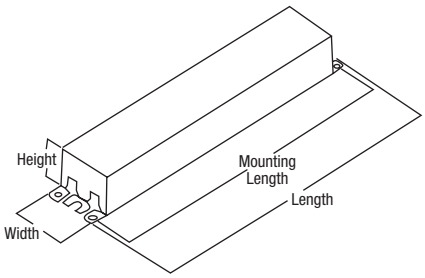
UL Listed Class P, Type 1 Outdoor
CSA Certified (where applicable)
70°C Max Case Temperature
FCC 47CFR Part 18 Non-Consumer Class A Sound Rating
ANSI C62.41 Cat. A Transient Protection
Remote Mounting up to 20 feet [1]

[1] Operation below 50°F may affect light output or lamp operation – see "Low Temp. Starting" definition.

Dimensions:
Overall: 9.5" L x 1.68" W x 1.18" H
Mounting: 8.90"

Packaging:
Quantity: 10 pieces/840 pieces
Weight: 1.6 lbs each (approx)

Wiring:
Leads only (no connectors provided)



System Life / Warranty

QUICKTRONIC products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

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Ordering Guide

Specifications subject to change without notice.

Item Number — **49863 QHE 2 x 32T8 / UNV ISL-SC** — Case Size
QUICKTRONIC High Efficiency
Number of Lamps
Starting/Ballast Factor
Line Voltage (120-277V)
Primary Lamp Wattage

OSRAM SYLVANIA National Customer Service and Sales Center
1-800-LIGHTBULB (1-800-544-4828)
www.sylvania.com

the system solution®

EB2LB

QUICKTRONIC® T8 Instant Start UNIVERSAL VOLTAGE

High Efficiency Series — *Low Ballast Factor*

Lamp/Ballast Guide

32W T8 - OCTRON®
QHE ISL SC Models
- 1-lamp QHE1x32T8/UNV
- 2-lamp QHE2x32T8/UNV
- 3-lamp QHE3x32T8/UNV
- 4-lamp QHE4x32T8/UNV

Also operates:
FBO32, FBO31, FO25, FBO24, FO17, FBO16, FO30/SS (30W), FBO30/SS (30W), FBO29/SS (29W), FO28/SS (28W) & FO25/SS (25W)

FO40T8 operation:
- 1 lamp on 2L ballast
- 2 lamps on 3L ballast
- 3 lamps on 4L ballast

Note: FO40T8 0°F Starting Temp.

Key System Features

- High Efficiency Systems over 90% efficient
- **Over 100 LPW (lumens/watt)** with OCTRON SUPERSAVER® lamps
- **Lowest power T8 I.S. Systems**
- Universal voltage (120-277)
- Small Can enclosure size
- 30-50% Energy savings
- -20°F (-29°C) min. starting temp. for OCTRON lamps
- 60°F (16°C) min. starting temperature with OCTRON SUPERSAVER lamps
- <10% THD
- Virtually eliminates lamp flicker

Application Information

SYLVANIA QUICKTRONIC High Efficiency
is ideally suited for:
- Any applications where the lowest power T8 systems are needed for **maximum energy savings**
- Energy Retrofits
- Commercial & Retail
- Hospitality & Institutional
- New Construction

SYLVANIA QUICKTRONIC High Efficiency (QHE) energy-saving electronic T8 ballasts save up to 6% over standard electronic ballasts without compromising light output or lamp life. The added energy savings also provides for a quicker payback. QHE ballasts also meet the most demanding utility rebate standards.

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates OCTRON T8 lamps with maximum efficacy and high lumen output, and provides **30-50% energy savings** when compared to F40T12 magnetic systems.

Small can enclosure allows for low profile fixture design. Small size also provides transportation, inventory and ergonomic benefits.

This product is also offered in new banded packaging and pallet packs.

SYLVANIA QUICKTRONIC High Efficiency (QHE) is also covered by our QUICK 60+® warranty, the first and most comprehensive lamp & ballast system warranty in the industry.

Parallel circuitry is utilized to keep the remaining lamps lit if one or more should go out.

System Information

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by half.

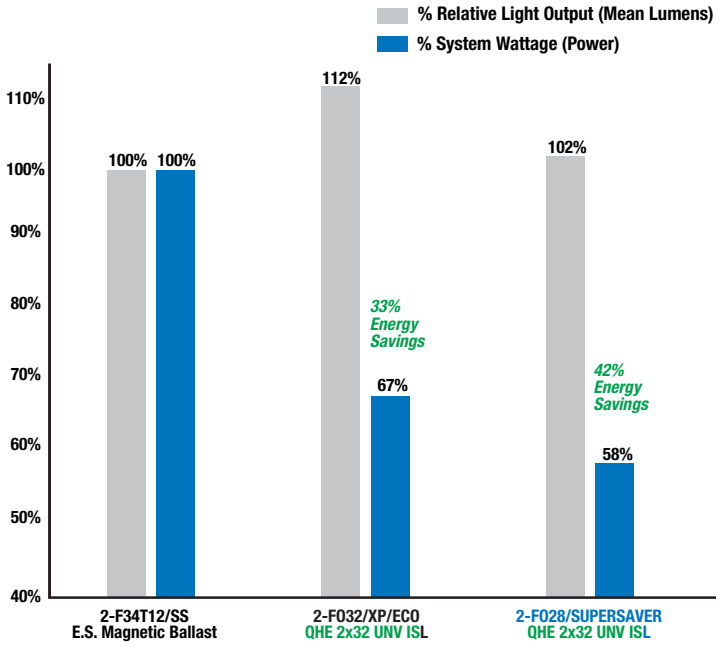
SYLVANIA QUICKTRONIC High Efficiency (QHE) uses instant start operation to provide the highest system efficacy and to assure low temperature starting capability. Instant start also provides for maximum remote wiring distances.

SYLVANIA QUICKTRONIC High Efficiency (QHE) electronic ballasts have very low harmonic distortion (<10% THD) for high system performance.

Ballast operates at >42kHz to reduce potential interference with infrared control systems.

A complete OSRAM SYLVANIA System Performance Guide showing performance characteristics for all combinations of lamps and ballasts is available upon request.

System Type (2-lamp)	Input Wattage	Initial Lumens	System LPW	Mean Lumens	Energy Savings
F34T12 - E.S. Magnetic Ballast	72	4660	65	3960	Baseline
FO32/XP - QHE2x32T8/UNV ISL-SC	**48**	**4680**	**98**	**4445**	**33%**
FO28/SS - QHE2x32T8/UNV ISL-SC	**42**	**4250**	**101**	**4040**	**42%**



SEE THE WORLD IN A NEW LIGHT SYLVANIA

Low Ballast Factor

T8 Instant Start UNV VOLTAGE

High Efficiency Systems

<10% THD High Efficiency Electronic T8 Fluorescent Systems (Low Ballast Factor)

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
49861	QHE 1X32T8/UNV ISL-SC	120-277	0.21/0.09	F032/XP	3000	1	0.78	2340	25	94
			0.20/0.09	F030/SS	2850	1	0.78	2220	24	93
			0.19/0.08	**F028/SS**	**2725**	**1**	**0.78**	**2125**	**22**	**97**
			0.17/0.08	F025/SS	2475	1	0.78	1930	20	97
49863	QHE 2X32T8/UNV ISL-SC	120-277	0.41/0.18	F032/XP	3000	2	0.78	4680	48	98
			0.38/0.16	F030/SS	2850	2	0.78	4445	45	99
			0.35/0.15	**F028/SS**	**2725**	**2**	**0.78**	**4250**	**42**	**101**
			0.32/0.14	F025/SS	2475	2	0.78	3860	37	104
49865	QHE 3X32T8/UNV ISL-SC	120-277	0.61/0.27	F032/XP	3000	3	0.78	7020	71	99
			0.58/0.25	F030/SS	2850	3	0.78	6670	68	98
			0.53/0.23	**F028/SS**	**2725**	**3**	**0.78**	**6380**	**63**	**101**
			0.48/0.21	F025/SS	2475	3	0.78	5790	55	105
49867	QHE 4X32T8/UNV ISL-SC	120-277	0.80/0.35	F032/XP	3000	4	0.78	9360	95	99
			0.75/0.32	F030/SS	2850	4	0.78	8890	89	100
			0.71/0.31	**F028/SS**	**2725**	**4**	**0.78**	**8500**	**84**	**101**
			0.62/0.27	F025/SS	2475	4	0.78	7720	74	104

Products listed above are 10 packs.

840 PC Pallet Packs

49862 QHE1x32T8/UNV-ISL-SC-PAL
49864 QHE2x32T8/UNV-ISL-SC-PAL
49866 QHE3x32T8/UNV-ISL-SC-PAL
49868 QHE4x32T8/UNV-ISL-SC-PAL

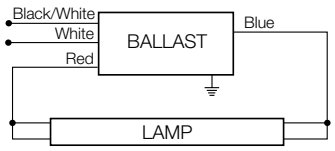
10 PC Banded Packs

49837 QHE1x32T8/UNV-ISL-SC-B
49838 QHE2x32T8/UNV-ISL-SC-B
49839 QHE3x32T8/UNV-ISL-SC-B
49840 QHE4x32T8/UNV-ISL-SC-B

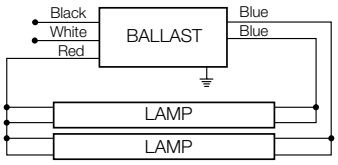
Performance Guide

Data based upon SYLVANIA OCTRON® XP™ lamps shown. QUICKTRONIC QHE Instant Start ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications.

QHE Instant Start ballasts will operate F17, F25 and F32 (and the U-Bend equivalent) T8 lamps. Complete performance data is available in the QUICKSYSTEMS section of the SYLVANIA Electronic Ballast Catalog.

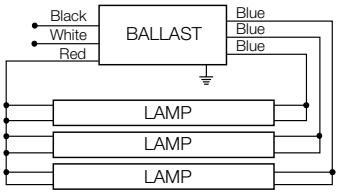


QUICKTRONIC 1x32



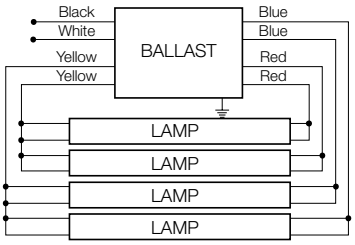
Note: For one lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 2x32



Note: For two lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 3x32



Note: For three lamp application, cap any unused blue lead. Insulate to 600 volts.

QUICKTRONIC 4x32

Specifications[1]

Starting Method: Instant Start
Ballast Factor: 0.78
Circuit Type: Parallel
Lamp Frequency: > 40KHz
Lamp CCF: Less than 1.7
Starting Temp: [1]
-20°F for OCTRON T8 lamps;
60°F for SUPERSAVER® T8 lamps
0°F for F040T8
Input Frequency: 50/60 Hz
Low THD: < 10%
Power Factor: > 98%
Voltage Range: 108-305V

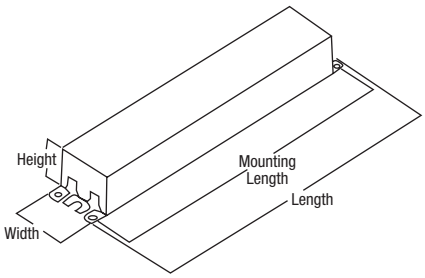
UL Listed Class P, Type 1 Outdoor
CSA Certified (where applicable)
70°C Max Case Temperature
FCC 47CFR Part 18 Non-Consumer Class A Sound Rating
ANSI C62.41 Cat. A Transient Protection
Remote Mounting up to 20 feet [1]

[1] Operation below 50°F may affect light output or lamp operation – see "Low Temp. Starting" definition.

Dimensions:
Overall: 9.5" L x 1.68" W x 1.18" H
Mounting: 8.90"

Packaging:
Quantity: 10 pieces/840 pieces
Weight: 1.6 lbs each (approx)

Wiring:
Leads only (no connectors provided)



System Life / Warranty

QUICKTRONIC products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

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Ordering Guide

Specifications subject to change without notice.

Item Number — **49863 QHE 2 x 32T8 / UNV ISL-SC** — Case Size
QUICKTRONIC High Efficiency
Number of Lamps
Starting/Ballast Factor
Line Voltage (120-277V)
Primary Lamp Wattage

OSRAM SYLVANIA National Customer Service and Sales Center
1-800-LIGHTBULB (1-800-544-4828)
www.sylvania.com

the system solution®

Ⓔ INVUE®

energy solutions

DESCRIPTION

The classic lines and sophisticated construction of the Vision Site luminaire make it an ideal complement to site design. The combination of smooth contours and sharp rear reveals allows the fixture to change character from different viewing angles while providing excellent low-glare photometrics. U.L. listed and CSA certified for wet locations.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction
HOUSING: One-piece, die-cast aluminum housing maintains a nominal 0.125" wall thickness. Integral reveal channels along top surface of housing promote heat extraction and prolonged electrical component life. Solid cast wall separates optical chamber from electrical area. DOOR: One-piece die-cast aluminum door frame. Door frame opens via release of two flush mounted toolless latches. Tempered 1/8" thick clear glass lens seals to door with a weather-tight continuous gasket. Optical chamber is sealed against entry of dirt and moisture by a continuous door mounted gasket which firmly compresses against optical enclosure walls. ARM: One-piece extruded rectangular arm available in standard 6" and 10" lengths. Internal bolt guides allow easy positioning of fixture during installation to pole or wall surface. STRUCTURAL MOUNT: Die-cast aluminum cleat factory mounted to luminaire and finished in luminaire color. Stainless steel structural rod measures 1/2" in diameter and is provided in luminaire finish color or optional natural finish. Product works in conjunction with accessory 10" arms. INVUE poles provided pre-drilled for suspension mount option. See INVUE pole brochure for a complete selection of matching poles.

Electrical
ELECTRICAL TRAY: Ballast and related electrical componentry are mounted to a reinforced one piece galvanized steel tray with integral handle. For ease of maintenance, tray hinges open via toolless release of one spring loaded latch. Electrical quick disconnects allow tray to be completely removed from housing providing ample hand and tool room for attachment of fixture during installation, and a safer servicing environment. Optional tray mounted fuse connections offer a distinct and easy to maintain alternative to common inline fuse connections.

Optical
LENS: Impact resistant 1/8" thick tempered clear flat glass. OPTICAL SYSTEMS: Choice of five (5) efficiency segmented optical systems constructed of premium 95% reflective anodized aluminum sheet. Optical segments are rigidly mounted inside a thick gauge aluminum housing for superior protection. All segment faces are clean of rivet heads, tabs, or other means of attachment which may cause streaking in the light distribution. Optional high efficiency hydroformed reflectors available in VXM housing only in four (4) distributions patterns. All reflector modules feature toolless removal, quick disconnect wiring plugs, and are field rotatable in 90 degree increments. HID lamp sources in medium housing (VXM) optics feature mogul-base lampholders.

Finish
Housing and arm finished in a 5 stage premium TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Standard colors include black, bronze, grey, white, dark platinum, and graphite metallic. RAL and custom color matches available. Consult your INVUE Lighting Systems Representative for more information.

VXM
VISION SITE MEDIUM

84 - 400W

Pulse Start Metal Halide

Metal Halide

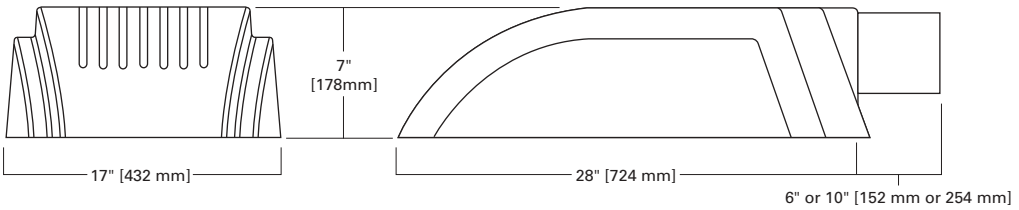
High Pressure Sodium

Compact Fluorescent

ARCHITECTURAL AREA LUMINAIRE

DARK SKY COMPLIANT FCO Full Cutoff

DIMENSIONS



WATTAGE TABLE

Lamp Type	Wattage
Pulse Start Metal Halide (MP)Ⓔ	150, 175, 250, 320, 350, 400W
High Pressure Sodium (HPS)	150, 250, 400W
Metal Halide (MH)	175, 250, 400W
Compact Fluorescent (CF)	(2) 42, (2) 57W

NOTE: Ⓔ EISA Compliant: 175-400W.

CERTIFICATION DATA

IP54 Rated
U.L. 1598 Listed
1.5G Vibration Tested
CSA Listed
40°C Ambient Temperature Rating
ISO 9001
Full Cutoff

EPA

Effective Projected Area: (Sq. Ft.)
Single: 1.6
Single Structural: 1.82

SHIPPING DATA

(Approximate)
Net Weight (lbs.): 51
Volume (cu. ft): 3.18

ISO SYSTEMS CERTIFIED

COOPER Lighting
www.cooperlighting.com

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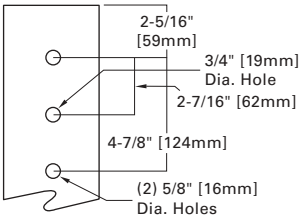
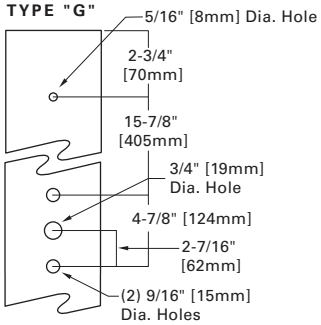
ARM DRILLING

TYPE "M"

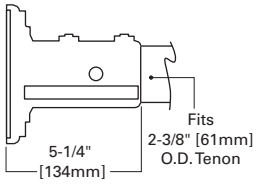


STRUCTURAL MOUNT

TYPE "G"

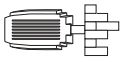


MAST ARM ADAPTER

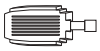


MOUNTING VARIATIONS

Wall Mount

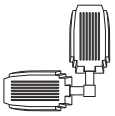


Arm Mount Single
EPA: 1.6

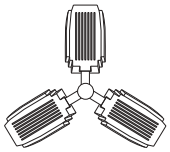


Arm Mount 2 @ 180°
EPA: 3.2

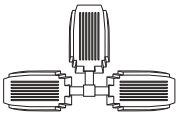
Arm Mount 2 @ 90°
EPA: 3.2



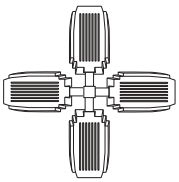
Arm Mount 3 @ 120°
(Round Pole Only)
EPA: 4.5



Arm Mount 3 @ 90°
EPA: 4.5



Arm Mount 4 @ 90°
EPA: 5.55



NOTE: 1 Assumes 10" arm for 90° and 120° mounting configurations, 6" for all else.

ORDERING INFORMATION

Sample Number: VXM-400-MH-MT-3S-BK-PRCPS-L

Product Family [1]
VXM=Vision Site Medium

Lamp Wattage [2]
MP
150=150W
175=175W
250=250W
320=320W
350=350W
400=400W[3]
MH [4]
175=175W
250=250W
400=400W[3]
HPS
150=150W
250=250W
400=400W
Compact Fluorescent
84=(2) 42W[5]
114= (2) 57W[5]

Lamp Type
MP=Pulse Start Metal Halide
MH=Metal Halide
HPS=High Pressure Sodium
CF=Compact Fluorescent [6]

Voltage [7]
120=120V
208=208V
240=240V
277=277V
347=347V
480=480V
DT=Dual-Tap wired[8] 277V
MT=Multi-Tap wired[9] 277V
TT=Triple-Tap wired[10] 347V
UNV=120-277V Universal Electronic Ballast

Optical System
2S=Type II
3S=Type III
4S=Type IV
5S=Type V
SL=Forward Throw w/ Spill Light Eliminator
FX=Wall Grazing Optic
2F=Design 20 Formed
3F=Design 30 Formed
4F=Design 40 Formed
5F=Design 50 Formed

Color [11]
BK=Black
AP=Grey
BZ=Bronze
WH=White
DP=Dark Platinum
GM=Graphite Metallic

Structural Options [1, 12]
Pole Mount
PRCPS=Strut Rod and Clevis Set for Square Pole (Painted to match fixture, does not include arm) [13]
PRCSS=Stainless Steel Strut Rod and Clevis Set for Square Poles (Clevis' painted to match fixture, does not include arm) [13]
PRCPR=Strut Rod and Clevis Set for Round Pole (Painted to match fixture, does not include arm) [14]
PRCSR=Stainless Steel Strut Rod and Clevis Set for Round Poles (Clevis' painted to match fixture, does not include arm) [14]
Wall Mount
WRCP=Strut Rod and Clevis Set (Painted to match fixture, does not include arm) [15]
WRCS=Stainless Steel Strut Rod and Clevis Set (Clevis' painted to match fixture, does not include arm) [15]

Options [12]
F= Single Fuse (120, 277 or 347V) Specify Voltage
FF= Double Fuse (208, 240 or 480V) Specify Voltage
Q= Quartz Restrike[16]
EM= Quartz Restrike w/ Time Delay (Also Strikes at Cold Start) [16]
EM/SC= Quartz Emergency Separate Circuit [16]
R= NEMA Twistlock Photocell Receptacle
DS= Dual Fluorescent Switching Control[17]
HS= House Side Shield[18]
VS= Polycarbonate Vandal Shield
T= Terminal Block
L= Lamp Included

Accessories [19]
MA1050-XX=6" Arm for Square Pole
MA1051-XX=10" Arm for Square Pole[20]
MA1052-XX=6" Arm for Round Pole
MA1053-XX=10" Arm for Round Pole[20]
MA1054-XX=Wall Bracket with 6" Arm[21]
MA1056-XX=Direct Mount for Square Pole
MA1057-XX=Direct Mount for Round Pole
MA1201-XX=Direct Wall Mount Kit[21]
MA1207-XX=Mast Arm Adapter
MA1231-XX=VXM Structural Mount Wall Mount Arm[22]
MA1017-XX=Single-arm Tenon Adapter for 2 3/8" O.D. Tenon
MA1018-XX=2@180 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1019-XX=3@120 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1045-XX=4@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1048-XX=2@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1115-XX=3@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1116-XX=2@120 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1010-XX= Single-arm Tenon Adapter for 3 1/2" O.D. Tenon
MA1011-XX= 2@180 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1012-XX= 3@120 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1013-XX= 4@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1014-XX= 2@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1015-XX= 2@120 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1016-XX= 3@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
OA/RA1016= NEMA Photocontrol - Multi-Tap
OA/RA1027= NEMA Photocontrol - 480V
OA/RA1201= NEMA Photocontrol - 347V

Notes: 1 Arm not included. See accessories. 2 Standard with mogul-base socket for HPS, MH and 175-400W MP. Standard with medium-base socket for MP lamps 150W and below. 3 400W MH and PSMH requires reduced envelope ED28 lamp. 4 MH products available for non-U.S. markets only. 5 Dual Compact Fluorescent lamp options available in Type 2S with 84 and 114W. Type 3S available in 84W only. 6 CF ballasts are 120 through 277V. Specify with UNV voltage designation. 7 Products also available in non-US voltages and 50Hz for international markets. Consult factory for availability and ordering information. 8 Dual-tap is 120/277V wired 277V. 9 Multi-tap is 120/208/240/277V wired 277V. 10 Triple-tap is 120/277/347V wired 347V. 11 Custom and RAL color matching available upon request. Consult your INVUE Lighting Systems Representative for further information. 12 Add as suffix in the order shown. 13 Compatible with 10" MA1051 arm only. 14 Compatible with 10" MA1053 arm only. 15 Wall mount structual options do not include arm assembly (See Accessories). Compatible with 10" MA1231 arm only. 16 Quartz options not available with SL optic. 17 Dual switching requires dual 42W or dual 57W Compact Fluorescent lamps. Allows independent switching control of each lamp through use of two (2) electronic ballasts. Allows 50% power reduction when dual ballasts are independently wired and controlled. 18 House side shield not available on 5S and SL optics. 19 Order separately, replace XX with color suffix. 20 Use when mounting fixture heads at 90° increments. 21 For use in down lighting applications only. 22 Includes arm only. Must specify WRCP or WRCS in fixture ordering logic. Down light only.

INVUE®

energy solutions

DESCRIPTION

The classic lines and sophisticated construction of Vision Site LED makes it an ideal complement to site design. Offering LED technology across the VXS and VXM, Vision provides true family scaling in both physical form and lumen capability for architectural site lighting applications. UL and cUL listed for use in wet locations.

		Type
Catalog #		
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction

HOUSING: Heavy wall, one piece die-cast aluminum housing has precise tolerance control and repeatability in manufacturing. Housing features a partition wall that isolates driver components for cooler operation. Integrel aluminum heat sink provides superior heat transfer in +40°C ambient environment. DOOR: One-piece die-cast aluminum construction with toolless release latch. Door swings down and is retained on two (2) catch hinges. GASKET: Continuous gasket provided to seal housing to optic tray. LENS: Downlight lens is LED board integrated acrylic over-optics, each individually sealed for IP66 rating. HARDWARE: Toolless release button latches are stainless steel/aluminum construction, painted to match housing and allows access to internal housing and electrical components.

Optics

DISTRIBUTION: Choice of fifteen (15) high efficiency AccuLED optical systems, featuring patented designs that maximize light collection and directional distribution onto the application region. Each optical lens is precision manufactured via injection molding then precisely arranged and sealed on the board media. LED's: High output LED's, 50,000+ hours life at >70% lumen maintenance, offered standard in 4000°K (+/- 275K) CCT and >70 CRI. LightBAR optic tray is able to rotate 360° in 90° increments for specific placement of the distribution relative to fixture.

Electrical

DRIVER: LED drivers are potted and heat sunk for optimal performance and prolonged life. Standard drivers feature electronic universal voltage (120-277V/50-60hz), greater than 0.9 power factor, less than 20% harmonic distortion and feature ambient temperature range of +40°C (104°F) down to minimum starting temperature of -30°C (-22°F). Shipped standard with Cooper Lighting proprietary circuit module designed to withstand 10kV of transient line surge. All LED LightBARS™ and drivers are mounted to dedicated mounting trays and are easily replaced by use of quick disconnects for ease of wiring. Driver tray is hinged and removable without the use of tools. Options to control light levels, energy savings and egress capabilities (battery pack and separate circuit) are available.

Mounting

ARM: One-piece extruded aluminum arm available in standard 6" and 10" lengths. Internal bolts guides allow easy positioning of fixture during installation to pole or wall surface. STRUCTURAL MOUNT: Die-cast aluminum cleat factory mounted to luminaire and finished in luminaire color. Stainless steel structural rod measures 1/2" in diameter and is provided in luminaire finish color or optional natural finish. Product works in conjunction with dedicated accessory arms (ordered seperately). Invue poles are provided pre-drilled when structural mount option drill pattern is specified. See Invue poles section for complete selection. Additional mounting accessories available.

Finish

Housing is finished in 5 stage super premium TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. LightBAR™ cover plates are standard white and may be specified to match finish of luminaire housing. Standard colors include black, bronze, grey, white, dark platinum and graphite metallic. RAL and custom color matches available. Consult Outdoor Architectural Colors brochure for a complete selection.

Warranty

VXM LED features a 5 year limited warranty.

VXM
VISION SITE MEDIUM LED

1 - 6 LightBARS

Solid State LED

ARCHITECTURAL LED AREA/SITE LUMINAIRE

SustainabLEDesign

CERTIFICATION DATA

40°C Ambient Temperature Rating
UL and cUL Listed
ISO 9001
IP66 LIghtBARS
ARRA Compliant
LM79 / LM80 Compliant
1.5G Vibration Tested

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 & 60hz, 347V/60hz, 480V/60hz
-30°C Minimum Temperature

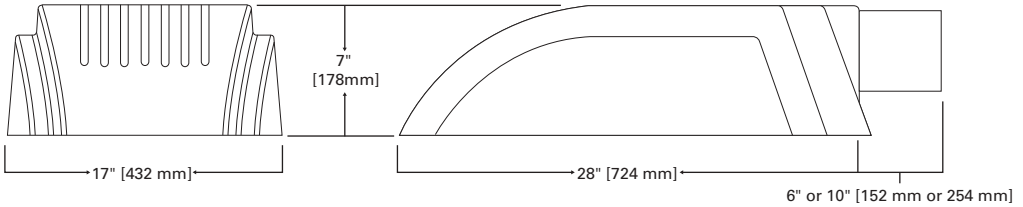
EPA

Effective Projected Area: (Sq. Ft.)
Single: ~ 1.6 (max.)
Single Structural: ~ 1.82 (max.)

SHIPPING DATA

Approximate Net Weight:
51 lbs. (23.18 kgs.)

DIMENSIONS



COOPER Lighting
www.cooperlighting.com

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POWER AND LUMENS BY BAR COUNT

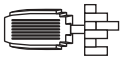
# of Bars	System Watts	Type SL2 Lumens	Type SL3 Lumens	Type SL4 Lumens	Type 5WQ Lumens
1 Bar	26	1,626	1,724	1,677	1,866
2 Bars	53	3,252	3,447	3,354	3,735
3 Bars	80	4,878	5,170	5,031	5,602
4 Bars	103	6,504	6,894	6,708	7,469
5 Bars	129	8,130	8,617	8,385	9,337
6 Bars	156	9,837	10,426	10,146	11,228

NOTE: Lumen values based upon 4000K CCT, 350mA drive current, 25°C ambient operating temperature.

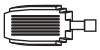
Ambient Temperature	Lumen Multiplier
10°C	1.04
15°C	1.03
25°C	1.00
40°C	0.96

MOUNTING VARIATIONS

Wall Mount

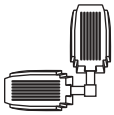


Arm Mount Single
EPA 1.6

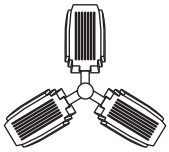


Arm Mount 2 @ 180°
EPA 3.2

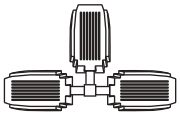
Arm Mount 2 @ 90°
EPA 3.2



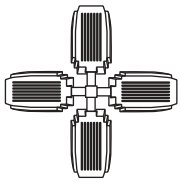
Arm Mount 3 @ 120° (Round Pole Only)
EPA 4.5



Arm Mount 3 @ 90°
EPA 4.5

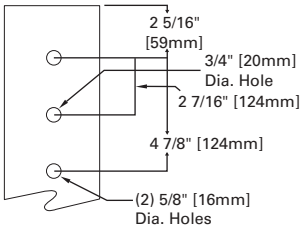


Arm Mount 4 @ 90°
EPA 5.55

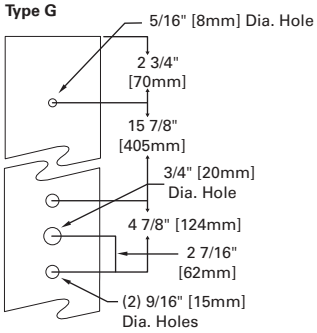


POLE DRILLING PATTERNS AND MOUNTING OPTIONS

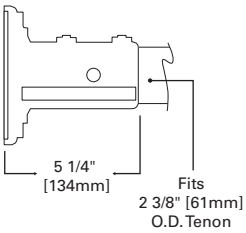
Type M



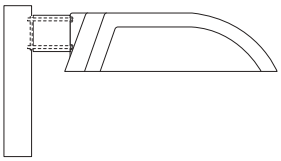
Structural Mount Type G



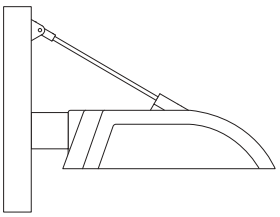
Mast Arm Adapter



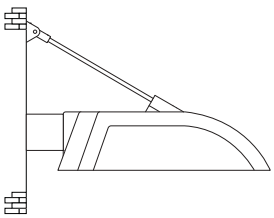
MOUNTING OPTIONS AND ACCESSORIES



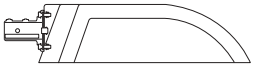
Extruded Arm



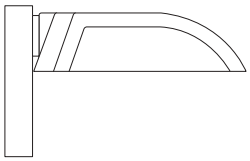
Structural Pole Mount
(Round or Square Pole)



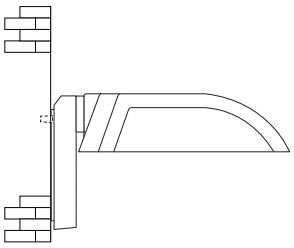
Structrual Wall Mount



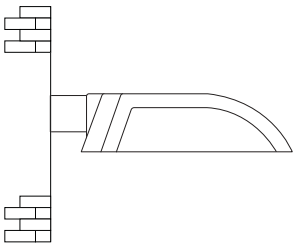
Mast Arm Adapter



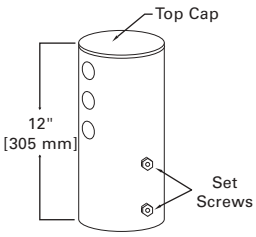
Direct Mount
(Round or Square Pole)



Direct Wall Mount Kit



Wall Bracket with Arm



Tenon Adapter

ORDERING INFORMATION

Sample Number: VXM-A06-LED-E1-T3-GM

Product Family [1]
VXM=Vision Site Medium

Number of Lightbars [2]
A01=1 Bar
A02=2 Bars
A03= 3 Bars
A04= 4 Bars
A05= 5 Bars
A06= 6 Bars

Lamp Type
LED=Solid State Light Emitting Diodes

Voltage
E1=Electronic (120-277V)
347=347V
480= 480V

Distribution
T2= Type II
T3= Type III
T4= Type IV
5MQ= Type V Square Medium
5WQ= Type V Square Wide
5XQ= Type V Square Wide
5MR= Type V Round Medium
5WR= Type V Round Wide
RW= Rectangular Wide
SL2=Type II w/Spill Control
SL3=Type III w/Spill Control
SL4=Type IV w/Spill Control
SLL=90 Degree Spill Light Eliminator Left
SLR=90 Degree Spill Light Eliminator Right

Finish [3]
BK=Black
AP=Grey
BZ=Bronze
WH=White
DP=Dark Platinum
GM=Graphite Metallic

Structural Options [1]

Pole Mount
PRCPS=Strut Rod and Clevis Set for Square Pole (Painted to match fixture, does not include arm) [4]
PRCCS=Stainless Strut Rod and Clevis Set for Square Pole (Clevis painted to match fixture, does not include arm) [4]
PRCPR= Strut Rod and Clevis Set for Round Pole (Painted to match fixture, does not include arm) [5]
PRCCR= Stainless Strut Rod and Clevis Set for Round Pole (Clevis painted to match fixture, does not included arm) [5]

Wall Mount
WRCP= Strut Rod and Clevis Set (Painted to match fixture, does not include arm) [6]
WRCS= Stainless Steel Strut Rod and Clevis Set (Clevis' painted to match fixture, does not include arm) [6]

Options [7]
T=Terminal Block
PC=Button Type Photocell (specify voltage)
R=NEMA Photocontrol Receptacle
2L=Bi-Level Switching [8]
LCF=LightBAR Cover Plate Matches Housing Finish
7060=70 CRI/6000K CCT [9]
IBP=Integral Battery Pack (Specify 120 or 277) [10]
ICB=Integral Cold Weather Battery Pack (Specify 120 or 277) [11]

Accessories [12]
MA1050-XX=6" Arm for Square Pole
MA1051-XX=10" Arm for Square Pole [13]
MA1052-XX=6" Arm for Round Pole
MA1053-XX=10" Arm for Round Pole [13]
MA1054-XX=Wall Bracket with 6" Arm [14]
MA1056-XX=Direct Mount for Square Pole
MA1057-XX= Direct Mount for Round Pole
MA1201-XX= Direct Wall Mount Kit [14]
MA1207-XX= Mast Arm Adapter
MA1231-XX= VXM Structural Mount Wall Mount Arm [15]
MA1017-XX= Single-arm Tenon Adapter for 2 3/8" O.D. Tenon
MA1018-XX= 2@180 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1019-XX= 3@120 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1045-XX= 4@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1048-XX= 2@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1115-XX= 3@90 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1116-XX= 2@120 Degree Tenon Adapter for 2 3/8" O.D. Tenon
MA1010-XX=Single-arm Tenon Adapter for 3 1/2" O.D. Tenon
MA1011-XX=2@180 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1012-XX=3@120 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1013-XX=4@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1014-XX=2@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1015-XX=2@120 Degree Tenon Adapter for 3 1/2" O.D. Tenon
MA1016-XX=3@90 Degree Tenon Adapter for 3 1/2" O.D. Tenon
OA/RA1016=NEMA Photocontrol - Multi-Tap
OA/RA1027=NEMA Photocontrol - 480V
OA/RA1201=NEMA Photocontrol - 347V
MA1253=10kV Circuit Module Replacement

Notes:
1. Arm not included. Order seperately. See accessories.
2. Standard 4000 K CCT and greater than 70 CRI.
3. Custom and RAL color matching available upon request. Consult your customer service representative for further information.
4. Compatible with 10" MA1051 arm only.
5. Compatible with 10" MA1053 arm only.
6. Wall mount structual options do not include arm assembly (See Accessories). Compatible with 10" MA1231 arm only.
7. Add as suffix in the order shown.
8. Low-level output varies by bar count. Consult factory. Requires quantity two or more LightBARS.
9. Consult customer service for lead times and lumen multiplier.
10. Available with A01, A02, A03, or A04 configurations only. Specify 120 or 277V. LED standard integral battery pack is rated for minimum operating temperature 32°F (0°C). Operates (1) lightbar for 90 minutes, minimum 1300 inital lumens. Not available in all configurations, consult factory. Rated for use in 25°C ambient.
11. Available with A01, A02, A03, or A04 configurations only. Specify 120 or 277V. LED cold weather integral battery pack is rated for minimum operating temperature -4°F (-20°C). Operates (1) lightbar for 90 minutes, minimum 1300 inital lumens. Not available in all configurations, consult factory. Rated for use in 25°C ambient.
12. Order separately, replace XX with color suffix.
13. Use when mounting fixture heads at 90° increments.
14. For use in downlighting applications only.
15. Includes arm only. Must specify WRCP or WRCS in fixture ordering logic. Down light only.

FINELITE

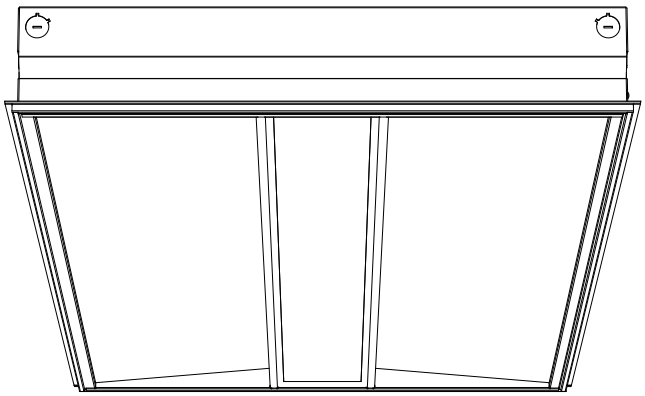
High Performance Recessed (HPR) 2x4

Project HPR-1-2x4-RCO-2T5HO-120V-SC-C1-IS1.00

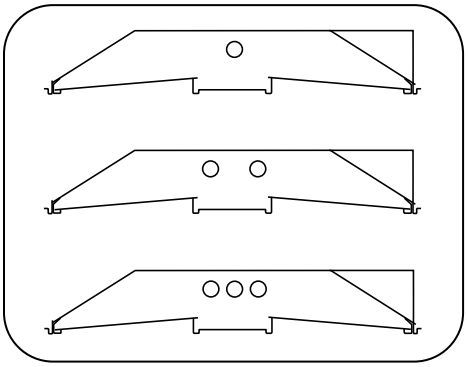
Firm Name McKinstry

Date_____ Type F1

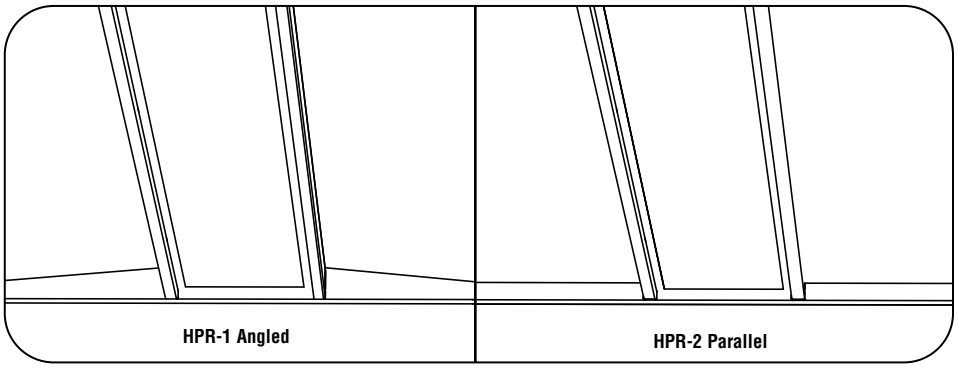
HPR is a highly effective recessed luminaire delivering excellent visual comfort and outstanding performance for offices, schools, healthcare, and retail applications. Advanced optical designs make HPR a powerful solution for low-ceiling applications and eliminate the shadows common to other recessed products.



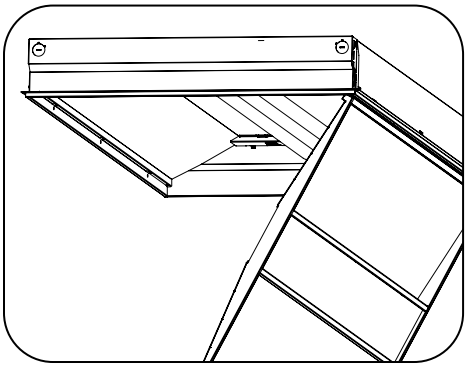
FEATURES



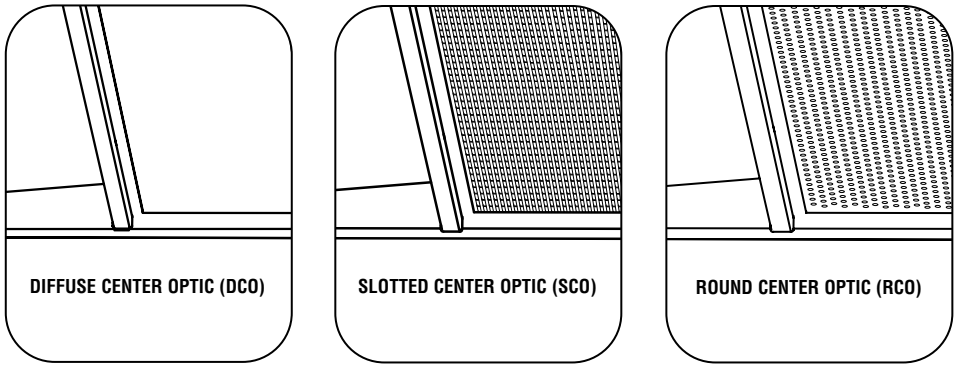
LAMP OPTIONS:
Available in 1, 2, or 3 T8, T5, or T5HO lamp cross sections.



LUMINAIRE STYLES:
HPR-1 features lenses angled toward the center-shielding element. HPR-2 features lenses parallel to the ceiling plane.



HINGED DOOR ASSEMBLY:
The hinged door assembly makes relamping and maintenance fast and easy.



CENTER SHIELDING OPTIONS:
HPR is available with three different center-shielding options: a diffuse center optic, a slotted center optic, and a round center optic.

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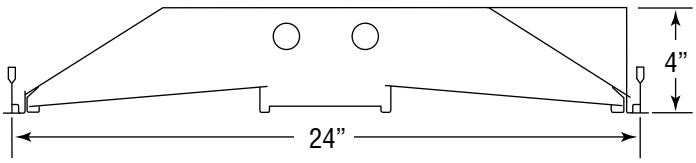
FINELITE

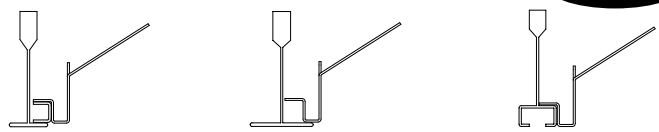
High Performance Recessed (HPR) 2x4

DIMENSIONS



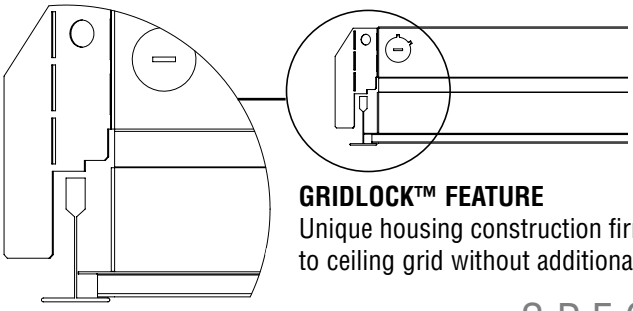
CEILING SYSTEM INFORMATION

IC - RATED

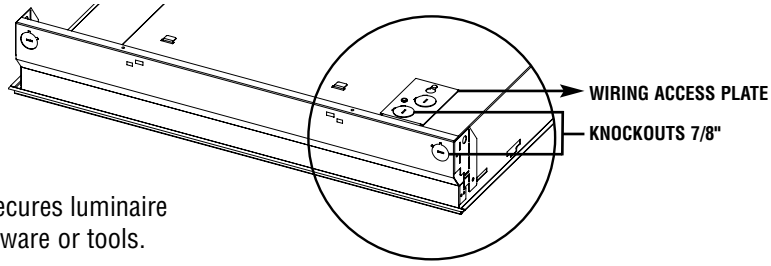


9/16” T-Bar | 15/16” T-Bar | Screw Slot T-Bar

CEILING SYSTEMS DETAIL



WIRING ACCESS DETAIL



GRIDLOCK™ FEATURE

Unique housing construction firmly secures luminaire to ceiling grid without additional hardware or tools.

SPECIFICATIONS

CONSTRUCTION:
Fixture assembly constructed using die-formed 20-gauge cold-rolled steel housing and ends. All components are hard-tooled to tolerances of 0.010". Ballast compartment is accessible from below. Optical system retained using hinged door frame assembly to provide easy access to ballast compartment and for re-lamping from below without the need of tools. Seismic brackets are integrated into the fixture assembly. Additional wire entrances are positioned on the ends of the housing to allow easy wiring access for the installer.

REFLECTORS:
Die-formed 20-gauge cold-rolled steel reflectors are finished in 96 LG high reflectance matte white powder coat paint.

OPTICAL SYSTEM:
Optical system components include side lens panels and a center optic element held in place with a frame constructed from die-formed cold-rolled steel. The side lenses are UV-stabilized and impact-resistant frosted virgin acrylic, 0.080” thick. They are either angled toward the center optic or parallel to the ceiling plane.

Available options for the center optic elements:

Diffuse Center Optic: UV-stabilized and impact-resistant frosted virgin acrylic. Optional Soft Glow Optic (SGO) available for T8 only.

Slotted Center Optic: Die-formed cold-rolled steel panel with 1/16" x 1/2" rectangular hole pattern. Virgin acrylic overlay.

Round Center Optic: Die-formed cold-rolled steel panel with precision-punched 3/32” round hole pattern arranged in staggered formation. Virgin acrylic overlay.

LAMPING:
Available in 1, 2, or 3 T8, T5, or T5HO lamp cross sections.

BALLAST:
UL listed Class P. Electronic instant-start ballast <10% THD, 0.88 BF standard for T8 lamps. Electronic program-start ballasts <10% THD, 1.0 BF standard for T5/T5HO lamps. Contact factory for available BF’s. Optional adders: program-start ballasts (standard for T5/T5HO), 347V, emergency battery packs, dimming or bi-level ballasts (controls by others).

ELECTRICAL:
Fixtures and electrical components are ETL listed conforming to UL1598 in the USA, and Canada and ETL listed certified to CAN/CSA C22.2 No. 250.0. In accordance with NEC code 410.73 (G) this luminaire contains an internal ballast disconnect. IC-Rated for all lamping except 3 T5HO. Optional Chicago Plenum available. Contact factory.

Daylight Sensor | Occupancy Sensor

ON-BOARD CONTROLS:
Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

MOUNTING:
Standard flange design works with most lay-in ceiling types. Integral pryout tabs secure luminaire to ceiling grid from above. Fixture offers tie-in locations for tie-wire on all corners. Consult local code for appropriate tie-wire recommendations. Drywall Kit available. Surface mount version available; refer to separate tech sheet.

AIR RETURN:
Refer to the 2x4, or 2x2 Air Return tech sheets for more information.

FEED:
18-gauge wire standard.

FINISH:
Housing and door assembly painted with 96 LG high reflectance matte white powder coat paint. Available in matte white only.

WIRING:
Master / Satellite wiring available. Contact factory for configuration options. Optional whips (with flex connectors) supplied in a max. of 11’ lengths.

WEIGHT:
Maximum weight: 2x4 - 33 lbs.

ORDERING GUIDE **HPR - 2 - 2X4 - DCO - 1 T8 - 277 - SC - C1 - IS.88 - OBO**

Finelite Series **HPR**
Luminaire Styles (1-Angled, 2-Parallel)
Size (2x4)
Center Optic (DCO-Diffuse, SCO-Slotted, RCO-Round)
Lamp Type (1, 2 or 3 T8, T5 or T5HO)
Voltage (120, 277, 347V)
Circuiting (SC-Single Circuit, DC-Dual Circuit, SD-Step Dimming)
Mounting (C1-1" T-Bar, C2-9/16" T-Bar, C3-Screw Slot, DW-Drywall Kit, SM-Surface Mount)
Ballast (IS-Instant Start, PS-Program Start, BL-Bi-level, DI-Dimming, and specify BF*)
On-Board Controls (OBD-Daylight, OBO-Occupancy, OBB-Both)

** Standard 0.88 for T8 lamps, 1.0 for T5 or T5HO. Contact factory for available BF’s*
Contact factory for Master/Satellite and factory-supplied whip options.

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METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity.

Catalog #		Type
Project		
Comments		Date
Prepared by		

APPLICATION

HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, etc.

SPECIFICATION FEATURES

A···Construction

Full bodied 20 gauge housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KO's for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

B···Electrical

Ballasts are Class "P" and are positively secured by mounting bolts. Pressure-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. UL/CUL listed. Suitable for damp locations.

C···Finish

White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

D···Downlight/Uplight Optics

Die formed reflectors are faceted with two optical distributions –medium and wide. Medium beam optical modules utilize 95% specular Miro 4 substrate while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame & lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

E···Mounting

The HB series is ideally suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

F···Options

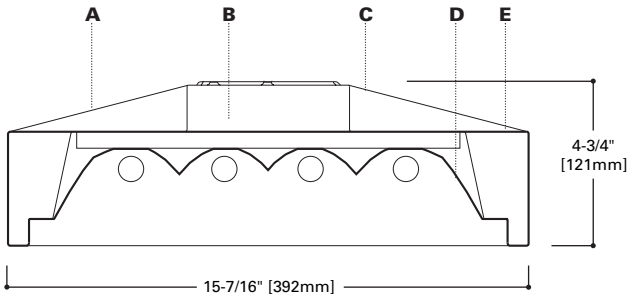
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY HB SERIES

15" x 4' High-Bay
4 Lamp

HIGH-BAY INDUSTRIAL LUMINAIRE

F-BAY™ FLUORESCENT HIGH-BAY



ENERGY DATA

Input Watts:
EB Ballast
432 (109)

EB/Plus Ballast
432 (147)

ER Ballast
432 (112)
454 (229)

ER/Plus Ballast
432 (144)

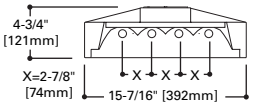
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular Inserts)
Catalog Number: HB-454T5-UPL

Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

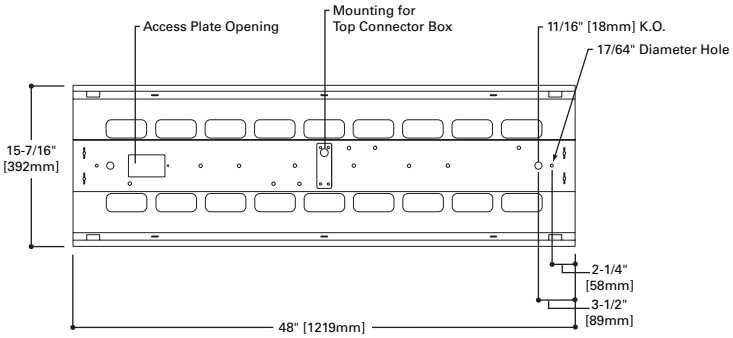
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

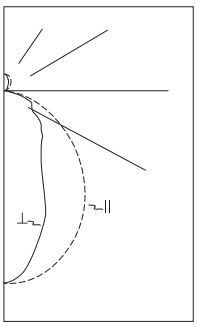
LAMP CONFIGURATIONS



DIMENSION TOP VIEW



PHOTOMETRICS



HB-454T5-UPL
Electronic Ballasts
(4) F54T5/835 HO lamps
4400 lumens
Spacing criterion: (II) 1.2 x mounting height, ( ) 0.8 x mounting height
Efficiency 93.6%
Test Report: HB454T5UPL.IES
LER =70
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.42

Candela

Angle	Along II	45°	Across
0	8806	8806	8806
5	8815	8634	8438
10	8678	8130	7623
15	8445	7394	6829
20	8137	6688	5747
25	7767	5901	4459
30	7315	4716	3623
35	6774	3747	3151
40	6199	3096	2884
45	5548	2637	2603
50	4849	2332	2411
55	4096	2014	1918
60	3315	1760	1541
65	2555	1264	1534
70	1788	1062	1205
75	1110	842	671
80	514	295	55
85	96	41	41
90	0	14	14

Coefficients of Utilization

Effective floor cavity reflectance 20%

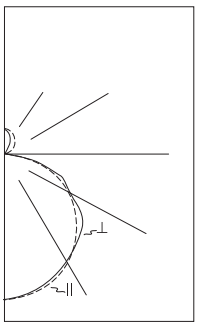
rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	110	110	110	110	107	107	107	107	101	101	101	95	95	95	90	90	90	88
1	102	98	94	91	99	95	92	89	90	88	85	86	83	82	81	80	78	76
2	93	86	81	76	90	84	79	75	80	76	72	76	73	70	73	70	67	65
3	86	77	70	65	83	75	69	64	72	66	62	68	64	60	65	61	58	56
4	79	69	61	56	77	67	60	55	64	58	54	62	57	52	59	55	51	49
5	73	62	55	49	71	61	54	48	58	52	47	56	51	46	54	49	45	43
6	68	57	49	43	66	55	48	43	53	47	42	51	46	41	49	44	41	39
7	64	52	44	39	62	51	44	39	49	43	38	47	41	37	45	40	37	35
8	59	48	40	35	58	47	40	35	45	39	34	44	38	34	42	37	33	32
9	56	44	37	32	54	43	36	32	42	36	31	40	35	31	39	34	30	29
10	52	41	34	29	51	40	34	29	39	33	29	38	32	28	37	32	28	26

Zonal Lumen Summary

Zone	Lumens	%Lamp	%Fixture
0-30	5656	32.1	34.3
0-40	8411	47.8	51.0
0-60	13046	74.1	79.2
0-90	15460	87.8	93.8
0-180	16480	93.6	100.0

Typical VCP Percentages

	Height Along		Height Across	
Room Size (Ft.)	8.5′	10.0′	8.5′	10.0′
20 x 20	30	35	31	38
30 x 30	27	28	30	29
30 x 60	25	25	35	31
60 x 30	32	32	34	32
60 x 60	30	27	38	34



HB-454T5-G-UPL
Electronic Ballasts
(4) F54T5/830 HO lamps
4400 lumens
Spacing criterion: (II) 1.3 x mounting height, ( ) 1.3 x mounting height
Efficiency 82.1%
Test Report: HB454T5GUPL.IES
LER =66
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.64

Candela

Angle	Along II	45°	Across
0	4435	4435	4435
5	4413	4411	4411
10	4364	4338	4321
15	4282	4227	4203
20	4164	4088	4068
25	4015	3919	3924
30	3835	3735	3777
35	3625	3537	3636
40	3391	3323	3479
45	3131	3105	3303
50	2843	2870	3112
55	2528	2616	2697
60	2183	2342	2275
65	1802	1876	2051
70	1387	1516	1644
75	949	1170	1066
80	516	574	377
85	134	118	113
90	2	11	10

Coefficients of Utilization

Effective floor cavity reflectance 20%

rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	97	97	97	97	94	94	94	94	88	88	88	84	84	84	79	79	79	77
1	89	85	82	79	86	83	80	77	78	76	74	74	72	70	70	69	67	65
2	81	74	69	64	78	72	67	63	69	65	61	65	62	59	62	59	57	55
3	74	65	59	54	71	64	58	53	61	56	51	58	53	50	55	51	48	47
4	67	58	51	45	65	56	50	45	54	48	44	51	46	43	49	45	42	40
5	61	51	44	38	59	50	43	38	47	41	37	45	40	36	43	39	35	33
6	56	45	38	33	54	44	37	32	42	36	32	40	35	31	39	34	30	29
7	52	41	33	28	50	40	33	28	38	32	28	36	31	27	35	30	26	25
8	48	36	29	24	46	36	29	24	34	28	24	33	27	23	31	26	23	21
9	44	33	26	21	42	32	25	21	31	25	20	29	24	20	28	23	20	18
10	41	30	23	18	39	29	23	18	28	22	18	27	21	18	26	21	17	16

Zonal Lumen Summary

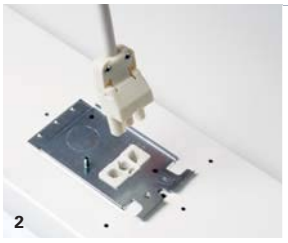
Zone	Lumens	%Lamp	%Fixture
0-30	3436	19.5	23.8
0-40	5677	32.3	39.3
0-60	10418	59.2	72.1
0-90	13546	77.0	93.7
0-180	14453	82.1	100.0

Typical VCP Percentages

	Height Along		Height Across	
Room Size (Ft.)	8.5′	10.0′	8.5′	10.0′
20 x 20	25	31	22	28
30 x 30	21	23	21	21
30 x 60	19	20	22	21
60 x 30	25	26	24	24
60 x 60	22	21	26	23

Modular F-Bay Power Supply

Cooper Lighting's F-Bay Modular Power Supply option allows external fixture access for safe and easy servicing. There is no need to remove lamps or reflectors to disconnect fixture power with F-Bay Modular Power Supply. Access to the individual fixtures power supply allows servicing without turning off all the fixtures disrupting occupants. F-Bay Modular Power Supply is a time saver in installation – simply plug & power.



1. Modular Power Supply Receptacle supplied mounted into fixture Access Plate.
2. Modular Power Cord & Plugs in 120, 277, 347, & 480V configurations for easy plug & power into existing supply.

No internal fixture access required for installation or disconnecting power.

Modular Motion Sensor Option supplied with Mounting Box and Modular Power Supply Receptacle.

Code Compliance

- UL/cUL Certified for Make/Break under load (UL2549)
- Meets NEC requirements for ballast disconnect (NEC 410.73G)
- Allows for addition of Occupancy Sensor without hard connections
- Receptacles complete with insulating/dustcap

ORDERING INFORMATION

SAMPLE NUMBER: HB-R-432-A-120V-EB81

Width
Blank=15"

Series
HB=High Bay

Mounting Arrangement
Blank=Stand Alone
R=Continuous Row Mount

No. of Lamps
4=4 Lamps

Lamp Type
32=32W T8 Lamps (48")
28T5=28W T5 Lamps (48")
54T5=T5HO Lamps (48")

Distribution
Blank=Medium (Specular Aluminum)
G=Wide (High Reflectance White)

Shielding
Blank=None
A=Prismatic Acrylic Lens & Doorframe
WG=Wireguard & Doorframe
A/WG=Acrylic Lens, Wireguard & Doorframe
CL=Clear Acrylic Lens & Doorframe
SWG=Heavy Duty Wireguard (Shipped separatley)

Voltage [2]
UNV=Universal 120/277 Voltage
UNC=Universal 347/480 Voltage (T5 linear only)
120V=120 Volt
277V=277 Volt
347V=347 Volt

Options
Lamps Installed
L8830=T8 Lamp, 80CRI 3000K
L8835=T8 Lamp, 80CRI 3500K
L8841=T8 Lamp, 80CRI 4100K
L8850=T8 Lamp, 80CRI 5000K
L5830=T5 Lamp, 80CRI 3000K
L5835=T5 Lamp, 80CRI 3500K
L5841=T5 Lamp, 80CRI 4100K
L5850=T5 Lamp, 80CRI 5000K
GL=Single Element Fuse
GM=Double Element Fuse
Emergency=EM Installed[2]

Ballast Type
T8 Systems
EB8__=T8 Electronic Instant Start.[4] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
EB8__/PLUS= T8 Electronic Instant Start.[4] High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
ER8__=T8 Electronic Program Rapid Start.[4] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
ER8__/PLUS= T8 Electronic Program Start.[4] High Ballast Factor >1.13. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
T5 Systems
EBT__=T5 Linear Electronic Program Rapid Start. [3] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
EHT__=T5 Linear Electronic Start High Ambient.[7] [8] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
DIM=Dimming

Options
UPL=Uplight Apertures
PI/CPI=Plug-In (1, 2 or 3)[9] see ordering information below
TILW=Tandem Inline Wiring
MWS=Modular Wiring System
MS=Aisle Coverage Motion Sensor[5]
MSO=360˚ Coverage Motion Sensor[5]
C3=3' Power Cord
C6=6' Power Cord
G2=Gasketed Door (Requires Selection of Lensed Doorframe)
MPR=Modular Power Receptacle[1]
PC3-=3' Power Cord & Plug (Specify Voltage)[2]
PC6-=6' Power Cord & Plug (Specify Voltage)[2]
TAP=Top Access Plate
TCBP=Top Connector Box Plate[6]

Packaging
U=Unit Pack
PAL=Palletized Out of Carton
PALC=Job Pack In Carton

Accessories (order separately)
SWG/HB-4FT-B=Heavy Duty Wireguard (HB)
AYC-CHAIN/SET/U=(2) Hooks, 36" Chain Sets w/S-Hooks
TCB=Top Connector Box
RH-1=Retrofit Hanger
FH-1=Fixture Hook
FL-1=Fixture Loop
HB-SPS=Single Point Cable Kit (13" Drop Length)
GRIPPLE-Y-=Y Mounting Toggle, #2 Cable (Specify 10' or 30')
MPC6=6' Modular Power Cord & Plug (Specify Voltage)
MC6=6' Modular Power Cord
MMS-CPD1200H=Aisle Motion Sensor, Box, Modular Power Receptacle (120-277V)
MMS-CPD500H=360˚ Motion Sensor, Box, Modular Power Receptacle (120-277V)

Doorframes (order separately)
HB-FRM/LENS=Prismatic Acrylic Lens & Frame (HB)
HB-FRM/CL PK=Clear Acrylic Lens & Frame (HB)
HB-FRM/WG PK=Wireguard & Frame (HB)
HB-FRM/LENS/WG PK=Prismatic Acrylic Lens, Frame and Wireguard (HB)

NOTES: [1]Requires use of voltage specific modular cord assembly. See accessories. [2]Voltage must be specified when ordered with plugs, motion or emergency ballasts. [3]EBT ballast systems suitable for operation in ambient environments up to 40˚C in open uplight configuration. [4]ER8 and EB8 ballast systems suitable for operation in ambient environments up to 50˚C in open uplight configuration. [5]Specify voltage. [6]For use with Top Connector Box options. See accessories. [7]2 lamp ballast configurations only in UNC versions. [8]EHT/HT5/HCT5 ballast systems suitable for ambient environments not to exceed 65˚C in open uplight configurations and less lens option. [9]Cannot be combined with cord or cord & plug. See PI ordering information below.

Quick Ship
Made To Order

Quick Ship Ordering Information

Sample Number: HB54T5-MP-UPL-I5

Includes V Hangers for rapid installation

Quick Ship orders ship in 5 days in order quantities not to exceed 200 pieces.

NOTE: Orders received after noon are entered on the following day.

Family
HB

Lamp Qty
4=4 Lamps

Lamp Type
32=32W T8 Lamps (48")
54=T5HO Lamps (48")

Ballast Type
T5HO Systems
T5=(1) 120/277V 4 Lamp T5 Electronic Program Rapid Start[4]
HT5=(1) 120/277V 4 Lamp T5 High Ambient Electronic Program Rapid Start[9]
HCT5=(1) 347/480V 2 Lamp T5 High Ambient Electronic Program Rapid Start[9]
T8 Systems[5]
Blank=(1) 120/277V 4 Lamp T8 Instant Start Electronic
PS=(1) 120/277V 4 Lamp T8 Electronic Program Rapid Start

Power Receptacle
Blank=Standard Wiring to Access Plate
MP=Modular Power Receptacle[9]

Uplight
UPL=Uplight

Lamping[11]
L4=Lamps Installed 80+CRI 4100K
L5=Lamps Installed 80+CRI 5000K

Accessories (order separately)
MPC6=6' Modular Power Cord & Plug (Specify Voltage)
MC6=6' Modular Power Cord
MMS-CPD1200H=Aisle Motion Sensor, Box, Modular Power Receptacle (120-277V)

NOTES: [9]Required when utilizing MMS-CPD1200H option. [10]Requires use of Modular cord and plug accessories. [11]High lumen (3100 initial) lamps supplied.

SHIPPING INFORMATION

Catalog No.	Wt.
HB-432-G-UPL	19 lbs.
HB-432-UPL	19 lbs.

PI OPTION ORDERING INFORMATION

Catalog Number Suffix	Number of Circuits	Circuit Wired To Ballast
PI 1 BLK	1	Black
PI 2 BLU	2	Blue
PI 2 BLK	2	Black
PI 3 RED	3	Red
PI 3 BLU	3	Blue
PI 3 BLK	3	Black

Catalog Numbering System

The PI System is available in sections up to 8' in length for continuous row wiring by simply plugging the sections together. Each PI section is factory wired to the ballast leads. Color coding of wires is as follows:

PI-1 = One Circuit - 2 Wires: one black, one white
PI-2 = Two Circuits - 3 Wires: one black, one blue, one white
PI-3 = Three Circuits - 4 wires: one black, one blue, one red, one white

When ordering the PI2/PI3 System it is necessary to specify the number of fixtures required for each circuit. All wiring to external feeds, using cord or cord & plug, are responsibility of installing licensed contractor. Cord and cord & plug sets must be ordered separately if PI option is chosen.

PI1 - Single Circuit Plug-In

SAMPLE NUMBER: PI1BLK-WG

PI1= Single Circuit
BLK=Black Hot
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

PI2 - Two Circuit Plug-In

SAMPLE NUMBER: PI2BLK-WG

PI2= Two Circuit
BLK=Black Hot
BLU=Blue Hot
Leave Blank=Single Neutral
/WHT=White Neutral
/GRY=Gray Neutral
Leave Blank=Single Neutral
2NEU=Two Neutrals
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

PI3 - Three Circuit Plug-In

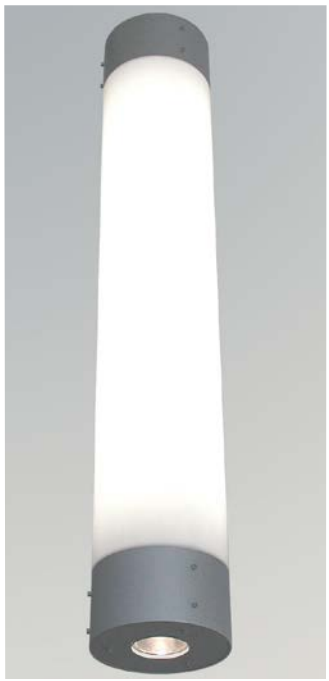
SAMPLE NUMBER: PI3BLK-WG

PI3= Three Circuit
BLK=Black Hot
BLU=Blue Hot
RED=Red Hot
Leave Blank=Single Neutral
/WHT=White Neutral
/GRY=Gray Neutral
Leave Blank=Single Neutral
2NEU=Two Neutrals
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

BIG LIGHT OPAL CYLINDER WITH DOWNLIGHT

DELRAY LIGHTING INCORPORATED

6300



BIG LIGHT PENDANT CYLINDER

Canopy mounts to standard J-box. Extruded aluminum center tube is a lamp holder and electronic ballast housing, ballast removes from bottom. Extruded aluminum top and bottom cylinder is 1/4" thick with aluminum cover plates and has a silver powder coat finish. Top plate will mount to rigid stem or aircraft cable. Mounting option and length of suspension must be specified, see back page for details. Fixtures use three T8 lamps wrapped by a seamless cylindrical Acrylic diffuser. See order info for downlight options. Separate switch leg for downlight is standard. PAR lamps are replaceable without removing cover. Dimming ballasts available for 32W and 17W lamps only. U.L. listed for damp locations.

TYPE: F3

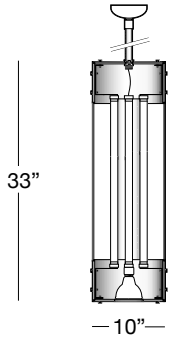
PROJECT: VMC

ORDER NUMBER: 6332-2-BLC-105

Model#	Voltage	Mount	Length	Option
6332	2	BLC	105	None
	1–120V **2**–277V	**BLA**–Pipe **BLC**–Cable	In Inches	**D3**–Dimming

Example:

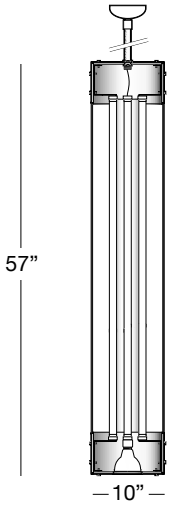
6320.	2.	BLA.	96	D3



6301
Three 17W T8 lamps, with one 75W PAR30S. *120V only.*

6321
Three 17W T8 lamps, with one 39W Metal Halide PAR30.

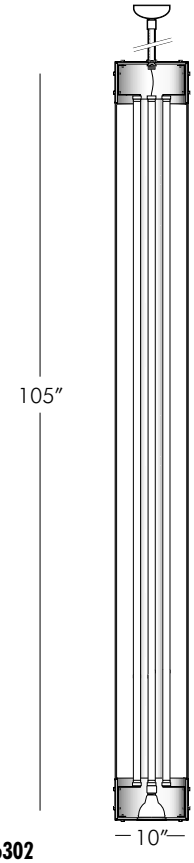
6331
Three 17W T8 lamps, with no downlight.



6300
Three 32W T8 lamps, with one 75W PAR30S. *120V only.*

6320
Three 32W T8 lamps, with one 39W Metal Halide PAR30.

6330
Three 32W T8 lamps, with no downlight.



6302
Three 59W T8 lamps, with one 75W PAR30S. *120V only.*

6322
Three 59W T8 lamps, with one 39W Metal Halide PAR30.

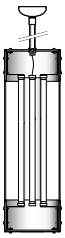
6332
Three 59W single pin T8 lamps, with no downlight.

BURBANK,
CALIFORNIA,
91505
WWW.
DELRAY
LIGHTING.
COM

DEC 2008

3-17 WATT

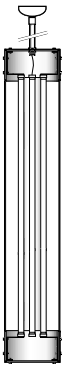
3-17W T8



6331
3-17W T8
G13 Base
Total lumens: 4200 mean
Total luminaire efficiency: 57.3%

3-32 WATT

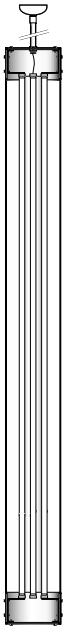
3-32W T8



6330
3-32W T8
G13 Base
Total lumens: 8850 mean
Total luminaire efficiency: 57.4%

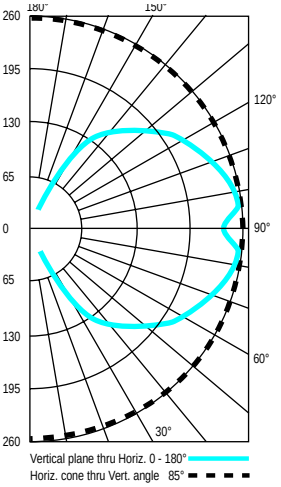
3-59 WATT

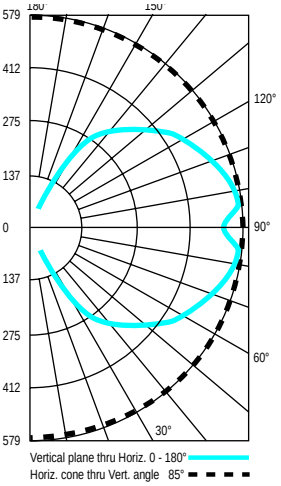
3-59W T8

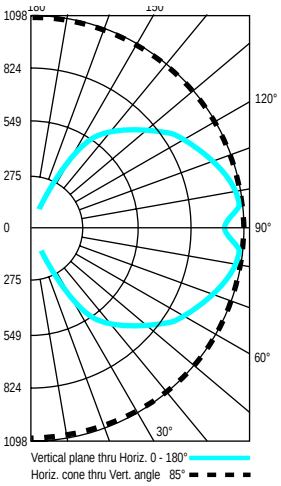


6332
3-59W T8
Fa8 Base
Total lumens: 17700 mean
Total luminaire efficiency: 57.3%

CP DISTRIBUTION







COEFFICIENTS OF UTILIZATION

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	61	61	61
1	52	47	43
2	45	39	34
3	41	33	28
4	37	29	23
5	33	25	19
6	31	22	17
7	28	20	15
8	26	18	13
9	24	16	11
10	22	15	10

MOUNTING OPTIONS

PIPE MOUNT
Order **BLA** mount for 1/2" pipe. Length must be specified. Includes ball aligner canopy rated for 75 lbs. and mounts to standard J-boxes.

CABLE MOUNT
Order **BLC** mount for any length, must be specified. 3/32" stainless steel aircraft cable adjusts with push button cable grippers for easy field adjustment. Not for use in windy areas.

DIMMING BALLAST

D3 Advance Mark X
- Wattage: 3-17 or 3-32
- Voltage: 120 or 277 (must be specified)
- Range: 5–100%
- Control wires: none
- Dimmers: standard incandescent

ACRYLIC DIFFUSER CLEANING

Warning: Do not clean with ammonia based cleaners (e.g. Windex®). Use only water or cleaners specifically formulated for cleaning plastics.

LR6-DR1000 6" Recessed Downlight

Product Description

The LR6-DR1000 is a recessed architectural downlight that utilizes Cree TrueWhite™ Technology to deliver 1,000 lumens of high quality light, with an unprecedented efficacy of 80 lumens per watt. Its exceptional CRI of 90 brings out the true beauty of applications ranging from offices, schools, hospitals, restaurants, airports, hotels, and homes. US Patent #7,213,940. Numerous patents pending.

Performance Summary

- Utilizes Cree TrueWhite™ technology
- Delivered light output = 1,000 lumens
- Input power = 12.5 Watts
- CRI = 90
- CCT = 2700K or 3500K
- Dimmable to 20%
- Three Year Warranty

Ordering Information

Intended for use with Cree H6 Housing, may be retrofitted into 6" housings from select manufacturers using the supplied GU24 whip adapter

Housing

H6-GU24 - Recessed Housing, 120V

Light Engine

LR6-DR1000 - 120V, Incandescent Color (2700K), GU24 Base

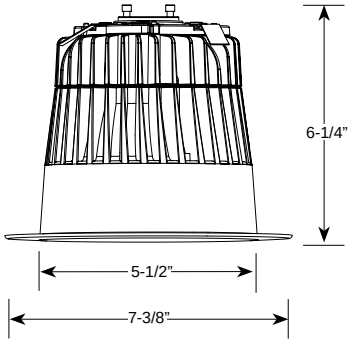
LR6C-DR1000 - 120V, Neutral Color (3500K), GU24 Base

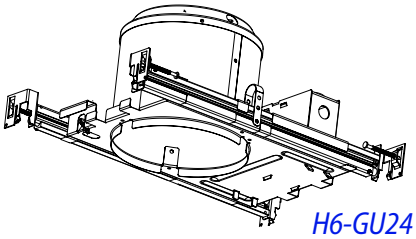
Accessories - Reference accessory spec sheets

Accessory Trims

- **LT6A-DR** - Diffuse anodized trim
- **LT6AW-DR** - Wheat diffuse anodized trim
- **LT6AP-DR** - Pewter diffuse anodized trim
- **LT6BB-DR** - Flat black trim
- **LT6WH-DR** - Smooth white trim

LR6C-DR1000





H6-GU24

CREE LED Lighting

CREE TRUE WHITE TECHNOLOGY

LR6-DR1000 6" Recessed Downlight

Product Information

Cree TrueWhite™ Technology

- A better way to generate white light that utilizes a patented mixture of unsaturated yellow and saturated red LEDs.
- Tuned to optimal color point before shipment.
- Color management system maintains color consistency over time and temperature.
- Designed to last 50,000 hours and maintain at least 70% of initial lumen output in IC and non-IC installations.

Construction

- Durable die-cast aluminum upper housing, lower housing, and upper cover.
- Integrated thermal management system conducts heat away from LEDs and transfers it to the surrounding environment. LED junction temperatures stay below specified maximums.
- Designed for use with H6-GU24 housing from Cree, 6" recessed architectural housing with rugged, integral, extruded aluminum bar hangers (h = 7")

Optical System

- Proprietary optical system utilizes a unique combination of reflective and refractive optical components to achieve a uniform, comfortable appearance. Pixelation and direct view of unshielded LEDs is eliminated.
- White Lower Reflector balances brightness of refractor with the ceiling to create comfortable high-angle appearance. Works with refractor to deliver an optimized distribution that illuminates walls and vertical surfaces increasing the perception of spaciousness.

Electrical System

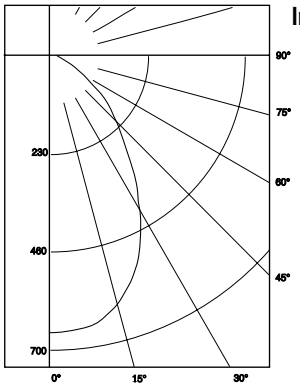
- Integral, high efficiency driver and power supply. Power factor > 0.9 Input voltage = 120V, 60Hz
- Dimmable to 20% with certain incandescent dimmers (reference www.CreeLEDLighting.com for recommended dimmers)

Regulatory and Voluntary Qualifications

- Tested and certified to UL standards. Suitable for damp locations.
- Utilize GU-24 base for new construction projects in California or other areas where high efficacy line voltage sockets are required.
- Exceeds California Title-24 high efficacy luminaire requirements.

Photometry

LR6 -DR1000
Based on OnSpex 30012426-F



Intensity (Candlepower) Summary

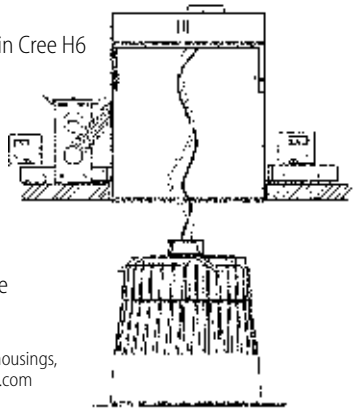
ANGLE	MEAN CP
0°	597
5°	593
15°	559
25°	463
35°	329
45°	207
55°	120
65°	61
75°	32
85°	7
90°	0

Zonal Lumen Summary

ZONE	LUMENS	%LAMP	%FIX
0°- 30°	424	42.42	42.42
0°- 40°	629	62.89	62.89
0°- 60°	897	89.71	89.71
0°- 90°	1000	100.00	100.00

Installation

- Designed to easily install in Cree H6 and 6" housings from select manufacturers.*
- Quick install system utilizes a unique retention feature. Simply attach socket to LR6-DR1000. Move light to ready position and slide into housing.



* for information on compatible housings, reference www.creeLEDlighting.com

Cree LED Lighting
Morrisville • NC • 27560 • USA
1-919-287-7700
Fax 1-919-991-0730
www.CreeLEDLighting.com

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Sheet# LR6-DR1000-03/2010

EB1L17B

QUICKTRONIC® T8 Instant Start UNIVERSAL VOLTAGE

High Efficiency Series — *Low Ballast Factor*

Lamp/Ballast Guide

32W T8 - OCTRON®
QHE ISL SC Models
1-lamp QHE1x32T8/UNV
2-lamp QHE2x32T8/UNV
3-lamp QHE3x32T8/UNV
4-lamp QHE4x32T8/UNV

Also operates:
FBO32, FBO31, FO25, FBO24, FO17, FBO16, FO30/SS (30W), FBO30/SS (30W), FBO29/SS (29W), FO28/SS (28W) & FO25/SS (25W)

FO40T8 operation:
1 lamp on 2L ballast
2 lamps on 3L ballast
3 lamps on 4L ballast

Note: FO40T8 0°F Starting Temp.

Key System Features

- High Efficiency Systems over 90% efficient
- **Over 100 LPW (lumens/watt)** with OCTRON SUPERSAVER® lamps
- **Lowest power T8 I.S. Systems**
- Universal voltage (120-277)
- Small Can enclosure size
- 30-50% Energy savings
- -20°F (-29°C) min. starting temp. for OCTRON lamps
- 60°F (16°C) min. starting temperature with OCTRON SUPERSAVER lamps
- <10% THD
- Virtually eliminates lamp flicker

Application Information

SYLVANIA QUICKTRONIC High Efficiency
is ideally suited for:

- Any applications where the lowest power T8 systems are needed for **maximum energy savings**
- Energy Retrofits
- Commercial & Retail
- Hospitality & Institutional
- New Construction

SYLVANIA QUICKTRONIC High Efficiency (QHE) energy-saving electronic T8 ballasts save up to 6% over standard electronic ballasts without compromising light output or lamp life. The added energy savings also provides for a quicker payback. QHE ballasts also meet the most demanding utility rebate standards.

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates OCTRON T8 lamps with maximum efficacy and high lumen output, and provides **30-50% energy savings** when compared to F40T12 magnetic systems.

Small can enclosure allows for low profile fixture design. Small size also provides transportation, inventory and ergonomic benefits.

This product is also offered in new banded packaging and pallet packs.

SYLVANIA QUICKTRONIC High Efficiency (QHE) is also covered by our QUICK 60+® warranty, the first and most comprehensive lamp & ballast system warranty in the industry.

Parallel circuitry is utilized to keep the remaining lamps lit if one or more should go out.

System Information

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by half.

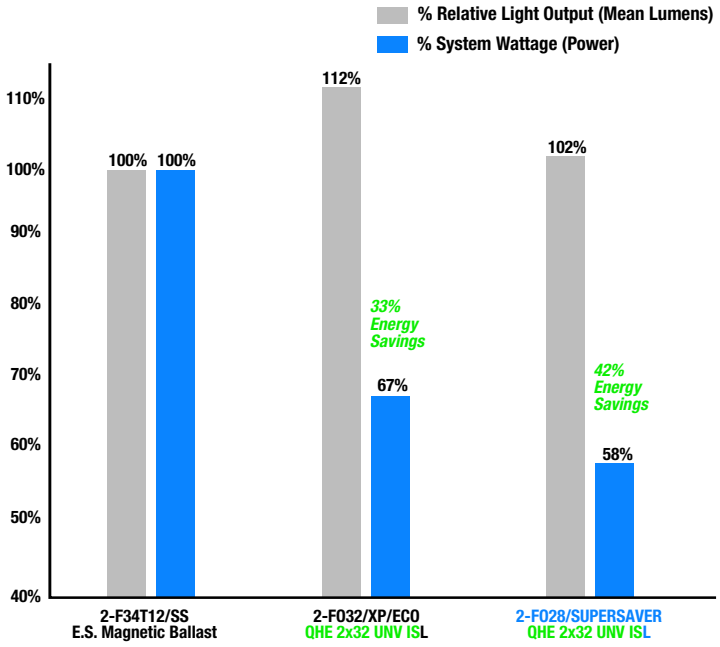
SYLVANIA QUICKTRONIC High Efficiency (QHE) uses instant start operation to provide the highest system efficacy and to assure low temperature starting capability. Instant start also provides for maximum remote wiring distances.

SYLVANIA QUICKTRONIC High Efficiency (QHE) electronic ballasts have very low harmonic distortion (<10% THD) for high system performance.

Ballast operates at >42kHz to reduce potential interference with infrared control systems.

A complete OSRAM SYLVANIA System Performance Guide showing performance characteristics for all combinations of lamps and ballasts is available upon request.

System Type (2-lamp)	Input Wattage	Initial Lumens	System LPW	Mean Lumens	Energy Savings
F34T12 - E.S. Magnetic Ballast	72	4660	65	3960	Baseline
FO32/XP - QHE2x32T8/UNV ISL-SC	**48**	**4680**	**98**	**4445**	**33%**
FO28/SS - QHE2x32T8/UNV ISL-SC	**42**	**4250**	**101**	**4040**	**42%**



SEE THE WORLD IN A NEW LIGHT SYLVANIA

Low Ballast Factor

T8 Instant Start UNV VOLTAGE

High Efficiency Systems

<10% THD High Efficiency Electronic T8 Fluorescent Systems (Low Ballast Factor)

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
49861	QHE 1X32T8/UNV ISL-SC	120-277	0.21/0.09	F032/XP	3000	1	0.78	2340	25	94
			0.20/0.09	F030/SS	2850	1	0.78	2220	24	93
			0.19/0.08	**F028/SS**	**2725**	**1**	**0.78**	**2125**	**22**	**97**
			0.17/0.08	F025/SS	2475	1	0.78	1930	20	97
49863	QHE 2X32T8/UNV ISL-SC	120-277	0.41/0.18	F032/XP	3000	2	0.78	4680	48	98
			0.38/0.16	F030/SS	2850	2	0.78	4445	45	99
			0.35/0.15	**F028/SS**	**2725**	**2**	**0.78**	**4250**	**42**	**101**
			0.32/0.14	F025/SS	2475	2	0.78	3860	37	104
49865	QHE 3X32T8/UNV ISL-SC	120-277	0.61/0.27	F032/XP	3000	3	0.78	7020	71	99
			0.58/0.25	F030/SS	2850	3	0.78	6670	68	98
			0.53/0.23	**F028/SS**	**2725**	**3**	**0.78**	**6380**	**63**	**101**
			0.48/0.21	F025/SS	2475	3	0.78	5790	55	105
49867	QHE 4X32T8/UNV ISL-SC	120-277	0.80/0.35	F032/XP	3000	4	0.78	9360	95	99
			0.75/0.32	F030/SS	2850	4	0.78	8890	89	100
			0.71/0.31	**F028/SS**	**2725**	**4**	**0.78**	**8500**	**84**	**101**
			0.62/0.27	F025/SS	2475	4	0.78	7720	74	104

Products listed above are 10 packs.

840 PC Pallet Packs

49862 QHE1x32T8/UNV-ISL-SC-PAL
49864 QHE2x32T8/UNV-ISL-SC-PAL
49866 QHE3x32T8/UNV-ISL-SC-PAL
49868 QHE4x32T8/UNV-ISL-SC-PAL

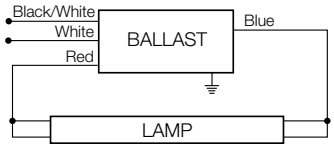
10 PC Banded Packs

49837 QHE1x32T8/UNV-ISL-SC-B
49838 QHE2x32T8/UNV-ISL-SC-B
49839 QHE3x32T8/UNV-ISL-SC-B
49840 QHE4x32T8/UNV-ISL-SC-B

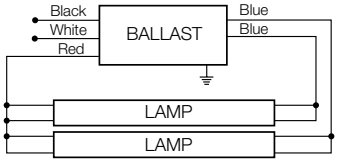
Performance Guide

Data based upon SYLVANIA OCTRON® XP™ lamps shown. QUICKTRONIC QHE Instant Start ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications.

QHE Instant Start ballasts will operate F17, F25 and F32 (and the U-Bend equivalent) T8 lamps. Complete performance data is available in the QUICKSYSTEMS section of the SYLVANIA Electronic Ballast Catalog.

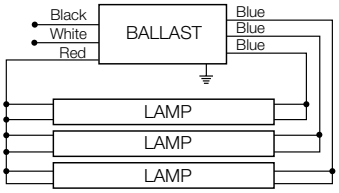


QUICKTRONIC 1x32



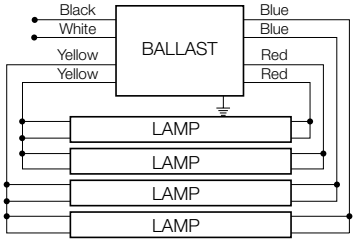
Note: For one lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 2x32



Note: For two lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 3x32



Note: For three lamp application, cap any unused blue lead. Insulate to 600 volts.

QUICKTRONIC 4x32

Specifications[1]

Starting Method: Instant Start
Ballast Factor: 0.78
Circuit Type: Parallel
Lamp Frequency: > 40KHz
Lamp CCF: Less than 1.7
Starting Temp: [1]
-20°F for OCTRON T8 lamps;
60°F for SUPERSAVER® T8 lamps
0°F for FO40T8
Input Frequency: 50/60 Hz
Low THD: < 10%
Power Factor: > 98%
Voltage Range: 108-305V

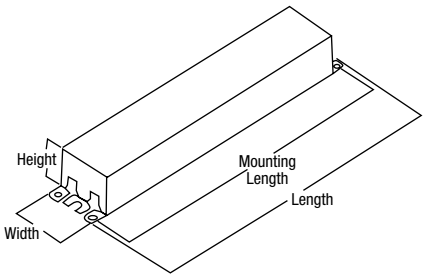
UL Listed Class P, Type 1 Outdoor
CSA Certified (where applicable)
70°C Max Case Temperature
FCC 47CFR Part 18 Non-Consumer Class A Sound Rating
ANSI C62.41 Cat. A Transient Protection
Remote Mounting up to 20 feet [1]

[1] Operation below 50°F may affect light output or lamp operation – see "Low Temp. Starting" definition.

Dimensions:
Overall: 9.5" L x 1.68" W x 1.18" H
Mounting: 8.90"

Packaging:
Quantity: 10 pieces/840 pieces
Weight: 1.6 lbs each (approx)

Wiring:
Leads only (no connectors provided)



System Life / Warranty

QUICKTRONIC products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

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Ordering Guide

Specifications subject to change without notice.

Item Number — **49863 QHE 2 x 32T8 / UNV ISL-SC** — Case Size
QUICKTRONIC High Efficiency
Number of Lamps
Starting/Ballast Factor
Line Voltage (120-277V)
Primary Lamp Wattage

OSRAM SYLVANIA National Customer Service and Sales Center
1-800-LIGHTBULB (1-800-544-4828)
www.sylvania.com

the system solution®

EB2LB

QUICKTRONIC® T8 Instant Start UNIVERSAL VOLTAGE

High Efficiency Series *Low Ballast Factor*

Lamp/Ballast Guide

32W T8 - OCTRON®
QHE ISL SC Models
1-lamp QHE1x32T8/UNV
2-lamp QHE2x32T8/UNV
3-lamp QHE3x32T8/UNV
4-lamp QHE4x32T8/UNV

Also operates:
FBO32, FBO31, FO25, FBO24, FO17, FBO16, FO30/SS (30W), FBO30/SS (30W), FBO29/SS (29W), FO28/SS (28W) & FO25/SS (25W)

FO40T8 operation:
1 lamp on 2L ballast
2 lamps on 3L ballast
3 lamps on 4L ballast

Note: FO40T8 0°F Starting Temp.

Key System Features

- High Efficiency Systems over 90% efficient
- **Over 100 LPW (lumens/watt)** with OCTRON SUPERSAVER® lamps
- **Lowest power T8 I.S. Systems**
- Universal voltage (120-277)
- Small Can enclosure size
- 30-50% Energy savings
- -20°F (-29°C) min. starting temp. for OCTRON lamps
- 60°F (16°C) min. starting temperature with OCTRON SUPERSAVER lamps
- <10% THD
- Virtually eliminates lamp flicker

Application Information

SYLVANIA QUICKTRONIC High Efficiency
is ideally suited for:

- Any applications where the lowest power T8 systems are needed for **maximum energy savings**
- Energy Retrofits
- Commercial & Retail
- Hospitality & Institutional
- New Construction

SYLVANIA QUICKTRONIC High Efficiency (QHE) energy-saving electronic T8 ballasts save up to 6% over standard electronic ballasts without compromising light output or lamp life. The added energy savings also provides for a quicker payback. QHE ballasts also meet the most demanding utility rebate standards.

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates OCTRON T8 lamps with maximum efficacy and high lumen output, and provides **30-50% energy savings** when compared to F40T12 magnetic systems.

Small can enclosure allows for low profile fixture design. Small size also provides transportation, inventory and ergonomic benefits.

This product is also offered in new banded packaging and pallet packs.

SYLVANIA QUICKTRONIC High Efficiency (QHE) is also covered by our QUICK 60+® warranty, the first and most comprehensive lamp & ballast system warranty in the industry.

Parallel circuitry is utilized to keep the remaining lamps lit if one or more should go out.

System Information

SYLVANIA QUICKTRONIC High Efficiency (QHE) operates from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by half.

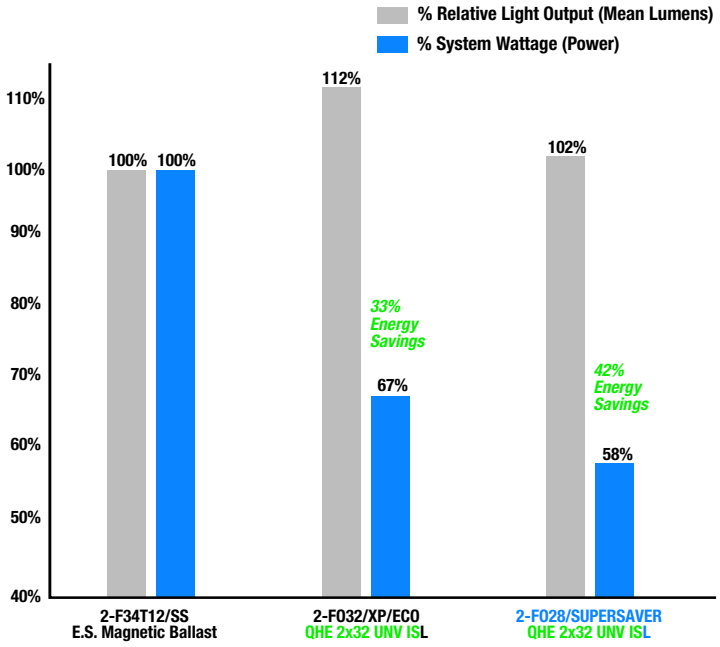
SYLVANIA QUICKTRONIC High Efficiency (QHE) uses instant start operation to provide the highest system efficacy and to assure low temperature starting capability. Instant start also provides for maximum remote wiring distances.

SYLVANIA QUICKTRONIC High Efficiency (QHE) electronic ballasts have very low harmonic distortion (<10% THD) for high system performance.

Ballast operates at >42kHz to reduce potential interference with infrared control systems.

A complete OSRAM SYLVANIA System Performance Guide showing performance characteristics for all combinations of lamps and ballasts is available upon request.

System Type (2-lamp)	Input Wattage	Initial Lumens	System LPW	Mean Lumens	Energy Savings
F34T12 - E.S. Magnetic Ballast	72	4660	65	3960	Baseline
FO32/XP - QHE2x32T8/UNV ISL-SC	**48**	**4680**	**98**	**4445**	**33%**
FO28/SS - QHE2x32T8/UNV ISL-SC	**42**	**4250**	**101**	**4040**	**42%**



SEE THE WORLD IN A NEW LIGHT SYLVANIA

Low Ballast Factor

T8 Instant Start UNV VOLTAGE

High Efficiency Systems

<10% THD High Efficiency Electronic T8 Fluorescent Systems (Low Ballast Factor)

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
49861	QHE 1X32T8/UNV ISL-SC	120-277	0.21/0.09	F032/XP	3000	1	0.78	2340	25	94
			0.20/0.09	F030/SS	2850	1	0.78	2220	24	93
			0.19/0.08	**F028/SS**	**2725**	**1**	**0.78**	**2125**	**22**	**97**
			0.17/0.08	F025/SS	2475	1	0.78	1930	20	97
49863	QHE 2X32T8/UNV ISL-SC	120-277	0.41/0.18	F032/XP	3000	2	0.78	4680	48	98
			0.38/0.16	F030/SS	2850	2	0.78	4445	45	99
			0.35/0.15	**F028/SS**	**2725**	**2**	**0.78**	**4250**	**42**	**101**
			0.32/0.14	F025/SS	2475	2	0.78	3860	37	104
49865	QHE 3X32T8/UNV ISL-SC	120-277	0.61/0.27	F032/XP	3000	3	0.78	7020	71	99
			0.58/0.25	F030/SS	2850	3	0.78	6670	68	98
			0.53/0.23	**F028/SS**	**2725**	**3**	**0.78**	**6380**	**63**	**101**
			0.48/0.21	F025/SS	2475	3	0.78	5790	55	105
49867	QHE 4X32T8/UNV ISL-SC	120-277	0.80/0.35	F032/XP	3000	4	0.78	9360	95	99
			0.75/0.32	F030/SS	2850	4	0.78	8890	89	100
			0.71/0.31	**F028/SS**	**2725**	**4**	**0.78**	**8500**	**84**	**101**
			0.62/0.27	F025/SS	2475	4	0.78	7720	74	104

Products listed above are 10 packs.

840 PC Pallet Packs

49862 QHE1x32T8/UNV-ISL-SC-PAL
49864 QHE2x32T8/UNV-ISL-SC-PAL
49866 QHE3x32T8/UNV-ISL-SC-PAL
49868 QHE4x32T8/UNV-ISL-SC-PAL

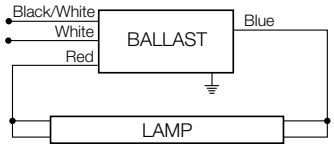
10 PC Banded Packs

49837 QHE1x32T8/UNV-ISL-SC-B
49838 QHE2x32T8/UNV-ISL-SC-B
49839 QHE3x32T8/UNV-ISL-SC-B
49840 QHE4x32T8/UNV-ISL-SC-B

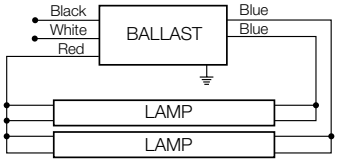
Performance Guide

Data based upon SYLVANIA OCTRON® XP™ lamps shown. QUICKTRONIC QHE Instant Start ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications.

QHE Instant Start ballasts will operate F17, F25 and F32 (and the U-Bend equivalent) T8 lamps. Complete performance data is available in the QUICKSYSTEMS section of the SYLVANIA Electronic Ballast Catalog.

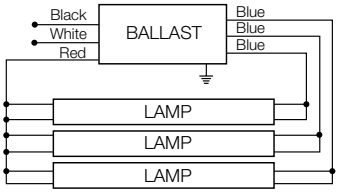


QUICKTRONIC 1x32



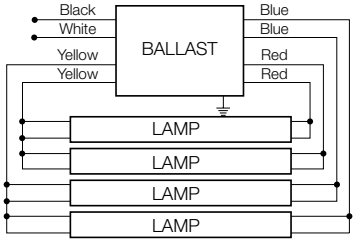
Note: For one lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 2x32



Note: For two lamp application, cap any blue lead. Insulate to 600 volts.

QUICKTRONIC 3x32



Note: For three lamp application, cap any unused blue lead. Insulate to 600 volts.

QUICKTRONIC 4x32

Specifications[1]

Starting Method: Instant Start
Ballast Factor: 0.78
Circuit Type: Parallel
Lamp Frequency: > 40KHz
Lamp CCF: Less than 1.7
Starting Temp: [1]
-20°F for OCTRON T8 lamps;
60°F for SUPERSAVER® T8 lamps
0°F for FO40T8
Input Frequency: 50/60 Hz
Low THD: < 10%
Power Factor: > 98%
Voltage Range: 108-305V

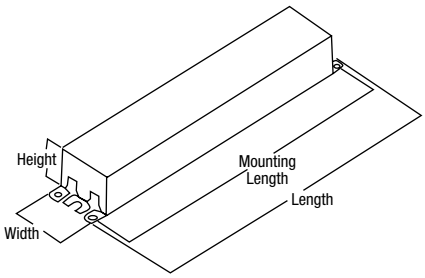
UL Listed Class P, Type 1 Outdoor
CSA Certified (where applicable)
70°C Max Case Temperature
FCC 47CFR Part 18 Non-Consumer Class A Sound Rating
ANSI C62.41 Cat. A Transient Protection
Remote Mounting up to 20 feet [1]

[1] Operation below 50°F may affect light output or lamp operation – see "Low Temp. Starting" definition.

Dimensions:
Overall: 9.5" L x 1.68" W x 1.18" H
Mounting: 8.90"

Packaging:
Quantity: 10 pieces/840 pieces
Weight: 1.6 lbs each (approx)

Wiring:
Leads only (no connectors provided)



System Life / Warranty

QUICKTRONIC products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

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Ordering Guide

Specifications subject to change without notice.

Item Number — **49863 QHE 2 x 32T8 / UNV ISL-SC** — Case Size
QUICKTRONIC High Efficiency
Number of Lamps
Starting/Ballast Factor
Line Voltage (120-277V)
Primary Lamp Wattage

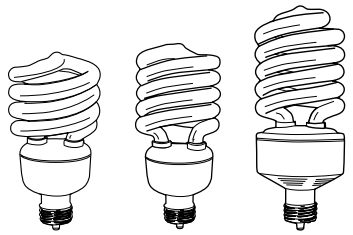
OSRAM SYLVANIA National Customer Service and Sales Center
1-800-LIGHTBULB (1-800-544-4828)
www.sylvania.com

the system solution®

289 Series

SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life

NEW

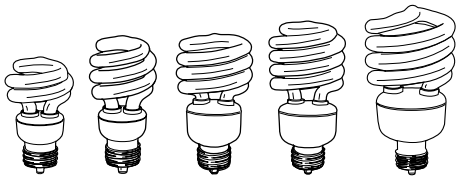


Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28927	27	100	1850	Medium	5.7	2.7
28932	32	130	2100	Medium	6.1	2.7
28942	42	150	2800	Medium	7.0	2.8

280 Series

SpringLamp® CFL, Electronic, NPF,
120 volts, 15,000 Hours Avg. Life

NEW

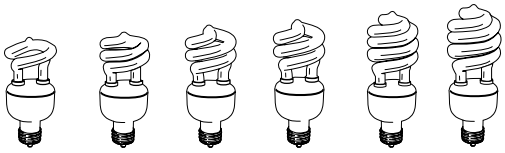


Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28009	9	40	550	Medium	3.6	1.9
28013	13	60	900	Medium	3.9	1.9
28018	18	75	1200	Medium	4.6	2.3
28023	23	100	1600	Medium	5.0	2.3
28027	27	100	1850	Medium	5.7	2.7

182 Series

SpringLamp® CFL, Electronic, HPF,
120 volts, 10,000 Hours Avg. Life

HPF



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
18214*	14	60	900	Medium	4.7	1.7
18219*	19	75	1250	Medium	4.7	2.1
18209	9	35	400	Medium	4.7	2.2
18211	11	40	550	Medium	4.8	2.2
18215 ★	15	60	930	Medium	5.3	2.2
18220 ★	20	75	1200	Medium	5.5	2.2
18223 ★	23	90	1400	Medium	5.8	2.2
18227	27	100	1950	Medium	6.0	2.2

* *Mini SpringLamp®* ★ *Energy Star*

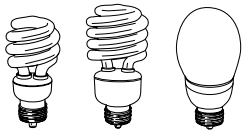
Fresh² Ti SpringLamp®

The World's First "Fresh Bulb" is a revolutionary new product that breaks down odors while providing energy efficient light.

fresh²Ti

F2

Fresh² Ti SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life, Medium base



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28914F2	14	60	800	Medium	4.7	1.7
28923F2	23	100	1600	Medium	5.0	2.3
11314F2	14	52	700	Medium	4.8	2.4

3 Way SpringLamp®

- *3 distinct light levels*
- *FCC compliant at each level*
- *150w incandescent equivalent*

3 way

190 Series

3 Way SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life, Medium base

Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	M.O.L. (inches)	Diameter (inches)
19032 ★	14/ 19/ 32	40/ 75/ 150	450/ 1100/ 1950	6.2	2.4

Dimmable SpringLamp®

The dimming range is from 100% down to 20%.

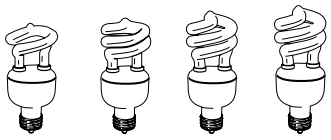
DIM

101 Series

SpringLamp® CFL, Electronic, HPF,
120 volts, 10,000 Hours Avg. Life

HPF

DIM



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
10109	9	35	400	Medium	4.7	2.2
10111	11	40	550	Medium	4.8	2.2
10115	15	60	930	Medium	5.3	2.2
10120 ★	20	75	1200	Medium	5.5	2.2

FINELITE

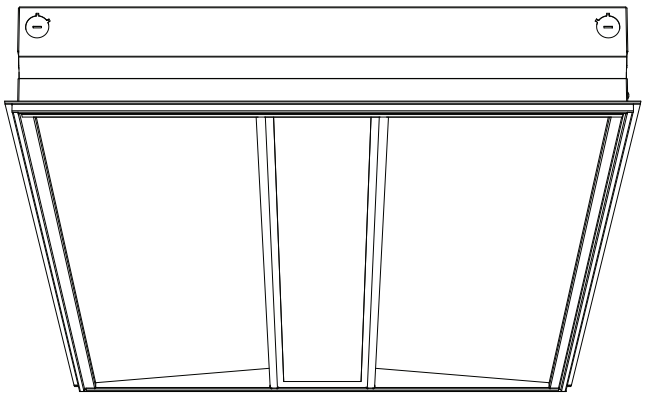
High Performance Recessed (HPR) 2x4

Project HPR-1-2x4-RCO-2T5HO-120V-SC-C1-IS1.00

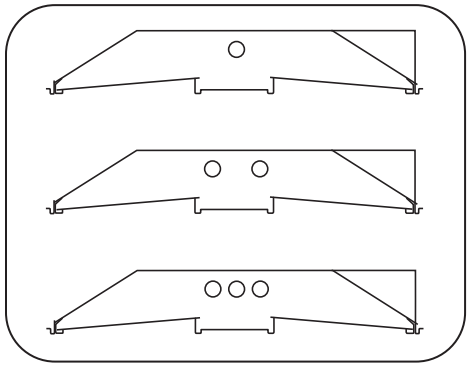
Firm Name McKinstry

Date_____ Type F1

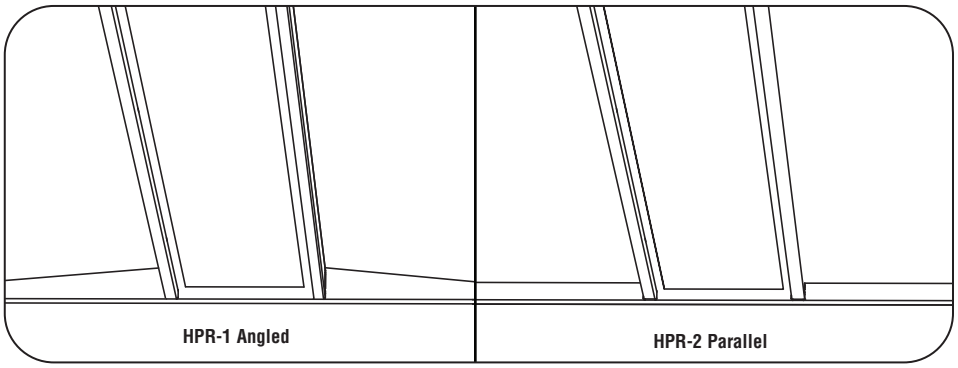
HPR is a highly effective recessed luminaire delivering excellent visual comfort and outstanding performance for offices, schools, healthcare, and retail applications. Advanced optical designs make HPR a powerful solution for low-ceiling applications and eliminate the shadows common to other recessed products.



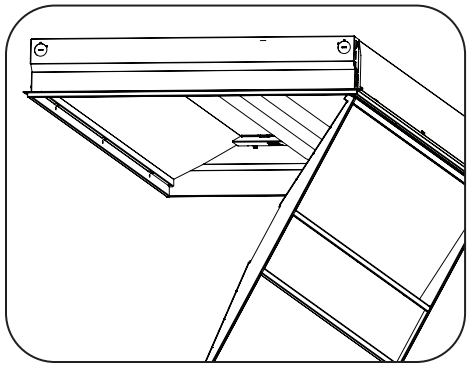
FEATURES



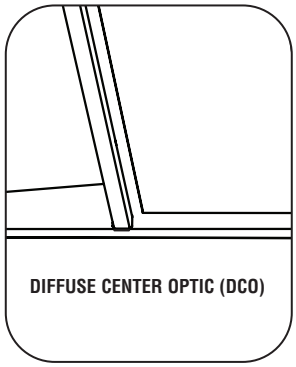
LAMP OPTIONS:
Available in 1, 2, or 3 T8, T5, or T5HO lamp cross sections.

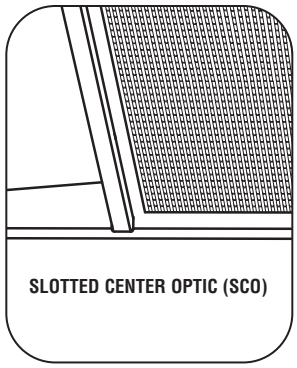


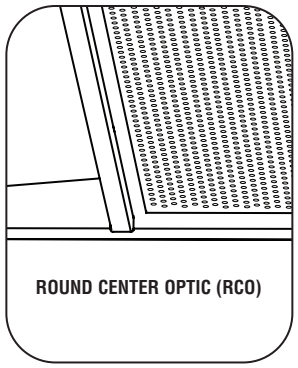
LUMINAIRE STYLES:
HPR-1 features lenses angled toward the center-shielding element. HPR-2 features lenses parallel to the ceiling plane.



HINGED DOOR ASSEMBLY:
The hinged door assembly makes relamping and maintenance fast and easy.







CENTER SHIELDING OPTIONS:
HPR is available with three different center-shielding options: a diffuse center optic, a slotted center optic, and a round center optic.

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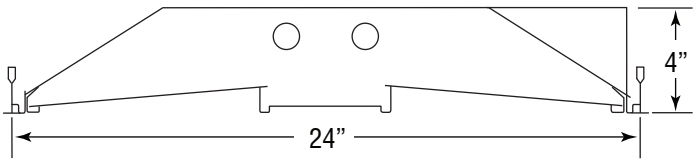
FINELITE

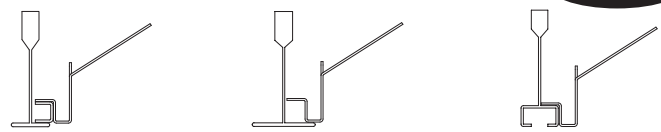
High Performance Recessed (HPR) 2x4

DIMENSIONS



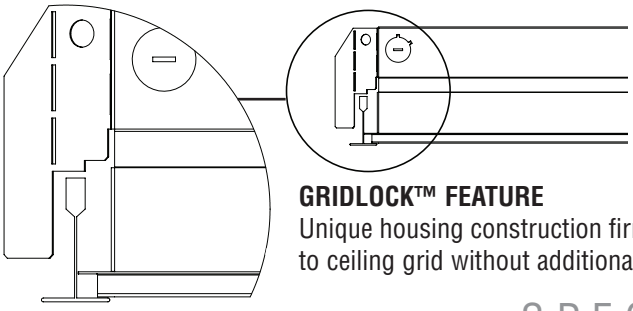
CEILING SYSTEM INFORMATION

IC - RATED

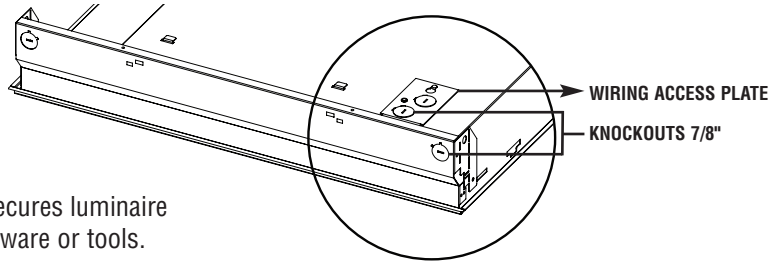


9/16” T-Bar | 15/16” T-Bar | Screw Slot T-Bar

CEILING SYSTEMS DETAIL



WIRING ACCESS DETAIL



GRIDLOCK™ FEATURE

Unique housing construction firmly secures luminaire to ceiling grid without additional hardware or tools.

SPECIFICATIONS

CONSTRUCTION:
Fixture assembly constructed using die-formed 20-gauge cold-rolled steel housing and ends. All components are hard-tooled to tolerances of 0.010". Ballast compartment is accessible from below. Optical system retained using hinged door frame assembly to provide easy access to ballast compartment and for re-lamping from below without the need of tools. Seismic brackets are integrated into the fixture assembly. Additional wire entrances are positioned on the ends of the housing to allow easy wiring access for the installer.

REFLECTORS:
Die-formed 20-gauge cold-rolled steel reflectors are finished in 96 LG high reflectance matte white powder coat paint.

OPTICAL SYSTEM:
Optical system components include side lens panels and a center optic element held in place with a frame constructed from die-formed cold-rolled steel. The side lenses are UV-stabilized and impact-resistant frosted virgin acrylic, 0.080” thick. They are either angled toward the center optic or parallel to the ceiling plane.

Available options for the center optic elements:

Diffuse Center Optic: UV-stabilized and impact-resistant frosted virgin acrylic. Optional Soft Glow Optic (SGO) available for T8 only.

Slotted Center Optic: Die-formed cold-rolled steel panel with 1/16" x 1/2" rectangular hole pattern. Virgin acrylic overlay.

Round Center Optic: Die-formed cold-rolled steel panel with precision-punched 3/32” round hole pattern arranged in staggered formation. Virgin acrylic overlay.

LAMPING:
Available in 1, 2, or 3 T8, T5, or T5HO lamp cross sections.

BALLAST:
UL listed Class P. Electronic instant-start ballast <10% THD, 0.88 BF standard for T8 lamps. Electronic program-start ballasts <10% THD, 1.0 BF standard for T5/T5HO lamps. Contact factory for available BF’s. Optional adders: program-start ballasts (standard for T5/T5HO), 347V, emergency battery packs, dimming or bi-level ballasts (controls by others).

ELECTRICAL:
Fixtures and electrical components are ETL listed conforming to UL1598 in the USA, and Canada and ETL listed certified to CAN/CSA C22.2 No. 250.0. In accordance with NEC code 410.73 (G) this luminaire contains an internal ballast disconnect. IC-Rated for all lamping except 3 T5HO. Optional Chicago Plenum available. Contact factory.

Daylight Sensor | Occupancy Sensor

ON-BOARD CONTROLS:
Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

MOUNTING:
Standard flange design works with most lay-in ceiling types. Integral pryout tabs secure luminaire to ceiling grid from above. Fixture offers tie-in locations for tie-wire on all corners. Consult local code for appropriate tie-wire recommendations. Drywall Kit available. Surface mount version available; refer to separate tech sheet.

AIR RETURN:
Refer to the 2x4, or 2x2 Air Return tech sheets for more information.

FEED:
18-gauge wire standard.

FINISH:
Housing and door assembly painted with 96 LG high reflectance matte white powder coat paint. Available in matte white only.

WIRING:
Master / Satellite wiring available. Contact factory for configuration options. Optional whips (with flex connectors) supplied in a max. of 11’ lengths.

WEIGHT:
Maximum weight: 2x4 - 33 lbs.

ORDERING GUIDE **HPR - 2 - 2X4 - DCO - 1 T8 - 277 - SC - C1 - IS.88 - OBO**

Finelite Series **HPR**
Luminaire Styles (1-Angled, 2-Parallel)
Size (2x4)
Center Optic (DCO-Diffuse, SCO-Slotted, RCO-Round)
Lamp Type (1, 2 or 3 T8, T5 or T5HO)
Voltage (120, 277, 347V)
Circuiting (SC-Single Circuit, DC-Dual Circuit, SD-Step Dimming)
Mounting (C1-1" T-Bar, C2-9/16" T-Bar, C3-Screw Slot, DW-Drywall Kit, SM-Surface Mount)
Ballast (IS-Instant Start, PS-Program Start, BL-Bi-level, DI-Dimming, and specify BF*)
On-Board Controls (OBD-Daylight, OBO-Occupancy, OBB-Both)

** Standard 0.88 for T8 lamps, 1.0 for T5 or T5HO. Contact factory for available BF’s*
Contact factory for Master/Satellite and factory-supplied whip options.

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T504PRI24

METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity.

		Type
Catalog #		
Project	Federal Way PS	
Comments	For Illahee MS, Saghalie MS, Green Gables ES, Sherwood ES, Enterprise ES	Date
Prepared by	JDS	9/4/09

APPLICATION

HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, etc.

SPECIFICATION FEATURES

A···Construction

Full bodied 20 gauge housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KO's for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

B···Electrical

Ballasts are Class "P" and are positively secured by mounting bolts. Pressure-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. UL/CUL listed. Suitable for damp locations.

C···Finish

White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

D···Downlight/Uplight Optics

Die formed reflectors are faceted with two optical distributions –medium and wide. Medium beam optical modules utilize 95% specular Miro 4 substrate while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame & lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

E···Mounting

The HB series is ideally suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

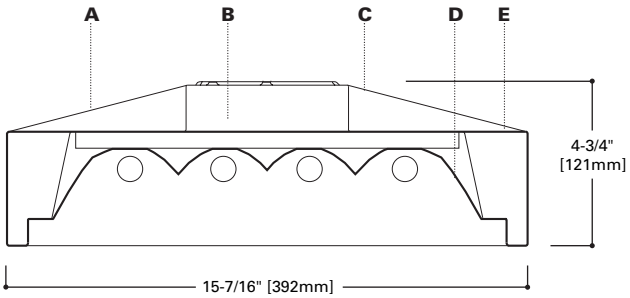
F···Options

Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY HB SERIES

15" x 4' High-Bay
4 Lamp

HIGH-BAY INDUSTRIAL LUMINAIRE



ENERGY DATA

Input Watts:
EB Ballast
432 (109)

EB/Plus Ballast
432 (147)

ER Ballast
432 (112)
454 (229)

ER/Plus Ballast
432 (144)

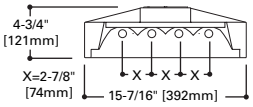
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular Inserts)
Catalog Number: HB-454T5-UPL

Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

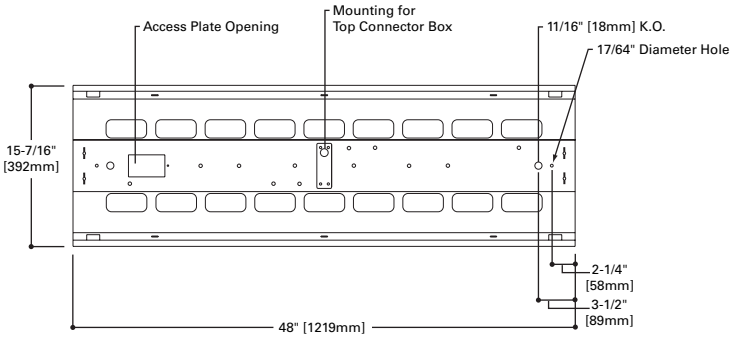
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

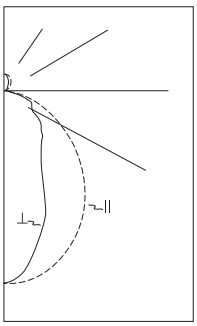
LAMP CONFIGURATIONS



DIMENSION TOP VIEW



PHOTOMETRICS



HB-454T5-UPL
Electronic Ballasts
(4) F54T5/835 HO lamps
4400 lumens
Spacing criterion: (II) 1.2 x mounting height, (⊥) 0.8 x mounting height
Efficiency 93.6%
Test Report: HB454T5UPL.IES
LER =70
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.42

Candela

Angle	Along II	45°	Across ⊥
0	8806	8806	8806
5	8815	8634	8438
10	8678	8130	7623
15	8445	7394	6829
20	8137	6688	5747
25	7767	5901	4459
30	7315	4716	3623
35	6774	3747	3151
40	6199	3096	2884
45	5548	2637	2603
50	4849	2332	2411
55	4096	2014	1918
60	3315	1760	1541
65	2555	1264	1534
70	1788	1062	1205
75	1110	842	671
80	514	295	55
85	96	41	41
90	0	14	14

Coefficients of Utilization

Effective floor cavity reflectance 20%

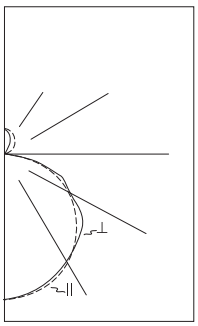
rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	110	110	110	110	107	107	107	107	101	101	101	95	95	95	90	90	90	88
1	102	98	94	91	99	95	92	89	90	88	85	86	83	82	81	80	78	76
2	93	86	81	76	90	84	79	75	80	76	72	76	73	70	73	70	67	65
3	86	77	70	65	83	75	69	64	72	66	62	68	64	60	65	61	58	56
4	79	69	61	56	77	67	60	55	64	58	54	62	57	52	59	55	51	49
5	73	62	55	49	71	61	54	48	58	52	47	56	51	46	54	49	45	43
6	68	57	49	43	66	55	48	43	53	47	42	51	46	41	49	44	41	39
7	64	52	44	39	62	51	44	39	49	43	38	47	41	37	45	40	37	35
8	59	48	40	35	58	47	40	35	45	39	34	44	38	34	42	37	33	32
9	56	44	37	32	54	43	36	32	42	36	31	40	35	31	39	34	30	29
10	52	41	34	29	51	40	34	29	39	33	29	38	32	28	37	32	28	26

Zonal Lumen Summary

Zone	Lumens	%Lamp	%Fixture
0-30	5656	32.1	34.3
0-40	8411	47.8	51.0
0-60	13046	74.1	79.2
0-90	15460	87.8	93.8
0-180	16480	93.6	100.0

Typical VCP Percentages

	Height Along		Height Across	
Room Size (Ft.)	8.5′	10.0′	8.5′	10.0′
20 x 20	30	35	31	38
30 x 30	27	28	30	29
30 x 60	25	25	35	31
60 x 30	32	32	34	32
60 x 60	30	27	38	34



HB-454T5-G-UPL
Electronic Ballasts
(4) F54T5/830 HO lamps
4400 lumens
Spacing criterion: (II) 1.3 x mounting height, (⊥) 1.3 x mounting height
Efficiency 82.1%
Test Report: HB454T5GUPL.IES
LER =66
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.64

Candela

Angle	Along II	45°	Across ⊥
0	4435	4435	4435
5	4413	4411	4411
10	4364	4338	4321
15	4282	4227	4203
20	4164	4088	4068
25	4015	3919	3924
30	3835	3735	3777
35	3625	3537	3636
40	3391	3323	3479
45	3131	3105	3303
50	2843	2870	3112
55	2528	2616	2697
60	2183	2342	2275
65	1802	1876	2051
70	1387	1516	1644
75	949	1170	1066
80	516	574	377
85	134	118	113
90	2	11	10

Coefficients of Utilization

Effective floor cavity reflectance 20%

rc	80%				70%				50%			30%			10%			0%
rw	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	97	97	97	97	94	94	94	94	88	88	88	84	84	84	79	79	79	77
1	89	85	82	79	86	83	80	77	78	76	74	74	72	70	70	69	67	65
2	81	74	69	64	78	72	67	63	69	65	61	65	62	59	62	59	57	55
3	74	65	59	54	71	64	58	53	61	56	51	58	53	50	55	51	48	47
4	67	58	51	45	65	56	50	45	54	48	44	51	46	43	49	45	42	40
5	61	51	44	38	59	50	43	38	47	41	37	45	40	36	43	39	35	33
6	56	45	38	33	54	44	37	32	42	36	32	40	35	31	39	34	30	29
7	52	41	33	28	50	40	33	28	38	32	28	36	31	27	35	30	26	25
8	48	36	29	24	46	36	29	24	34	28	24	33	27	23	31	26	23	21
9	44	33	26	21	42	32	25	21	31	25	20	29	24	20	28	23	20	18
10	41	30	23	18	39	29	23	18	28	22	18	27	21	18	26	21	17	16

Zonal Lumen Summary

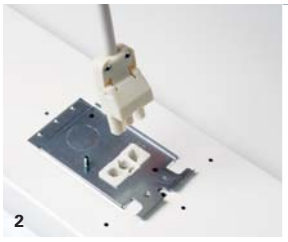
Zone	Lumens	%Lamp	%Fixture
0-30	3436	19.5	23.8
0-40	5677	32.3	39.3
0-60	10418	59.2	72.1
0-90	13546	77.0	93.7
0-180	14453	82.1	100.0

Typical VCP Percentages

	Height Along		Height Across	
Room Size (Ft.)	8.5′	10.0′	8.5′	10.0′
20 x 20	25	31	22	28
30 x 30	21	23	21	21
30 x 60	19	20	22	21
60 x 30	25	26	24	24
60 x 60	22	21	26	23

Modular F-Bay Power Supply

Cooper Lighting's F-Bay Modular Power Supply option allows external fixture access for safe and easy servicing. There is no need to remove lamps or reflectors to disconnect fixture power with F-Bay Modular Power Supply. Access to the individual fixtures power supply allows servicing without turning off all the fixtures disrupting occupants. F-Bay Modular Power Supply is a time saver in installation – simply plug & power.



1. Modular Power Supply Receptacle supplied mounted into fixture Access Plate.
2. Modular Power Cord & Plugs in 120, 277, 347, & 480V configurations for easy plug & power into existing supply.

No internal fixture access required for installation or disconnecting power.

Modular Motion Sensor Option supplied with Mounting Box and Modular Power Supply Receptacle.

Code Compliance

- UL/cUL Certified for Make/Break under load (UL2549)
- Meets NEC requirements for ballast disconnect (NEC 410.73G)
- Allows for addition of Occupancy Sensor without hard connections
- Receptacles complete with insulating/dustcap

ORDERING INFORMATION

SAMPLE NUMBER: HB-R-432-A-120V-EB81

Width
Blank=15"

Series
HB=High Bay

Mounting Arrangement
Blank=Stand Alone
R=Continuous Row Mount

No. of Lamps
4=4 Lamps

Lamp Type
32=32W T8 Lamps (48")
28T5=28W T5 Lamps (48")
54T5=T5HO Lamps (48")

Distribution
Blank=Medium (Specular Aluminum)
G=Wide (High Reflectance White)

Shielding
Blank=None
A=Prismatic Acrylic Lens & Doorframe
WG=Wireguard & Doorframe
A/WG=Acrylic Lens, Wireguard & Doorframe
CL=Clear Acrylic Lens & Doorframe
SWG=Heavy Duty Wireguard (Shipped separatley)

Voltage [2]
UNV=Universal 120/277 Voltage
UNC=Universal 347/480 Voltage (T5 linear only)
120V=120 Volt
277V=277 Volt
347V=347 Volt

Options
Lamps Installed
L8830=T8 Lamp, 80CRI 3000K
L8835=T8 Lamp, 80CRI 3500K
L8841=T8 Lamp, 80CRI 4100K
L8850=T8 Lamp, 80CRI 5000K
L5830=T5 Lamp, 80CRI 3000K
L5835=T5 Lamp, 80CRI 3500K
L5841=T5 Lamp, 80CRI 4100K
L5850=T5 Lamp, 80CRI 5000K
GL=Single Element Fuse
GM=Double Element Fuse
Emergency=EM Installed[2]

NOTES: [1]Requires use of voltage specific modular cord assembly. See accessories. [2]Voltage must be specified when ordered with plugs, motion or emergency ballasts. [3]EBT ballast systems suitable for operation in ambient environments up to 40˚C in open uplight configuration. [4]ER8 and EB8 ballast systems suitable for operation in ambient environments up to 50˚C in open uplight configuration. [5]Specify voltage. [6]For use with Top Connector Box options. See accessories. [7]2 lamp ballast configurations only in UNC versions. [8]EHT/HT5/HCT5 ballast systems suitable for ambient environments not to exceed 65˚C in open uplight configurations and less lens option. [9]Cannot be combined with cord or cord & plug. See PI ordering information below.

Ballast Type
T8 Systems
EB8__=T8 Electronic Instant Start.[4] Total Harmonic Distortion < 10%
No. of Ballast: 1, 2 or 3
EB8__/PLUS= T8 Electronic Instant Start.[4] High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast: 1, 2 or 3
ER8__=T8 Electronic Program Rapid Start.[4] Total Harmonic Distortion < 10%
No. of Ballast: 1, 2 or 3
ER8__/PLUS= T8 Electronic Program Start.[4] High Ballast Factor >1.13. Total Harmonic Distortion < 10%
No. of Ballast: 1, 2 or 3
T5 Systems
EBT__=T5 Linear Electronic Program Rapid Start. [3] Total Harmonic Distortion < 10%
No. of Ballast: 1, 2 or 3
EHT__=T5 Linear Electronic Start High Ambient.[7] [8] Total Harmonic Distortion < 10%
No. of Ballast: 1, 2 or 3
DIM=Dimming

Options
UPL=Uplight Apertures
PI/CPI=Plug-In (1, 2 or 3)[9] see ordering information below
TILW=Tandem Inline Wiring
MWS=Modular Wiring System
MS=Aisle Coverage Motion Sensor[5]
MSO=360˚ Coverage Motion Sensor[5]
C3=3' Power Cord
C6=6' Power Cord
G2=Gasketed Door (Requires Selection of Lensed Doorframe)
MPR=Modular Power Receptacle[1]
PC3-=3' Power Cord & Plug (Specify Voltage)[2]
PC6-=6' Power Cord & Plug (Specify Voltage)[2]
TAP=Top Access Plate
TCBP=Top Connector Box Plate[6]

Packaging
U=Unit Pack
PAL=Palletized Out of Carton
PALC=Job Pack In Carton

Accessories (order separately)
SWG/HB-4FT-B=Heavy Duty Wireguard (HB)
AYC-CHAIN/SET/U=(2) Hooks, 36" Chain Sets w/S-Hooks
TCB=Top Connector Box
RH-1=Retrofit Hanger
FH-1=Fixture Hook
FL-1=Fixture Loop
HB-SPS=Single Point Cable Kit (13" Drop Length)
GRIPPLE-Y-=Y Mounting Toggle, #2 Cable (Specify 10' or 30')
MPC6=6' Modular Power Cord & Plug (Specify Voltage)
MC6=6' Modular Power Cord
MMS-CPD1200H=Aisle Motion Sensor, Box, Modular Power Receptacle (120-277V)
MMS-CPD500H=360˚ Motion Sensor, Box, Modular Power Receptacle (120-277V)

Doorframes (order separately)
HB-FRM/LENS=Prismatic Acrylic Lens & Frame (HB)
HB-FRM/CL PK=Clear Acrylic Lens & Frame (HB)
HB-FRM/WG PK=Wireguard & Frame (HB)
HB-FRM/LENS/WG PK=Prismatic Acrylic Lens, Frame and Wireguard (HB)

Quick Ship
Made To Order

Quick Ship Ordering Information

Sample Number: HB54T5-MP-UPL-I5

Quick Ship orders ship in 5 days in order quantities not to exceed 200 pieces.

NOTE: Orders received after noon are entered on the following day.

Includes V Hangers for rapid installation

Family
HB

Lamp Qty
4=4 Lamps

Lamp Type
32=32W T8 Lamps (48")
54=T5HO Lamps (48")

NOTES: [9]Required when utilizing MMS-CPD1200H option. [10]Requires use of Modular cord and plug accessories. [11]High lumen (3100 initial) lamps supplied.

Ballast Type
T5HO Systems
T5=(1) 120/277V 4 Lamp T5 Electronic Program Rapid Start[4]
HT5=(1) 120/277V 4 Lamp T5 High Ambient Electronic Program Rapid Start[9]
HCT5=(1) 347/480V 2 Lamp T5 High Ambient Electronic Program Rapid Start[9]
T8 Systems[5]
Blank=(1) 120/277V 4 Lamp T8 Instant Start Electronic
PS=(1) 120/277V 4 Lamp T8 Electronic Program Rapid Start

Power Receptacle
Blank=Standard Wiring to Access Plate
MP=Modular Power Receptacle[9]

Uplight
UPL=Uplight

Lamping[11]
L4=Lamps Installed 80+CRI 4100K
L5=Lamps Installed 80+CRI 5000K

Accessories (order separately)
MPC6=6' Modular Power Cord & Plug (Specify Voltage)
MC6=6' Modular Power Cord
MMS-CPD1200H=Aisle Motion Sensor, Box, Modular Power Receptacle (120-277V)

SHIPPING INFORMATION

Catalog No.	Wt.
HB-432-G-UPL	19 lbs.
HB-432-UPL	19 lbs.

PI OPTION ORDERING INFORMATION

Catalog Number Suffix	Number of Circuits	Circuit Wired To Ballast
PI 1 BLK	1	Black
PI 2 BLU	2	Blue
PI 2 BLK	2	Black
PI 3 RED	3	Red
PI 3 BLU	3	Blue
PI 3 BLK	3	Black

Catalog Numbering System

The PI System is available in sections up to 8' in length for continuous row wiring by simply plugging the sections together. Each PI section is factory wired to the ballast leads. Color coding of wires is as follows:

PI-1 = One Circuit - 2 Wires: one black, one white
PI-2 = Two Circuits - 3 Wires: one black, one blue, one white
PI-3 = Three Circuits - 4 wires: one black, one blue, one red, one white

When ordering the PI2/PI3 System it is necessary to specify the number of fixtures required for each circuit. All wiring to external feeds, using cord or cord & plug, are responsibility of installing licensed contractor. Cord and cord & plug sets must be ordered separately if PI option is chosen.

PI1 - Single Circuit Plug-In

SAMPLE NUMBER: PI1BLK-WG

PI1= Single Circuit
BLK=Black Hot
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

PI2 - Two Circuit Plug-In

SAMPLE NUMBER: PI2BLK-WG

PI2= Two Circuit
BLK=Black Hot
BLU=Blue Hot
Leave Blank=Single Neutral
/WHT=White Neutral
/GRY=Gray Neutral
Leave Blank=Single Neutral
2NEU=Two Neutrals
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

PI3 - Three Circuit Plug-In

SAMPLE NUMBER: PI3BLK-WG

PI3= Three Circuit
BLK=Black Hot
BLU=Blue Hot
RED=Red Hot
Leave Blank=Single Neutral
/WHT=White Neutral
/GRY=Gray Neutral
Leave Blank=Single Neutral
2NEU=Two Neutrals
NG= No Ground (ground provided by fixture body)
WG= With Ground (separate ground wire in harness)

McGRAW-EDISON®

energy solutions

DESCRIPTION

The Talon is the most versatile, functionally designed, universally adaptable outdoor luminaire available. Incorporating modular LED LightBAR™ technology, Talon brings outstanding uniformity and energy conscious illumination to walkways, parking lots, roadways, building areas, and any security lighting application. UL and cUL listed for wet locations.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction

One-piece heavy-wall, die-cast aluminum construction with integral reveal channels along top surface of housing. Optimized for reliable operation from 40°C down to -30°C, internal cast-in wall separates optical and electrical chambers allowing components to operate cooler. Stainless steel latches and hinges allow for toolless opening and removal of door frame.

Optics

Choice of fifteen (15) high efficiency, patent pending AccuLED optical systems manufactured from injection molded acrylic. Optics are precisely designed to shape the distribution maximizing efficiency and application spacing. AccuLED optics create consistent distributions with the scalability to meet customized application requirements. Talon optics feature quick disconnect wiring plugs and are field-rotatable in 90° increments allowing manipulation of distribution independent of fixture position. Offered standard in 4000°K (+/- 275K) CCT and >70 CRI.

Electrical

Offered standard with LED drivers and related electrical componentry hard mounted to die-cast housing details for optimal heat transfer and operating efficiency. Talon operates from 120-277V 50/60Hz, 347V 60Hz, 480V 60Hz. Optional galvanized steel swing-down power tray with integral handle allow tray to be removed from housing providing ample hand and tool room for attachment of fixture during installation. Offered standard with the Cooper Lighting proprietary circuit module designed to withstand 10kV transient line surge. 50,000+ hour life with >70% lumen maintenance. LightBARS™ feature an IP66 enclosure rating.

Mounting

Extruded 8" aluminum arm includes internal bolt guides allowing for easy positioning of fixture during installation to pole or wall surface. Standard single carton packaging of housing, square pole arm and round pole adapter for contractor friendly arrival of product on site. Optional mounting methods include a wall mount plate, an external mast arm that accepts 2 3/8" O.D. horizontal tenons and direct mounting to pole or wall surfaces. Tenon adapters available to slipfit over poles equipped with 2 3/8" or 3 1/2" O.D. tenon. 3G vibration rated.

Finish

Housing and arm finished in a 5 stage super durable TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Standard colors include black, bronze, grey, white, dark platinum, and graphite metallic. RAL and custom color matches available. Consult the McGraw-Edison Architectural Colors brochure for the complete selection.

Warranty

Talon LED features a 5 year limited warranty.

TLM
TALON MEDIUM LED

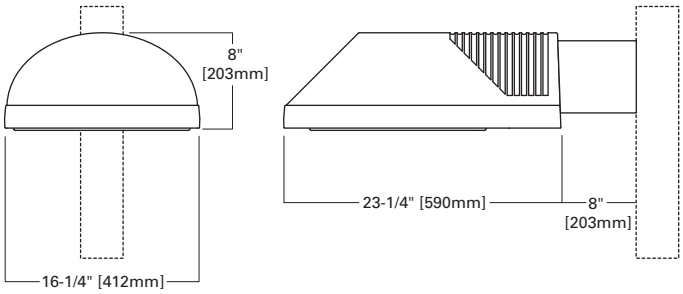
2 - 6 LightBARS

Solid State LED

ARCHITECTURAL AREA LUMINAIRE

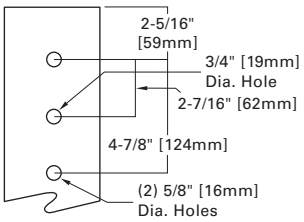
SustainabLEDesign

DIMENSIONS

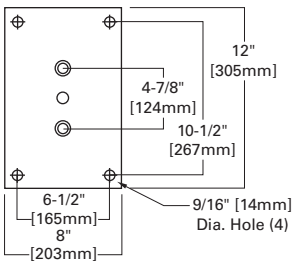


ARM DRILLING

TYPE "M"



WALL MOUNT



CERTIFICATION DATA

40°C Ambient Temperature Rating
UL and cUL Listed
LM79 / LM80 Compliant
IP66 LightBARS
3G Vibration Tested
ARRA Compliant
ISO 9001

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 & 60hz, 347V/60hz, 480V/60hz
-30°C Minimum Temperature

EPA

Effective Projected Area: (Sq. Ft.)
Luminaire w/o Arm: 0.79
8" Arm: 0.43

SHIPPING DATA

Approximate Net Weight:
57 lbs. (25.91 kgs.)

COOPER Lighting
www.cooperlighting.com

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POWER AND LUMENS BY BAR COUNT

# of Bars	System Watts	Type SL2 Lumens	Type SL3 Lumens	Type SL4 Lumens	Type 5WQ Lumens
2 Bars	53	3,252	3,447	3,354	3,735
3 Bars	80	4,878	5,170	5,031	5,602
4 Bars	103	6,504	6,894	6,708	7,469
5 Bars	129	8,130	8,617	8,385	9,337
6 Bars	156	9,837	10,426	10,146	11,228

Ambient Temperature	Lumen Multiplier
10°C	1.04
15°C	1.03
25°C	1.00
40°C	0.96

NOTE: Lumen values based upon 4000K CCT, 350mA drive current, 25°C ambient operating temperature.

MOUNTING CONFIGURATIONS

Wall Mount

Arm Mount Single
EPA 1.22

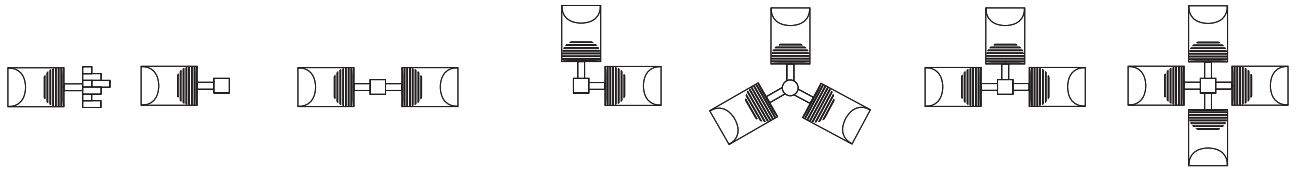
Arm Mount 2 @ 180°
EPA 2.44

Arm Mount 2 @ 90°
EPA 2.44

Arm Mount 3 @ 120°
(Round Pole Only)
EPA 3.23

Arm Mount 3 @ 90°
EPA 3.23

Arm Mount 4 @ 90°
EPA 3.63



ORDERING INFORMATION

Sample Number: TLM-A03-LED-E1-T3-BK

Product Family [1]
TLM =Talon Site Medium

Number of Lightbars [2]
A02 =2 Bars
A03 =3 Bars
A04 =4 Bars
A05 =5 Bars
A06 =6 Bars

Lamp Type
LED =Solid State Light Emitting Diodes

Voltage
E1 =Electronic (120-277V)
347 =347V
480 =480V

Distribution
T2 =Type II
T3 =Type III
T4 =Type IV
5MQ =Type V Square Medium
5WQ =Type V Square Wide
5XQ =Type V Square Extra Wide
5MR =Type V Round Medium
5WR =Type V Round Wide
SL2 =Type II w/Spill Control
SL3 =Type III w/Spill Control
SL4 =Type IV w/Spill Control
RW =Rectangular Wide
SLL =90 Degree Spill Light Eliminator Left
SLR =90 Degree Spill Light Eliminator Right

Color [3]
AP =Grey
BZ =Bronze
BK =Black
WH =White
DP =Dark Platinum
GM =Graphite Metallic

Options [4]
P =Button Type Photocontrol [5] (120V, 208, 240, or 277V)
R =NEMA Twistlock Photocontrol Receptacle
PT =Electrical Power Tray
2L =Bi-Level Switching Capable [6]
7060 =70 CRI/6000K CCT [7]
LCF =LightBAR Cover Plate Matches Housing Finish
WM =Wall Mount with Arm
DM =Direct Mount for Round or Square Pole
DW =Direct Wall Mount
MS =External Mast Arm Adapter
ICB =Integral Cold Weather [5, 8] Battery Pack (Specify 120V or 277V)

Accessories [9]
MA1010-XX =Single Tenon Adapter for 3 1/2'' O.D. Tenon
MA1011-XX =2@180° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1012-XX =3@120° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1013-XX =4@90° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1014-XX =2@90° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1015-XX =2@120° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1016-XX =3@90° Tenon Adapter for 3 1/2'' O.D. Tenon
MA1017-XX =Single Tenon Adapter for 2 3/8'' O.D. Tenon
MA1018-XX =2@180° Tenon Adapter for 2 3/8'' O.D. Tenon
MA1019-XX =3@120° Tenon Adapter for 2 3/8'' O.D. Tenon
MA1045-XX =4@90° Tenon Adapter for 2 3/8'' O.D. Tenon
MA1048-XX =2@90° Tenon Adapter for 2 3/8'' O.D. Tenon
MA1049-XX =3@90° Tenon Adapter for 2 3/8'' O.D. Tenon
OA/RA1016 =NEMA Twistlock Photocontrol - Multi-Tap
OA/RA1027 =NEMA Twistlock Photocontrol - 480V
OA/RA1201 =NEMA Twistlock Photocontrol - 347V
OA/RA1013 =Shorting Cap
MA1253 =10kV Circuit Module Replacement

Notes:
1 8" arm and round pole adapter included with fixture.
2 Standard 4000K CCT and greater than 70CRI.
3 Custom and RAL color matching available upon request. Consult Cooper Lighting Representative for further information.
4 Add as suffix.
5 Must specify voltage.
6 Low-Level output varies by bar count specified. Consult Factory.
7 Consult Factory for lead times and lumen multiplier.
8 Available with A02, A03, or A04 configurations only. Rated for 25 ° C ambient. Available with SL2, SL3, 5WQ, 5WR, 5MQ, and 5MR optics only.
9 Order separately, replace XX with color suffix.

LR6-DR1000 6" Recessed Downlight

Product Description

The LR6-DR1000 is a recessed architectural downlight that utilizes Cree TrueWhite™ Technology to deliver 1,000 lumens of high quality light, with an unprecedented efficacy of 80 lumens per watt. Its exceptional CRI of 90 brings out the true beauty of applications ranging from offices, schools, hospitals, restaurants, airports, hotels, and homes. US Patent #7,213,940. Numerous patents pending.

Performance Summary

- Utilizes Cree TrueWhite™ technology
- Delivered light output = 1,000 lumens
- Input power = 12.5 Watts
- CRI = 90
- CCT = 2700K or 3500K
- Dimmable to 20%
- Three Year Warranty

Ordering Information

Intended for use with Cree H6 Housing, may be retrofitted into 6" housings from select manufacturers using the supplied GU24 whip adapter

Housing

H6-GU24 - Recessed Housing, 120V

Light Engine

LR6-DR1000 - 120V, Incandescent Color (2700K), GU24 Base

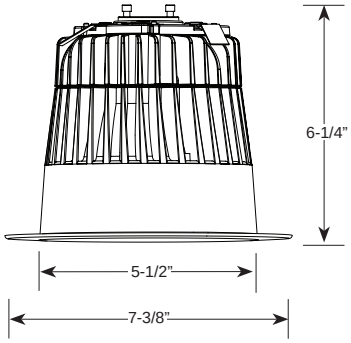
LR6C-DR1000 - 120V, Neutral Color (3500K), GU24 Base

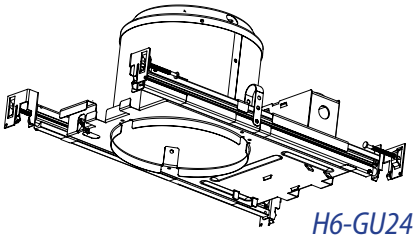
Accessories - Reference accessory spec sheets

Accessory Trims

- **LT6A-DR** - Diffuse anodized trim
- **LT6AW-DR** - Wheat diffuse anodized trim
- **LT6AP-DR** - Pewter diffuse anodized trim
- **LT6BB-DR** - Flat black trim
- **LT6WH-DR** - Smooth white trim

LR6C-DR1000





H6-GU24

CREE LED Lighting

CREE TRUE WHITE TECHNOLOGY

LR6-DR1000 6" Recessed Downlight

Product Information

Cree TrueWhite™ Technology

- A better way to generate white light that utilizes a patented mixture of unsaturated yellow and saturated red LEDs.
- Tuned to optimal color point before shipment.
- Color management system maintains color consistency over time and temperature.
- Designed to last 50,000 hours and maintain at least 70% of initial lumen output in IC and non-IC installations.

Construction

- Durable die-cast aluminum upper housing, lower housing, and upper cover.
- Integrated thermal management system conducts heat away from LEDs and transfers it to the surrounding environment. LED junction temperatures stay below specified maximums.
- Designed for use with H6-GU24 housing from Cree, 6" recessed architectural housing with rugged, integral, extruded aluminum bar hangers (h = 7")

Optical System

- Proprietary optical system utilizes a unique combination of reflective and refractive optical components to achieve a uniform, comfortable appearance. Pixelation and direct view of unshielded LEDs is eliminated.
- White Lower Reflector balances brightness of refractor with the ceiling to create comfortable high-angle appearance. Works with refractor to deliver an optimized distribution that illuminates walls and vertical surfaces increasing the perception of spaciousness.

Electrical System

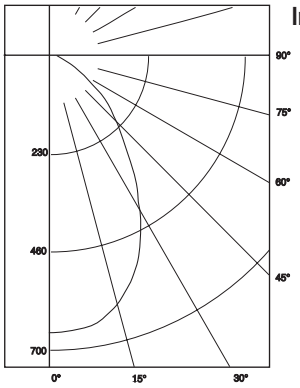
- Integral, high efficiency driver and power supply. Power factor > 0.9 Input voltage = 120V, 60Hz
- Dimmable to 20% with certain incandescent dimmers (reference www.CreeLEDLighting.com for recommended dimmers)

Regulatory and Voluntary Qualifications

- Tested and certified to UL standards. Suitable for damp locations.
- Utilize GU-24 base for new construction projects in California or other areas where high efficacy line voltage sockets are required.
- Exceeds California Title-24 high efficacy luminaire requirements.

Photometry

LR6 -DR1000
Based on OnSpex 30012426-F



Intensity (Candlepower) Summary

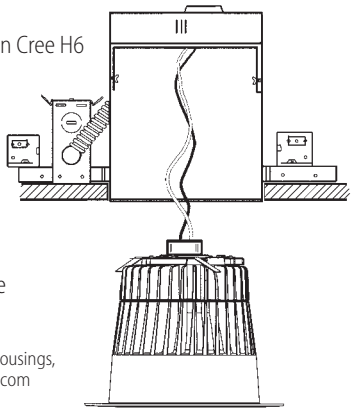
ANGLE	MEAN CP
0°	597
5°	593
15°	559
25°	463
35°	329
45°	207
55°	120
65°	61
75°	32
85°	7
90°	0

Zonal Lumen Summary

ZONE	LUMENS	%LAMP	%FIX
0°- 30°	424	42.42	42.42
0°- 40°	629	62.89	62.89
0°- 60°	897	89.71	89.71
0°- 90°	1000	100.00	100.00

Installation

- Designed to easily install in Cree H6 and 6" housings from select manufacturers.*
- Quick install system utilizes a unique retention feature. Simply attach socket to LR6-DR1000. Move light to ready position and slide into housing.



* for information on compatible housings, reference www.creeLEDlighting.com

Cree LED Lighting
Morrisville • NC • 27560 • USA
1-919-287-7700
Fax 1-919-991-0730
www.CreeLEDLighting.com

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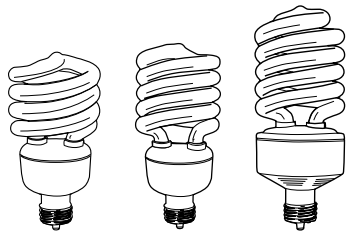
Sheet# LR6-DR1000-03/2010

289 Series

SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life

NEW

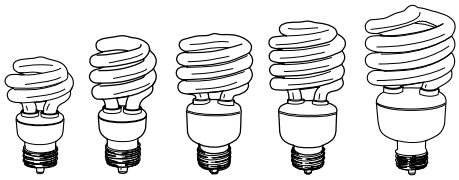


Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28927	27	100	1850	Medium	5.7	2.7
28932	32	130	2100	Medium	6.1	2.7
28942	42	150	2800	Medium	7.0	2.8

280 Series

SpringLamp® CFL, Electronic, NPF,
120 volts, 15,000 Hours Avg. Life

NEW

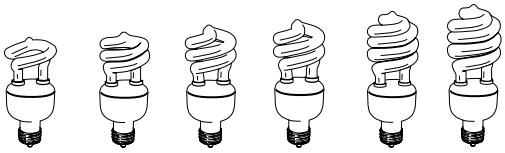


Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28009	9	40	550	Medium	3.6	1.9
28013	13	60	900	Medium	3.9	1.9
28018	18	75	1200	Medium	4.6	2.3
28023	23	100	1600	Medium	5.0	2.3
28027	27	100	1850	Medium	5.7	2.7

182 Series

SpringLamp® CFL, Electronic, HPF,
120 volts, 10,000 Hours Avg. Life

HPF



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
18214*	14	60	900	Medium	4.7	1.7
18219*	19	75	1250	Medium	4.7	2.1
18209	9	35	400	Medium	4.7	2.2
18211	11	40	550	Medium	4.8	2.2
18215 ★	15	60	930	Medium	5.3	2.2
18220 ★	20	75	1200	Medium	5.5	2.2
18223 ★	23	90	1400	Medium	5.8	2.2
18227	27	100	1950	Medium	6.0	2.2

* *Mini SpringLamp®* ★ *Energy Star*

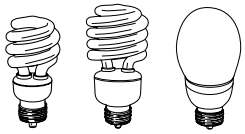
Fresh² Ti SpringLamp®

The World's First "Fresh Bulb" is a revolutionary new product that breaks down odors while providing energy efficient light.

fresh²Ti

F2

Fresh² Ti SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life, Medium base



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
28914F2	14	60	800	Medium	4.7	1.7
28923F2	23	100	1600	Medium	5.0	2.3
11314F2	14	52	700	Medium	4.8	2.4

3 Way SpringLamp®

- *3 distinct light levels*
- *FCC compliant at each level*
- *150w incandescent equivalent*

3 way

190 Series

3 Way SpringLamp® CFL, Electronic, NPF,
120 volts, 10,000 Hours Avg. Life, Medium base

Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	M.O.L. (inches)	Diameter (inches)
19032 ★	14/ 19/ 32	40/ 75/ 150	450/ 1100/ 1950	6.2	2.4

Dimmable SpringLamp®

The dimming range is from 100% down to 20%.

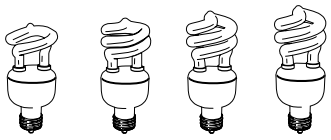
DIM

101 Series

SpringLamp® CFL, Electronic, HPF,
120 volts, 10,000 Hours Avg. Life

HPF

DIM



Item #	Wattage	Incandescent Watts Comparison	Initial Lumens	Base Type	M.O.L. (inches)	Diameter (inches)
10109	9	35	400	Medium	4.7	2.2
10111	11	40	550	Medium	4.8	2.2
10115	15	60	930	Medium	5.3	2.2
10120 ★	20	75	1200	Medium	5.5	2.2

PRECISION PARAGON
EFFICIENCY, ECONOMY, SUSTAINABILITY.

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(352) 692-5900 FL

TMF Series – Low Wattage LED Flood

Seeking an Ultra-long Life Energy Efficien Lighting Solution?

- As LED efficacie climb and costs begin to descend, LED is becoming viable in more and more general lighting applications.
- Many low wattage spot, flood, security, and accent applications can benefi from the directional characteristics of LED.
- Amazingly, a single TMF LED floo replaces ground mounted 150-250 watt HID fl gpole floods sign lighters, and palm flood with ease.

Why P2? It's Simple. Our Experience.

- Properly deployed, and aimed at commercially viable applications, LED is a valuable light source.
- Improperly deployed on your project, it can be a nightmare that damages your credibility with your customer.
- Anyone can adapt LED to existing fixture bodies and many have created LED light sources that mimic legacy light source form factors but fail to deliver comparable performance.
- It takes a real expert to combine LED technology with proper lighting fundamentals and commercially viable applications.
- Our engineers have the tools and expertise to thermally and photometrically model your system to ensure that the long life and performance promised by LED is delivered.

Long Life, Low Watt LED Flood Light

Application

- Building Signage
- Flagpoles
- Palm Trees
- Wall Wash
- Utility Spot
- Utility Flood
- Accent
- Security

TMF - 24W – FL – TG – 60K – 18C – UL – 350 – YC – BB

TMF	24W	FL	TG	60K	18C	UL	350	YC	BB
Fixture Series	Input Watts	Primary Optics	Secondary Optics	Color Temp	LED Chip Quantity	Voltage	Drive Current	Mounting	Fixture Finish

Fixture Series
TMF = LED Flood Light

Input Watts
8W = 8 Watt (6 Chip, 350mA)
15W = 15 Watt (12 Chip, 350mA)
17W = 17 Watt (6 Chip, 700mA)
23W = 23 Watt (12 Chip, 520mA)
24W = 24 Watt (18 Chip, 350mA)

Primary Optics
SP = 12 Deg Spot (Stock)
FL = 50 Deg Flood (Stock)

Secondary Optics
TG = Clear Tempered Glass Lens (STD)
CP = Clear Polycarb Lens
HF = Horizontal Flood Linear Refractor

Color Temperature
60K = 6000 Kelvin (Stock)
42K = 4200 Kelvin

Qty of LED Chips
6C = 6 Chip Board
12C = 12 Chip Board
18C = 18 Chip Board

Voltage
UL = 120 through 277 volt

Drive Current
350 = 350 mA Across Chip
520 = 520 mA Across Chip
700 = 700 mA Across Chip [1]
[1] Available only with 17W/6C

Mounting
YM = Yoke Mount Only w/18" Cord
YC = Yoke Mount with WCA
Cover Plate Assembly

Other Accessories Ordered Separately
AJ = Architectural Junction Box
BX = Brass In-grade Junction Box
WCA = Two Piece Wall/Ceiling Adaptor
GS = Ground Stake
PA = Cast Post Top Adaptor
TS = Tree Strap
12NA = 1/2" Water Tight NPT Adaptor
34NA = 3/4" Water Tight NPT Adaptor

Fixture Finish
BB = Black
BW = White
BZ = Bronze
RAL = RALxxxx (RAL Specification

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TMF Series – Low Wattage LED Flood

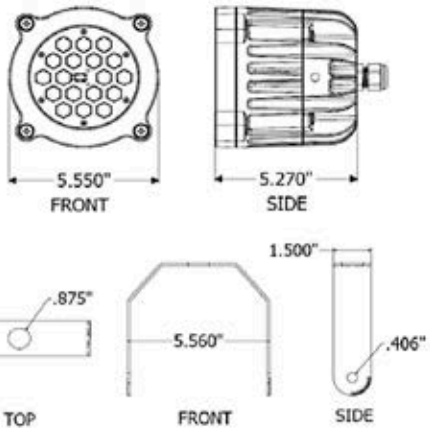
YC = Yoke Mount with complete WCA Adaptor Assembly

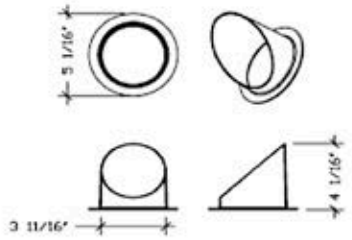
Wall Mount
- Utility Flood
- Utility Spot
- Accent
- Security

Ground Mount
- Building Signage
- Flagpoles
- Palm Trees
- Landscape
- Wall Wash

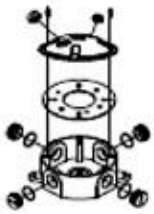
Fixture Construction

- Die cast aluminum body designed for maximum heat dissipation.
- Designed to meet IP66 standards.
- Sealed tempered glass lens.
- Stainless steel fasteners.
- Dedicated constant current driver.
- Advanced thermal management techniques and components.

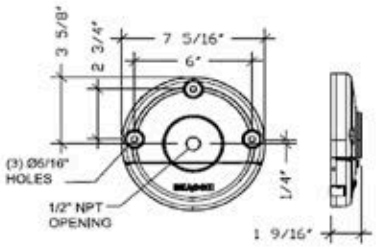




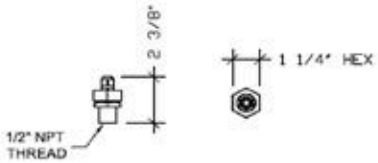
VS = Visor



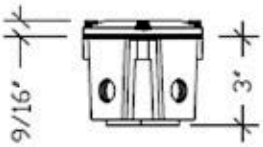
AJ = Architectural J-Box



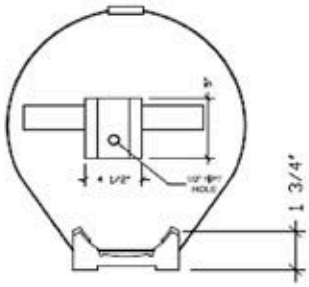
WCA = Two Piece Wall/Ceiling Adapter



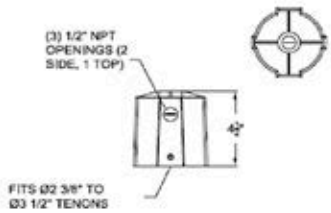
12NA = Aluminum/Brass Water Tight NPT Adaptor



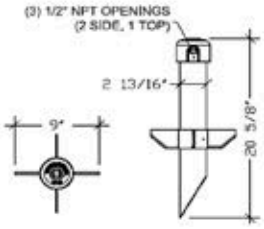
BX = Brass In-grade Junction Box



TS = Tree Strap



PA = Cast Post Top Adaptor

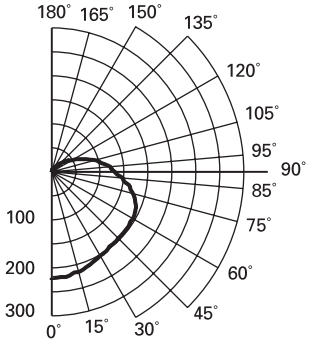


GS = Ground Stake

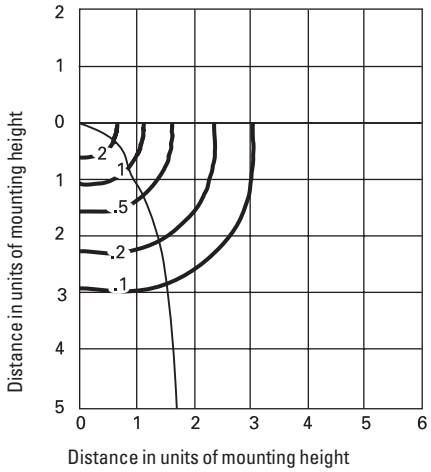
VR3C Rough Service Ceiling/Wall-Mounted Fixture, Compact Fluorescent

VR3C 2/26DTT, (2) 26W, double twin-tube Fluorescent lamps, **ceiling mounted**, 3600 rated lumens each. Test number 1195041202.

Distribution Curves



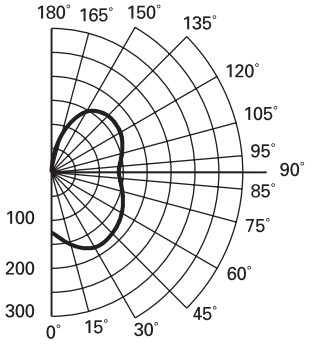
Coefficient of Utilization ———
Initial Footcandles ━━━



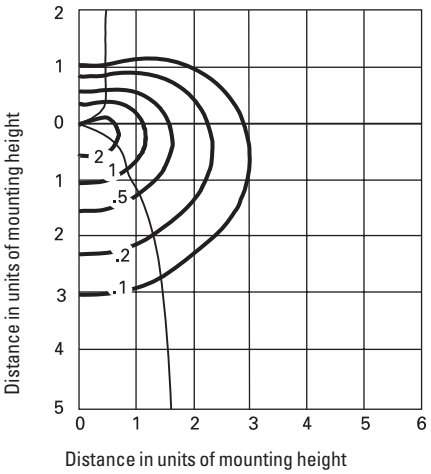
Distribution Data

	0°	45°	90°
0°	221	221	221
5°	220	222	223
15°	215	224	227
25°	207	224	226
35°	200	223	217
45°	198	226	214
55°	199	233	220
65°	191	249	217
75°	172	256	200
85°	142	238	167
90°	126	220	151

VR3C 2/26DTT IR, (2) 26W, double twin-tube Fluorescent lamps, **wall mounted**, 3600 rated lumens each. Test number 1195041301.



Coefficient of Utilization ———
Initial Footcandles ━━━



Distribution Data

	0°	45°	90°
0°	126	126	126
5°	141	143	135
15°	171	184	165
25°	187	217	196
35°	191	233	213
45°	190	229	217
55°	192	220	213
65°	196	215	196
75°	204	210	170
85°	210	206	146
90°	210	205	141

Tested to current IES and NEMA standards under stabilized laboratory conditions. Various operating factors can cause differences between laboratory data and actual field measurements. Dimensions and specifications on this sheet are based on the most current available data and are subject to change without notice.

Mounting Height Correction Factor

To obtain the footcandle value for different mounting heights multiply the footcandle value by the above correction factor.

MH	6'	10'	12'	14'
8'	1.78	0.64	0.44	0.33

LITHONIA LIGHTING®

An AcuityBrands Company

Lithonia Lighting
Rough Service
One Lithonia Way, Conyers, GA 30012
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www.lithonia.com

Sheet #: VR3CF_O

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NEW ! 25 YEAR LINEAR PERFORMANCE WARRANTY AND A PRODUCT WORKMANSHIP WARRANTY OF 5 YEARS*

SOLARWORLD TOP QUALITY

Length	65.94 in (1675 mm)
Width	39.41 in (1001 mm)
Height	1.22 in (31 mm)[1)]
Frame	Aluminum
Weight	46.7 lbs (21,2 kg)

ÖKO-TEST LIFE WORTH LIVING
SolarWorld Sunmodule Plus SW 225 poly
very good
issue 05/2010

TEST WINNER No. 1 PHOTON MODULE TEST 2008
The independent Photon magazine confirms: SolarWorld is test winner. Up to 10% more yield!

TEST WINNER No. 1 PHOTON MODULE TEST 2009
The independent Photon magazine confirms: SolarWorld is test winner. Up to 12% more yield!

Sunmodule®
SW 250 mono

World-class quality
SolarWorld products are manufactured in state- of- the- art factories according to strict German and US quality standards.

Award-winning products
SolarWorld modules have been ranked number one for two years running in ongoing comparison tests carried out by the Photon trade magazine. Sunmodule plus panels generated up to 12% more yield than other major brand panels.

SolarWorld Plus-Sorting
Plus-Sorting guarantees highest system efficiency. SolarWorld only delivers modules that have greater than or equal to the nameplate rated power.

25-year Linear Performance Guarantee*
SolarWorld guarantees, over 25 years, that the modules' performance will not decrease by more than 0.7% per year – a distinct added value compared to industry-standard two-tiered guarantees.

*in accordance with the applicable SolarWorld service certificate at purchase
www.solarworld-global.com/service-certificate

SOLARWORLD

We turn sunlight into power.

Sunmodule®
SW 250 mono

PERFORMANCE UNDER STANDARD TEST CONDITIONS (STC)*

		SW 250
Maximum power	P_{max}	250 Wp
Open circuit voltage	U_{oc}	37.8 V
Maximum power point voltage	U_{mpp}	31.1 V
Short circuit current	I_{sc}	8.28 A
Maximum power point current	I_{mpp}	8.05 A

*STC: 1000W/m², 25°C, AM 1.5

PERFORMANCE AT 800 W/m², NOCT, AM 1.5

		SW 250
Maximum power	P_{max}	183.3 Wp
Open circuit voltage	U_{oc}	34.6 V
Maximum power point voltage	U_{mpp}	28.5 V
Short circuit current	I_{sc}	6.68 A
Maximum power point current	I_{mpp}	6.44 A

Minor reduction in efficiency under partial load conditions at 25°C: at 200W/m², 95% (+/-3%) of the STC efficiency (1000 W/m²) is achieved.

COMPONENT MATERIALS

Cells per module	60
Cell type	Mono crystalline
Cell dimensions	6.14 in x 6.14 in (156 mm x 156 mm)
Front	tempered glass (EN 12150)

SYSTEM INTEGRATION PARAMETERS

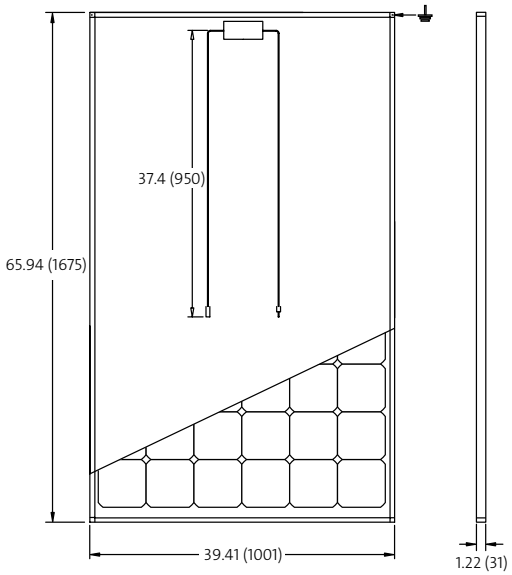
Maximum system voltage SC II	1000 V
Max. system voltage USA NEC	600 V
Maximum reverse current	16 A
Increased snowload acc. to IEC 61215	5,4 kN/m²
Number of bypass diodes	3

THERMAL CHARACTERISTICS

NOCT	47 °C
TC I_{sc}	0.042 %/K
TC U_{oc}	-0.33 %/K
TC P_{mpp}	-0.45 %/K

ADDITIONAL DATA

Measuring tolerance	+/- 3 %
Junction box	IP65
Connector	MC4
SolarWorld Plus-Sorting[2]	$P_{Flash} \geq P_{max}$



· Qualified, IEC 61215
· Safety tested, IEC 61730
· Periodic Inspection

3)

MADE IN USA

1) Temporarily, also modules with a frame height of 34 mm can be supplied. Please inquire with your dealer.
2) The output identified by SolarWorld (P_{Flash}) is always higher than the nominal output (P_{max}) of the module.
3) Depending on the market.
SolarWorld AG reserves the right to make specification changes without notice. This data sheet complies with the requirements of EN 50380.

02.12.2010 EN

Directed Engineering Study cont.

SECTION 5.7 FIM'S CONSIDERED BUT NOT USED

The following FIM's were considered but are not recommended:

03.02-VMC: MULTIZONE UNIT REPLACEMENT

A Multizone unit in the East Penthouse serves the kitchen and dining room below. This unit is 100% outside air with a hydronic heat and a chilled water cooling coil. Hot and cold deck ductwork then feeds 10 sets of zone dampers. The unit was installed in 1969 and is in need of frequent repairs.

The proposed FIM would replace the multizone unit with an air handling system equipped with the necessary appurtenances to provide a fully functioning system that meet or exceeds the existing unit operation. The measure includes modification to the zone coils and controls. The unit will be controlled and monitored by the existing Siemens Apogee control system but may require modifications to implement energy saving strategies.

Valley Medical Center has decided not to pursue this measure at this time. Savings and costs were developed to the ROM stage before being removed from the final list of proposed measures.

09.03-VMC: DAY SURGERY BUILDING LIGHTING UPGRADE

The Day Surgery Building on the Valley Medical Center campus has existing inefficient T-12 lamps with magnetic ballasts.

The proposed FIM would retrofit existing T12 lamps and magnetic ballasts located in the day surgery building with T8 lamps and electronic ballasts. Install occupancy sensors in waiting rooms, staff rooms and private offices. Valley Medical Center has decided not to pursue this measure at this time.

09.04-VMC: RADIOLOGY/ONCOLOGY LIGHTING UPGRADE

The Radiology and Oncology wing of the Valley Medical Center has inefficient lighting that operates regardless of daylighting provided by skylights.

This measure includes retrofitting existing fixtures using T12 lamps and electronic ballasts and the installation of photocell control where sky lights exist for daylight harvesting purposes. Valley Medical Center has decided not to pursue this measure at this time.

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	East Penthouse Project-All FIMs
Company	Valley Medical Center
Report Generated On:	10-May-11

Component Number 6152 Valley Medical Center

Component Description 3.02-VMC Multizone Unit Replacement

A Multizone unit in the East Penthouse serves the kitchen and dining room below. This unit is 100% outside air with a hydronic heat and a chilled water cooling coil. Hot and cold deck ductwork then feeds 10 sets of zone dampers. The unit was installed in 1969 and is in need of frequent repairs.

The proposed FIM would replace the multizone unit with an air handling system equipped with the necessary appurtenances to provide a fully functioning system that meet or exceeds the existing unit operation. The measure includes modification to the zone coils and controls. The unit will be controlled and monitored by the existing Siemens Apogee control system but may require modifications to implement energy saving strategies.

A Multizone unit in the East Penthouse serves the kitchen and dining room below. This unit is 100% outside air with a hydronic heat and a chilled water cooling coil. Hot and cold deck ductwork then feeds 10 sets of zone dampers. The unit was installed in 1969 and is in need of frequent repairs.

The proposed FIM would replace the multizone unit with an air handling system equipped with the necessary appurtenances to provide a fully functioning system that meet or exceeds the existing unit operation. The measure includes modification to the zone coils and controls. The unit will be controlled and monitored by the existing Siemens Apogee control system but may require modifications to implement energy saving strategies.

Cost / Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	51,750	$3,364
Electric Demand	kW	0	$0
Natural Gas	Therm	4,500	$4,545
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$7,909**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$6,000	1	1	1	

Cost (Rough Estimate Only) **

Total ROM Cost $971,000 to $1,100,000

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

FIM Considered but not used

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	East Penthouse Project-All FIMs
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number	6725	Valley Medical Center

Component Description 9.03-VMC Day Surgery Building

Retrofit existing T12 lamps and magnetic ballasts located in the day surgery building with T8 lamps and electronic ballasts. Install occupancy sensors in waiting rooms, staff rooms and private offices.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	3,244	$211
Electric Demand	kW	14	$72
Natural Gas	Therm	-5	($5)
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$278**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$721	1	1	1	

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

FIM Considered but not used

FIM Detail Report

Project	Valley Medical Center AHU and Lighting Upgrades
Scenario	East Penthouse Project-All FIMs
Company	Valley Medical Center
Report Generated On:	5-May-11

Component Number	6818	Valley Medical Center

Component Description 9.04-VMC Radiology/Oncology Lighting Upgrade

This measure includes retrofitting existing fixtures using T12 lamps and electronic ballasts and the installation of photocell control where sky lights exist for daylight harvesting purposes.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings	Dollar Savings
Electricity	kWh	1,281	$83
Electric Demand	kW	1	$5
Natural Gas	Therm	-2	($2)
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$86**

Other Savings *

Type		Amount	Frequency (Years)	First Year	Last Year	Notes
Utility Rebate		$285	1	1	1	

* Incentives are contingent on final approval. Funds are shown for reference only.

** Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are

Confidential and Proprietary

Directed Engineering Study cont.

SECTION 5.8 HVAC SYSTEM DATA & TEST TRENDS

VALLEY MEDICAL CENTER	**JOB NO.** P10759	**PAGE**
DESCRIPTION: 01.01-VMC Heating Water Upgrade-Trending		1/1
Valley Medical Center Reheat Trending Data		**BY** KMR
		DATE 5/4/2011

	HHX1	HHX2
Average Delta T	26	20
Max Delta T	32	24
Min Delta T	18	15

Example Trend Data

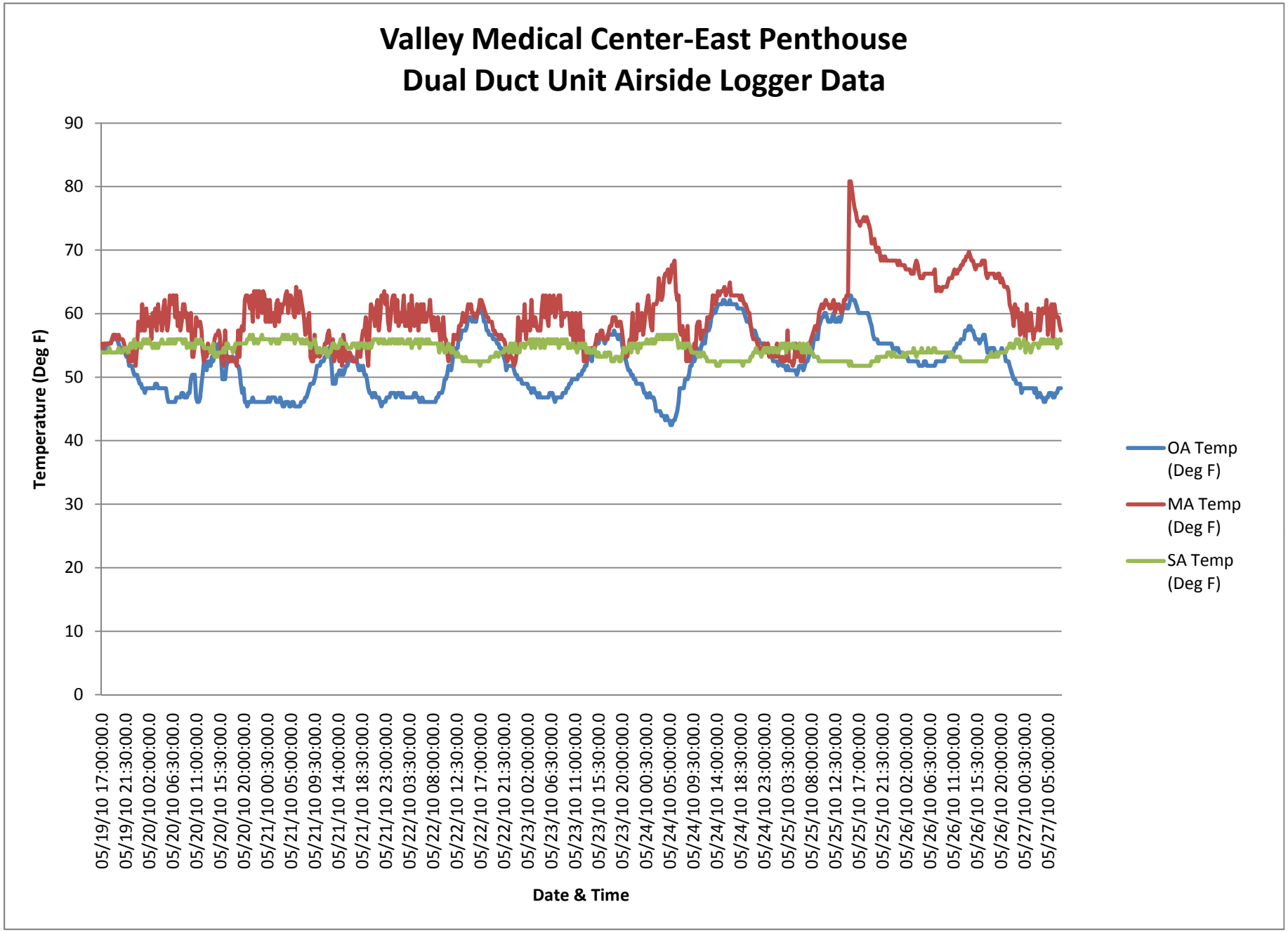
Date	Time	HHX1RT	HHX1ST	HHX1 Delta T	HHX2RT	HHX2ST	HHX2 Delta T
4/8/2011	0:30:00	131.03	162.1	31.07	139.88	162.57	22.69
4/8/2011	0:45:00	129.53	160.84	31.31	139.79	162.06	22.27
4/8/2011	1:00:00	131.03	161.35	30.32	139.28	162.95	23.67
4/8/2011	1:15:00	131.07	161.96	30.89	139.74	162.66	22.92
4/8/2011	1:30:00	130.04	161.91	31.87	140.35	162.81	22.46
4/8/2011	1:45:00	130.79	161.21	30.42	139.56	162.66	23.1
4/8/2011	2:00:00	130.56	161.31	30.75	140.92	162.95	22.03
4/8/2011	2:15:00	130.32	161.68	31.36	139.88	162.66	22.78
4/8/2011	2:30:00	129.9	160.23	30.33	139.46	162.9	23.44
4/8/2011	2:45:00	131.64	161.35	29.71	140.45	163.27	22.82
4/8/2011	3:00:00	130.93	161.31	30.38	140.35	163.09	22.74
4/8/2011	3:15:00	131.26	161.16	29.9	139.79	163.27	23.48
4/8/2011	3:30:00	130.18	160.56	30.38	140.07	162.71	22.64
4/8/2011	3:45:00	131.45	161.45	30	140.73	163.46	22.73
4/8/2011	4:00:00	132.34	162.29	29.95	140.49	163.18	22.69
4/8/2011	4:15:00	132.99	161.21	28.22	140.73	163.46	22.73
4/8/2011	4:30:00	132.71	161.63	28.92	140.4	163.7	23.3
4/8/2011	4:45:00	132.76	160.41	27.65	140.26	163.65	23.39
4/8/2011	5:00:00	132.53	161.12	28.59	140.68	163.56	22.88
4/8/2011	5:15:00	132.76	160.93	28.17	140.45	163.88	23.43
4/8/2011	5:30:00	133.14	160.56	27.42	140.35	163.6	23.25
4/8/2011	5:45:00	133.32	159.99	26.67	139.13	162.95	23.82
4/8/2011	6:00:00	133.51	160.27	26.76	140.17	163.18	23.01
4/8/2011	6:15:00	132.01	159.85	27.84	139.46	162.48	23.02
4/8/2011	6:30:00	132.67	160.6	27.93	138.38	162.06	23.68
4/8/2011	6:45:00	134.21	160.56	26.35	139.56	162.85	23.29
4/8/2011	7:00:00	135.15	160.23	25.08	140.12	162.71	22.59
4/8/2011	7:15:00	133.65	160.04	26.39	139.93	163.23	23.3
4/8/2011	7:30:00	134.68	161.12	26.44	140.12	162.2	22.08
4/8/2011	7:45:00	133.84	160.46	26.62	139.56	162.99	23.43
4/8/2011	8:00:00	134.54	162.01	27.47	140.68	162.43	21.75
4/8/2011	8:15:00	136.14	160.74	24.6	140.21	162.43	22.22
4/8/2011	8:30:00	139.18	162.29	23.11	139.98	162.2	22.22
4/8/2011	8:45:00	140.12	164.02	23.9	140.82	162.34	21.52
4/8/2011	9:00:00	139.42	163.65	24.23	140.03	162.29	22.26
4/8/2011	9:15:00	138.76	162.99	24.23	138.99	161.16	22.17
4/8/2011	9:30:00	137.4	162.57	25.17	139.74	161.02	21.28
4/8/2011	9:45:00	137.73	162.9	25.17	141.1	161.87	20.77
4/8/2011	10:00:00	137.31	162.76	25.45	140.63	162.29	21.66
4/8/2011	10:15:00	135.57	160.56	24.99	140.54	160.6	20.06
4/8/2011	10:30:00	135.34	160.98	25.64	140.96	160.6	19.64

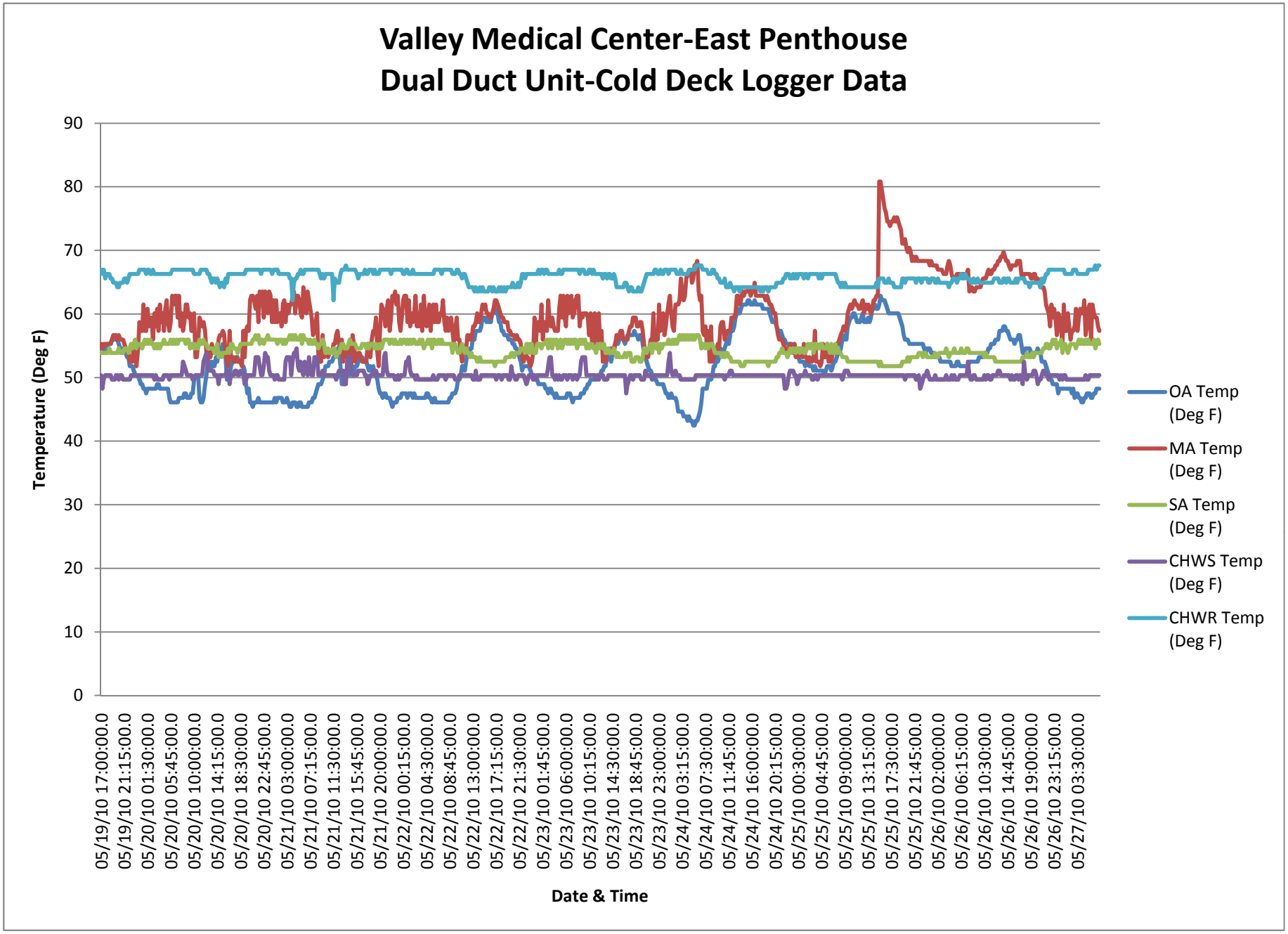
VALLEY MEDICAL CENTER	**JOB NO.** P10759	**PAGE**
DESCRIPTION: 01.01-VMC Heating Water Upgrade-Trending		1/5
Valley Medical Center Preheat Trending Data		**BY** KMR
		DATE 4/18/2011

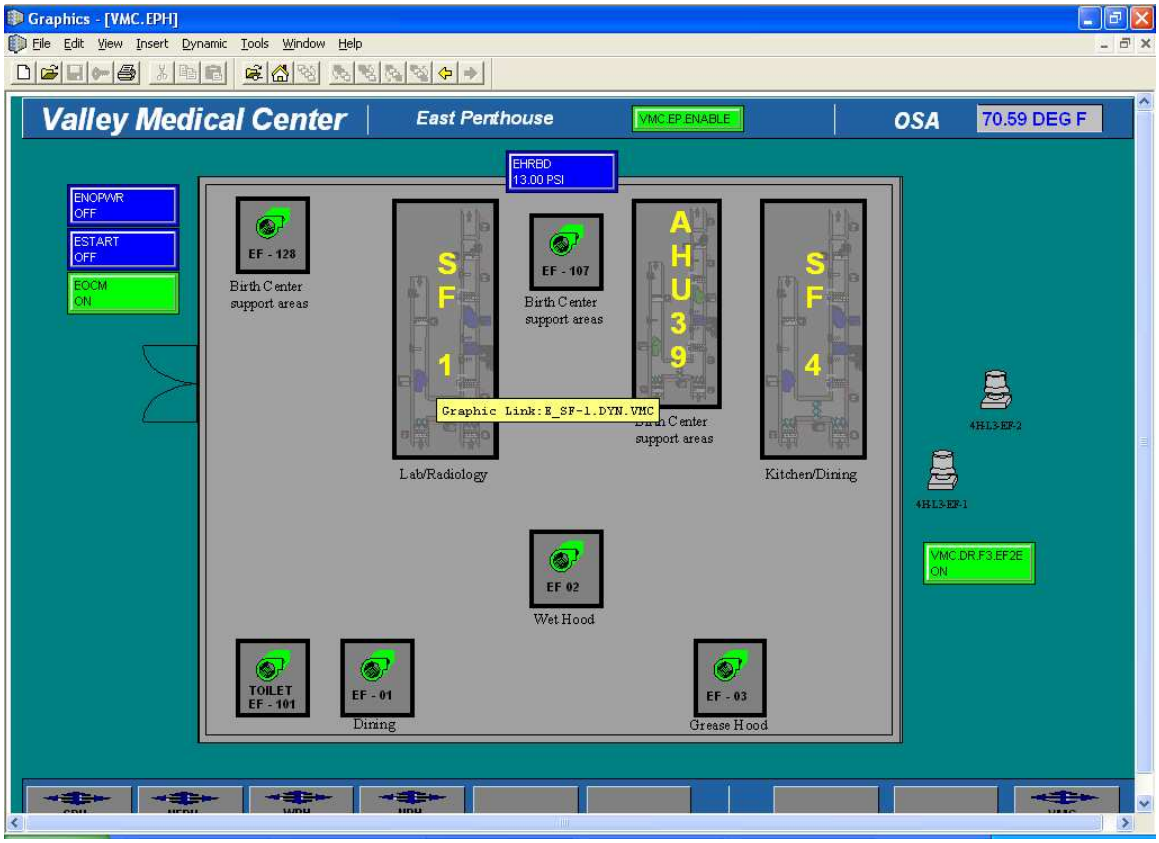
	HHX1
Average Delta T	10
Max Delta T	26
Min Delta T	5

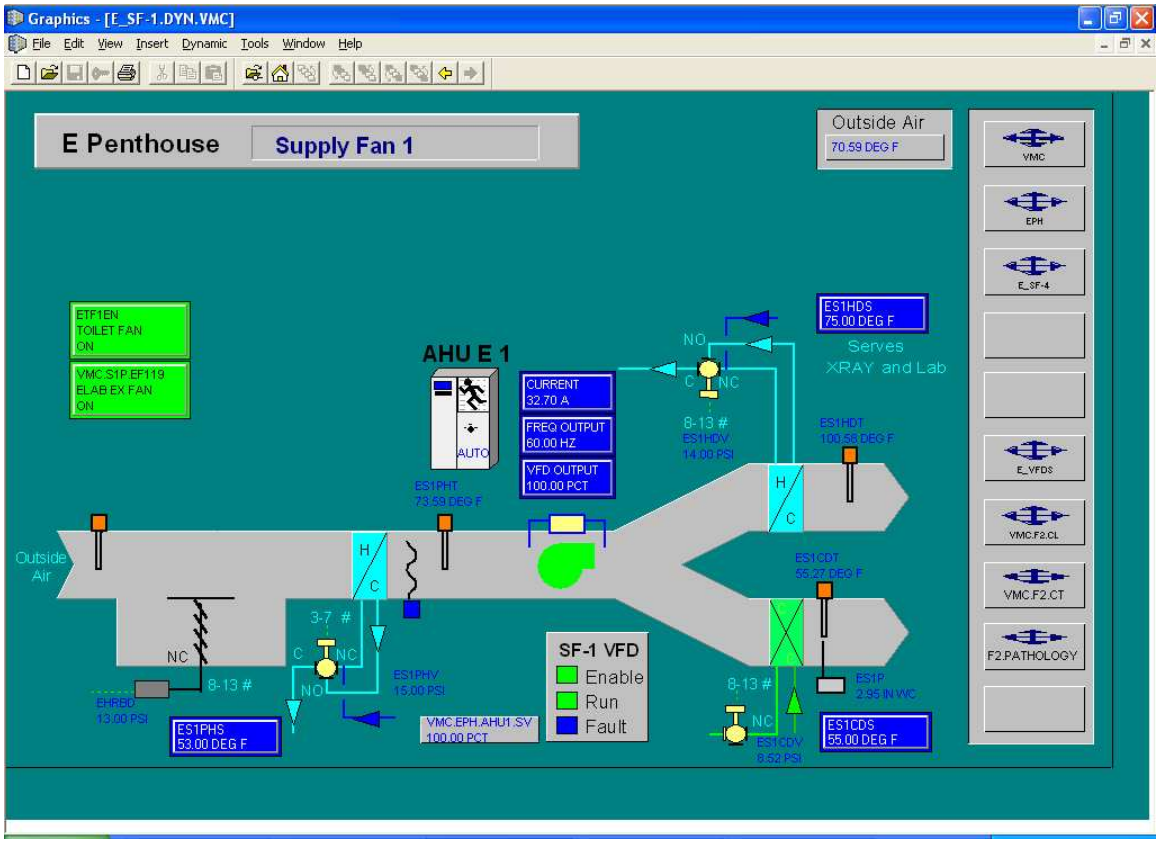
Example Trend Data

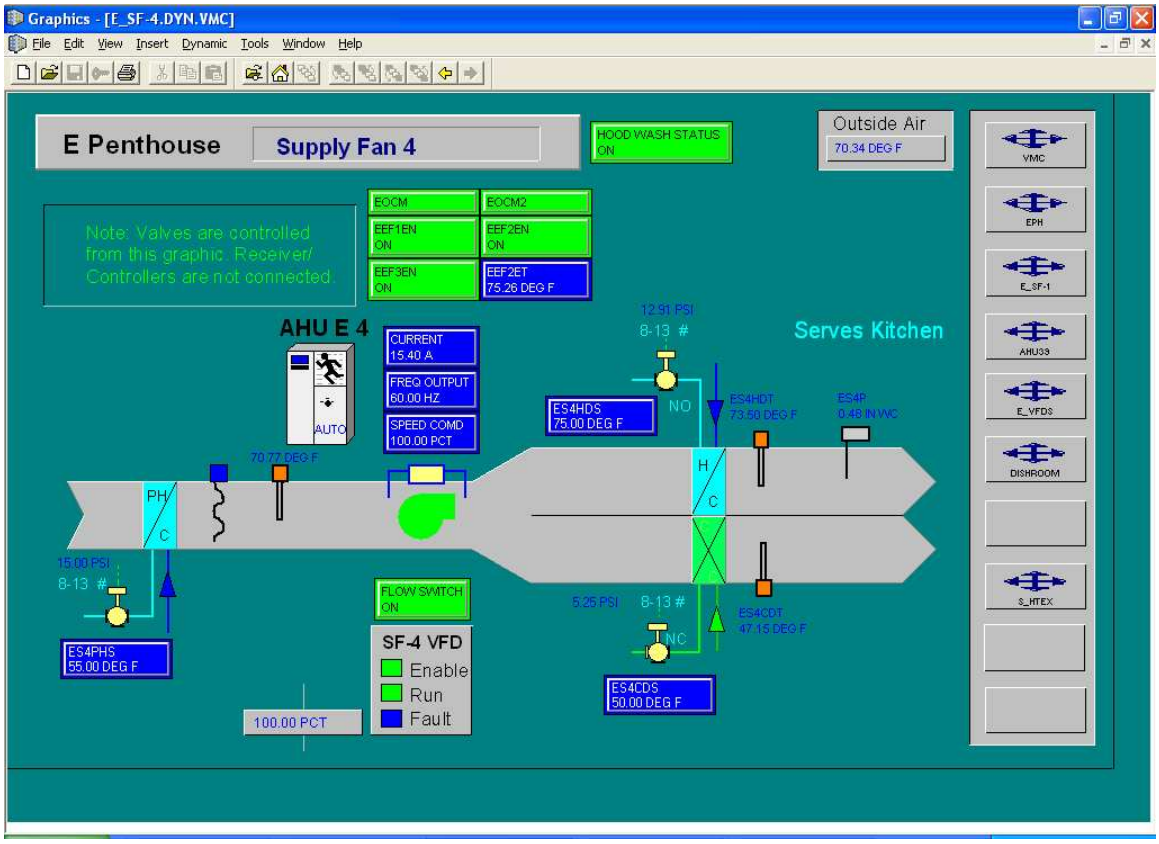
Date	Time	SHX1P1	SHX1P2	SHX1RT	SHX1ST	Preheat Delta T
4/8/2011	0:30:00	ON	OFF	166.99	181.56	14.57
4/8/2011	0:45:00	ON	OFF	161.31	181.92	20.61
4/8/2011	1:00:00	ON	OFF	159.34	173.16	13.82
4/8/2011	1:15:00	ON	OFF	165.76	173.84	8.08
4/8/2011	1:30:00	ON	OFF	165.59	190.11	24.52
4/8/2011	1:45:00	ON	OFF	158.28	171.74	13.46
4/8/2011	2:00:00	ON	OFF	164.91	173.84	8.93
4/8/2011	2:15:00	ON	OFF	162.83	184.6	21.77
4/8/2011	2:30:00	ON	OFF	160.92	167.6	6.68
4/8/2011	2:45:00	ON	OFF	167.11	187.75	20.64
4/8/2011	3:00:00	ON	OFF	161.09	176.1	15.01
4/8/2011	3:15:00	ON	OFF	164.86	175.57	10.71
4/8/2011	3:30:00	ON	OFF	166.09	186.02	19.93
4/8/2011	3:45:00	ON	OFF	159.96	166.49	6.53
4/8/2011	4:00:00	ON	OFF	167.84	190.42	22.58
4/8/2011	4:15:00	ON	OFF	157.21	171.37	14.16
4/8/2011	4:30:00	ON	OFF	163.79	180.4	16.61
4/8/2011	4:45:00	ON	OFF	160.47	179.82	19.35
4/8/2011	5:00:00	ON	OFF	163	168.54	5.54
4/8/2011	5:15:00	ON	OFF	162.16	187.8	25.64
4/8/2011	5:30:00	ON	OFF	159.12	167.02	7.9
4/8/2011	5:45:00	ON	OFF	163.39	189.11	25.72
4/8/2011	6:00:00	ON	OFF	155.86	167.65	11.79
4/8/2011	6:15:00	ON	OFF	163.45	182.76	19.31
4/8/2011	6:30:00	ON	OFF	159.79	178.04	18.25
4/8/2011	6:45:00	ON	OFF	161.54	168.54	7
4/8/2011	7:00:00	ON	OFF	163.68	188.27	24.59
4/8/2011	7:15:00	ON	OFF	161.31	169.17	7.86
4/8/2011	7:30:00	ON	OFF	161.14	180.72	19.58
4/8/2011	7:45:00	ON	OFF	162.55	174	11.45
4/8/2011	8:00:00	ON	OFF	165.76	178.88	13.12
4/8/2011	8:15:00	ON	OFF	160.24	176.99	16.75
4/8/2011	8:30:00	ON	OFF	166.43	174.68	8.25
4/8/2011	8:45:00	ON	OFF	161.76	184.7	22.94
4/8/2011	9:00:00	ON	OFF	159.74	167.49	7.75

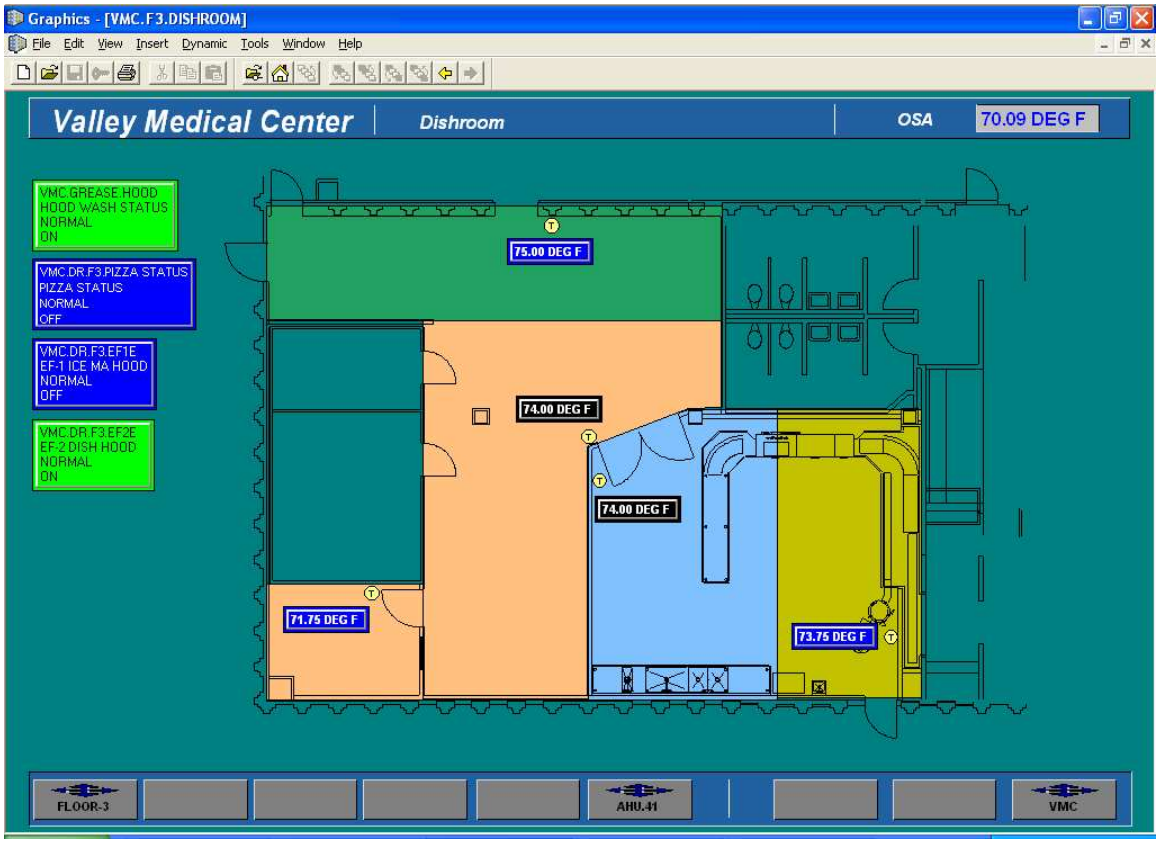

Valley Medical Center-East Penthouse
Dual Duct Unit Airside Logger Data
Temperature (Deg F)
90
80
70
60
50
40
30
20
10
0
05/19/10 17:00:00.0
05/19/10 21:30:00.0
05/20/10 02:00:00.0
05/20/10 06:30:00.0
05/20/10 11:00:00.0
05/20/10 15:30:00.0
05/20/10 20:00:00.0
05/21/10 00:30:00.0
05/21/10 05:00:00.0
05/21/10 09:30:00.0
05/21/10 14:00:00.0
05/21/10 18:30:00.0
05/21/10 23:00:00.0
05/22/10 03:30:00.0
05/22/10 08:00:00.0
05/22/10 12:30:00.0
05/22/10 17:00:00.0
05/22/10 21:30:00.0
05/23/10 02:00:00.0
05/23/10 06:30:00.0
05/23/10 11:00:00.0
05/23/10 15:30:00.0
05/23/10 20:00:00.0
05/24/10 00:30:00.0
05/24/10 05:00:00.0
05/24/10 09:30:00.0
05/24/10 14:00:00.0
05/24/10 18:30:00.0
05/24/10 23:00:00.0
05/25/10 03:30:00.0
05/25/10 08:00:00.0
05/25/10 12:30:00.0
05/25/10 17:00:00.0
05/25/10 21:30:00.0
05/26/10 02:00:00.0
05/26/10 06:30:00.0
05/26/10 11:00:00.0
05/26/10 15:30:00.0
05/26/10 20:00:00.0
05/27/10 00:30:00.0
05/27/10 05:00:00.0
Date & Time
OA Temp (Deg F)
MA Temp (Deg F)
SA Temp (Deg F)

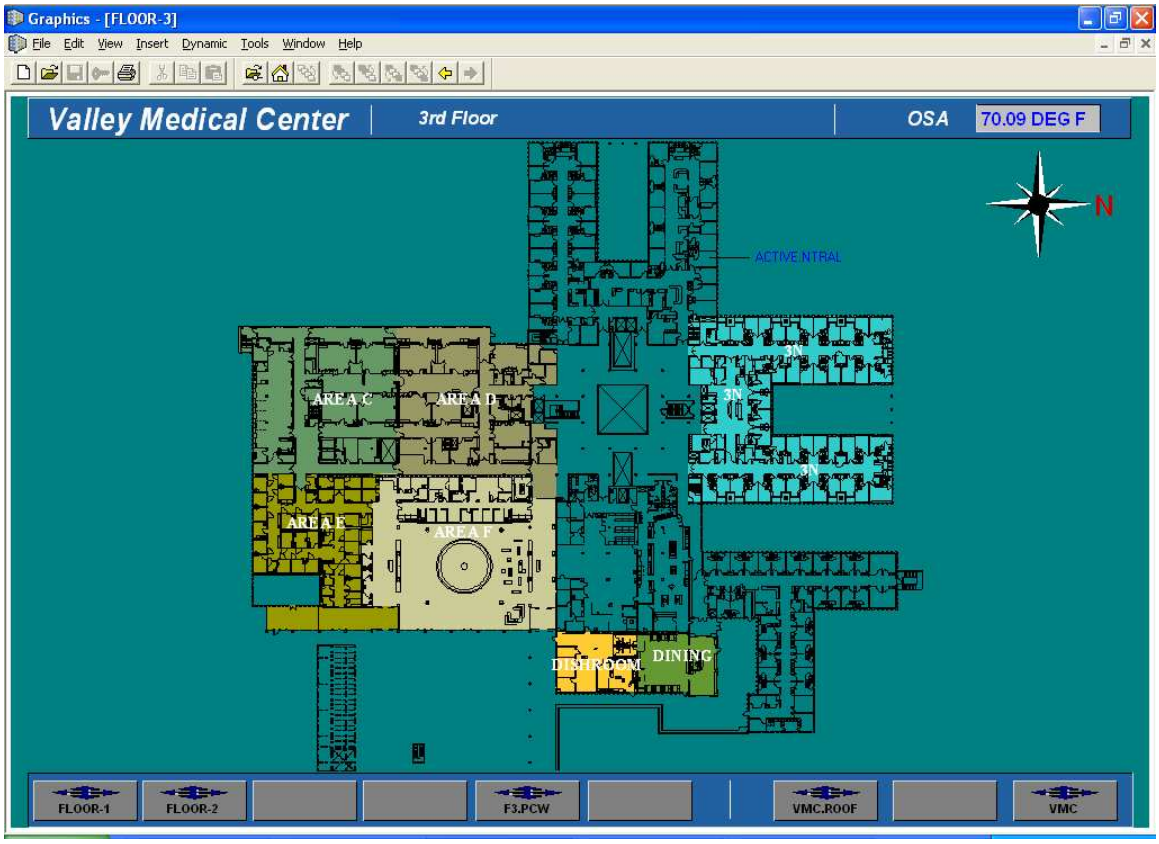

Valley Medical Center-East Penthouse
Dual Duct Unit-Cold Deck Logger Data
Temperature (Deg F)
90
80
70
60
50
40
30
20
10
0
05/19/10 17:00:00.0
05/19/10 21:15:00.0
05/20/10 01:30:00.0
05/20/10 05:45:00.0
05/20/10 10:00:00.0
05/20/10 14:15:00.0
05/20/10 18:30:00.0
05/20/10 22:45:00.0
05/21/10 03:00:00.0
05/21/10 07:15:00.0
05/21/10 11:30:00.0
05/21/10 15:45:00.0
05/21/10 20:00:00.0
05/22/10 00:15:00.0
05/22/10 04:30:00.0
05/22/10 08:45:00.0
05/22/10 13:00:00.0
05/22/10 17:15:00.0
05/22/10 21:30:00.0
05/23/10 01:45:00.0
05/23/10 06:00:00.0
05/23/10 10:15:00.0
05/23/10 14:30:00.0
05/23/10 18:45:00.0
05/23/10 23:00:00.0
05/24/10 03:15:00.0
05/24/10 07:30:00.0
05/24/10 11:45:00.0
05/24/10 16:00:00.0
05/24/10 20:15:00.0
05/25/10 00:30:00.0
05/25/10 04:45:00.0
05/25/10 09:00:00.0
05/25/10 13:15:00.0
05/25/10 17:30:00.0
05/25/10 21:45:00.0
05/26/10 02:00:00.0
05/26/10 06:15:00.0
05/26/10 10:30:00.0
05/26/10 14:45:00.0
05/26/10 19:00:00.0
05/26/10 23:15:00.0
05/27/10 03:30:00.0
Date & Time
OA Temp (Deg F)
MA Temp (Deg F)
SA Temp (Deg F)
CHWS Temp (Deg F)
CHWR Temp (Deg F)

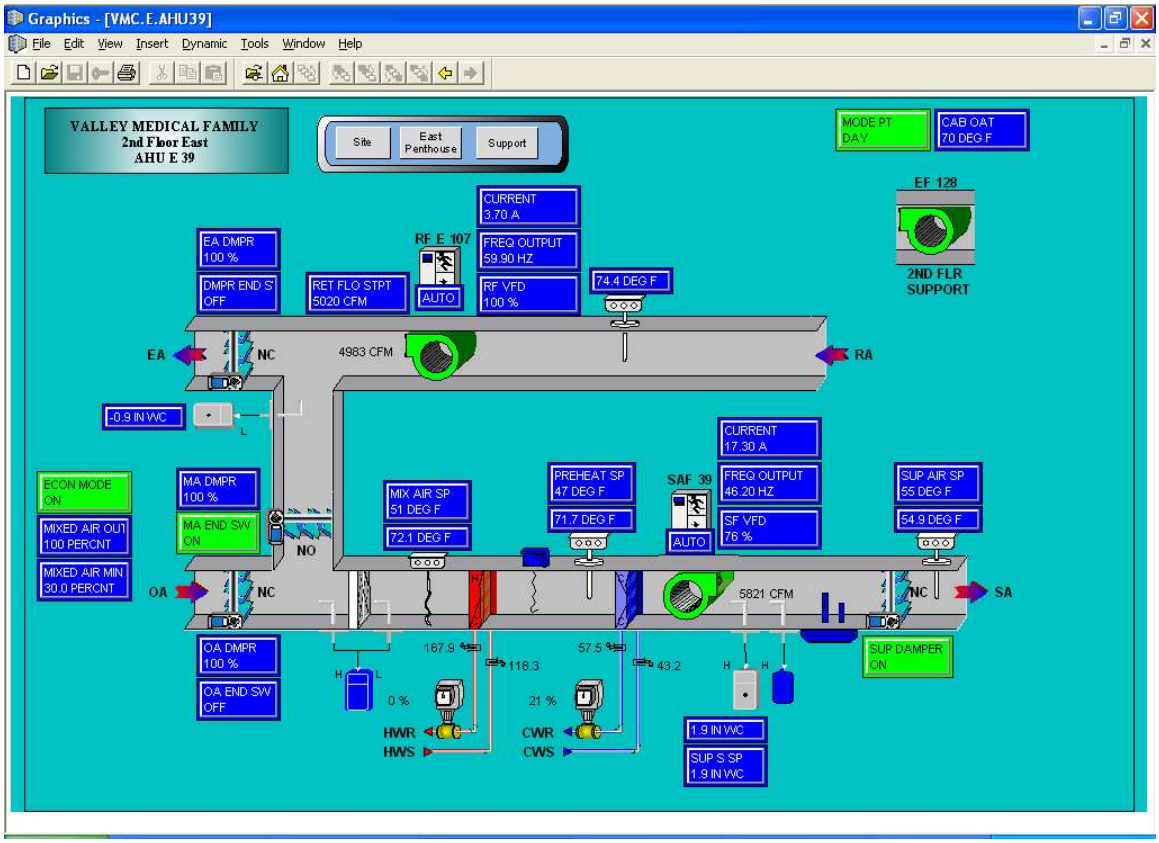

Graphics - [VMC.EPH]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
East Penthouse
VMC.EP.ENABLE
OSA
70.59 DEG F
EHRBD
13.00 PSI
ENOPWR
OFF
ESTART
OFF
EOCM
ON
EF - 128
Birth Center support areas
SF 1
EF - 107
Birth Center support areas
AHU 39
SF 4
Graphic Link: E_SF-1.DYN.VMC
Birth Center support areas
Lab/Radiology
Kitchen/Dining
4H.L3.EF-2
4H.L3.EF-1
VMC.DR.F3.EF2E
ON
EF 02
Wet Hood
TOILET
EF - 101
EF - 01
Dining
EF - 03
Grease Hood

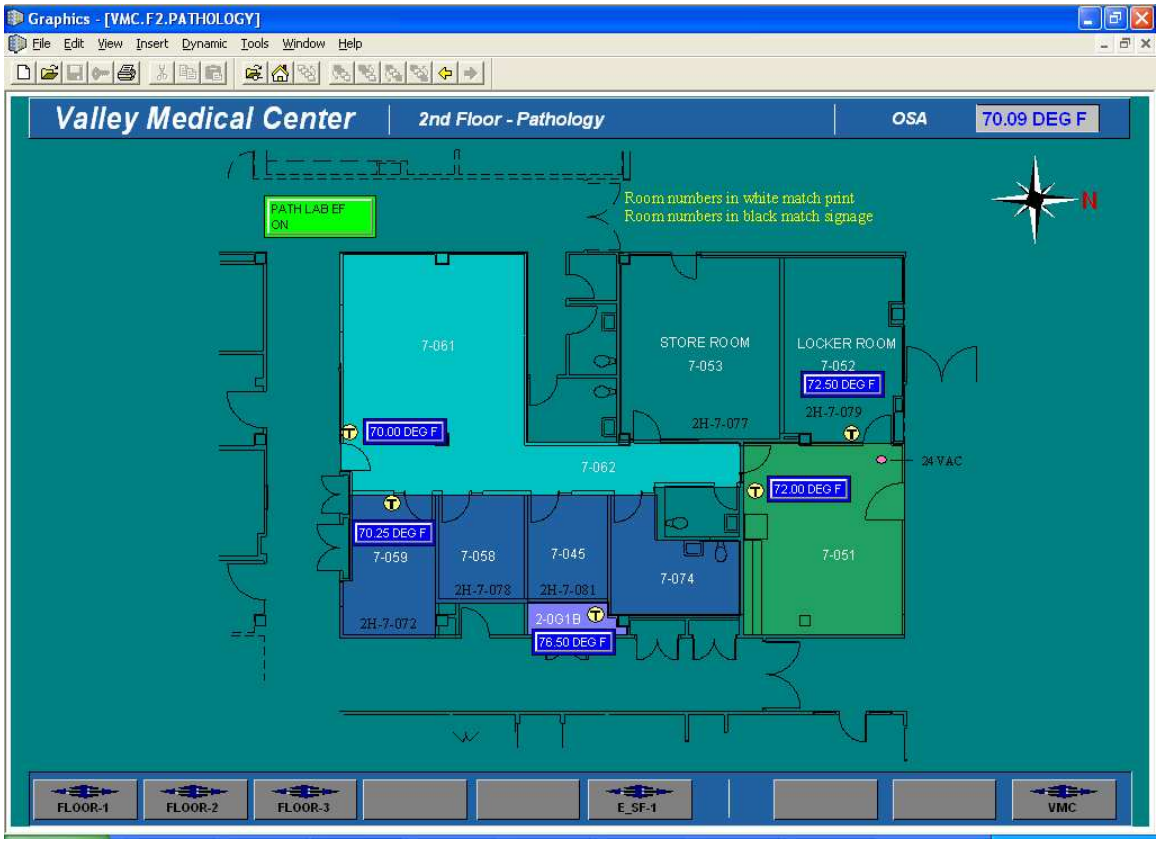

Graphics - [E_SF-1.DYN.VMC]
File Edit View Insert Dynamic Tools Window Help
E Penthouse
Supply Fan 1
Outside Air
70.59 DEG F
VMC
EPH
E_SF-4
E_VFDS
VMC.F2.CL
VMC.F2.CT
F2.PATHOLOGY
ETF1EN
TOILET FAN
ON
VMC.S1P.EF119
ELAB EX FAN
ON
AHU E 1
AUTO
CURRENT
32.70 A
FREQ OUTPUT
60.00 HZ
VFD OUTPUT
100.00 PCT
ES1HDS
75.00 DEG F
Serves
XRAY and Lab
8-13 #
ES1HDV
14.00 PSI
ES1HDT
100.58 DEG F
ES1PHT
73.59 DEG F
Outside Air
ES1CDT
55.27 DEG F
3-7 #
NC
8-13 #
EHRBD
13.00 PSI
ES1PHS
53.00 DEG F
ES1PHV
15.00 PSI
VMC.EPH.AHU1.SV
100.00 PCT
SF-1 VFD
Enable
Run
Fault
8-13 #
ES1CDV
8.52 PSI
ES1P
2.95 IN WC
ES1CDS
55.00 DEG F

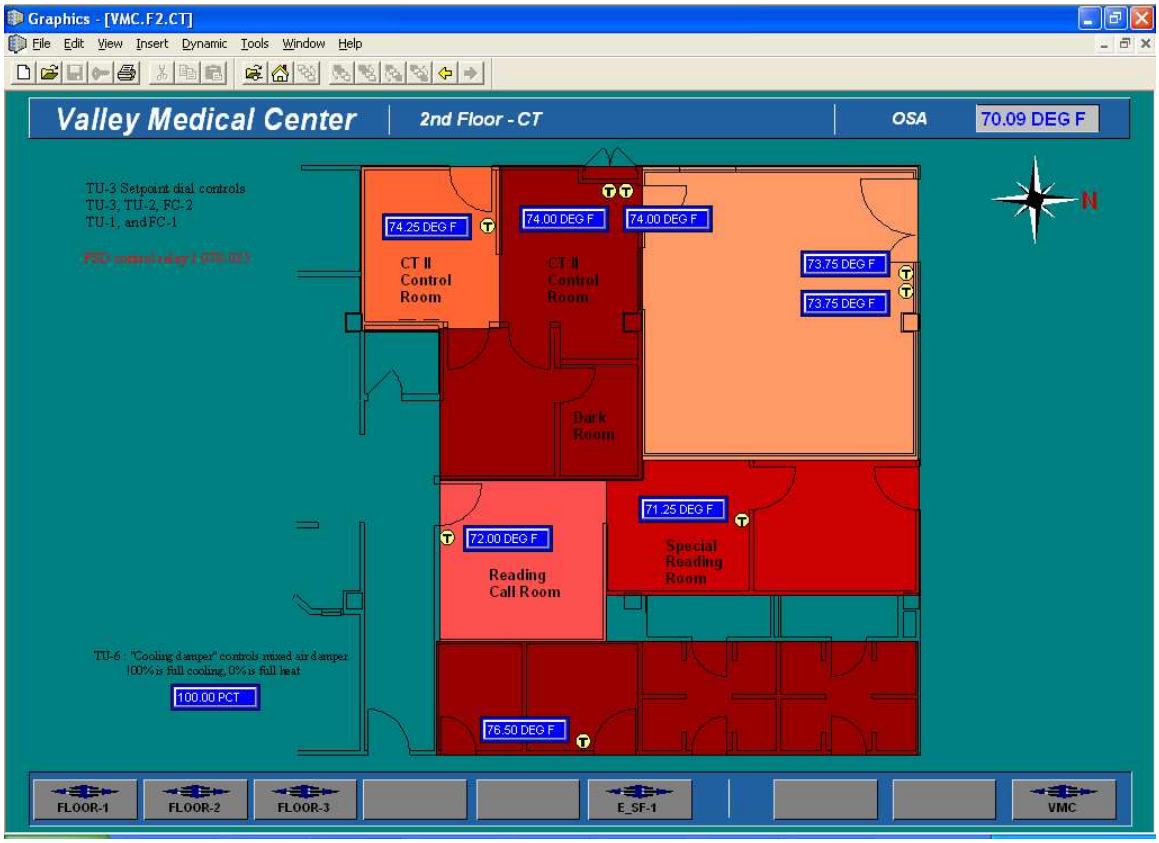

Graphics - [E_SF-4.DYN.VMC]
File Edit View Insert Dynamic Tools Window Help
E Penthouse
Supply Fan 4
HOOD WASH STATUS
ON
Outside Air
70.34 DEG F
VMC
EPH
E_SF-1
AHU39
E_VFDS
DISHROOM
S_HTEX
Note: Valves are controlled from this graphic. Receiver/ Controllers are not connected.
EOCM
EOCM2
EEF1EN
ON
EEF2EN
ON
EEF3EN
ON
EEF2ET
75.26 DEG F
AHU E 4
AUTO
CURRENT
15.40 A
FREQ OUTPUT
60.00 HZ
SPEED COMD
100.00 PCT
12.91 PSI
8-13 #
Serves Kitchen
ES4HDS
75.00 DEG F
NO
ES4HDT
73.50 DEG F
ES4P
0.48 IN WC
70.77 DEG F
PH
C
H
C
15.00 PSI
8-13 #
ES4PHS
55.00 DEG F
FLOW SWITCH
ON
SF-4 VFD
Enable
Run
Fault
5.25 PSI
8-13 #
NC
ES4CDT
47.15 DEG F
ES4CDS
50.00 DEG F
100.00 PCT

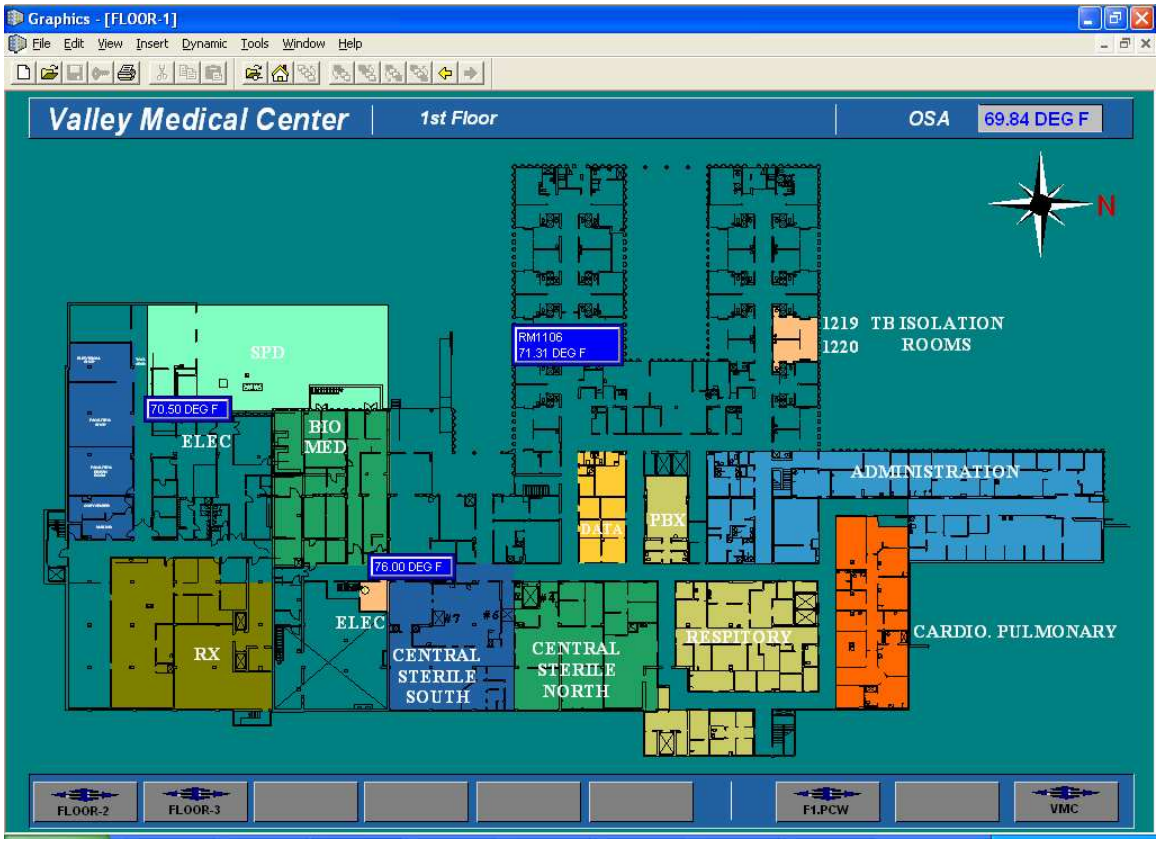

Graphics - [VMC.F3.DISHROOM]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
Dishroom
OSA
70.09 DEG F
VMC.GREASE HOOD
HOOD WASH STATUS
NORMAL
ON
VMC.DR.F3.PIZZA STATUS
PIZZA STATUS
NORMAL
OFF
VMC.DR.F3.EF1E
EF-1 ICE MA HOOD
NORMAL
OFF
VMC.DR.F3.EF2E
EF-2 DISH HOOD
NORMAL
ON
75.00 DEG F
74.00 DEG F
74.00 DEG F
71.75 DEG F
73.75 DEG F
FLOOR-3
AHU-41
VMC


Graphics - [FLOOR-3]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
3rd Floor
OSA
70.09 DEG F
N
ACTIVE NTRAL
AREA C
AREA D
3N
AREA E
AREA F
DISHROOM
DINING
FLOOR-1
FLOOR-2
F3.PCW
VMC.ROOF
VMC


Graphics - [VMC.E.AHU39]
File Edit View Insert Dynamic Tools Window Help
VALLEY MEDICAL FAMILY
2nd Floor East
AHU E 39
Site
East Penthouse
Support
MODE PT
DAY
CAB OAT
70 DEG F
EF 128
2ND FLR
SUPPORT
CURRENT
3.70 A
FREQ OUTPUT
59.90 HZ
RF VFD
100 %
RF E 107
AUTO
74.4 DEG F
EA DMPR
100 %
DMPR END S
OFF
RET FLO STPT
5020 CFM
EA
NC
4983 CFM
RA
-0.9 IN WC
L
CURRENT
17.30 A
FREQ OUTPUT
46.20 HZ
SF VFD
76 %
SAF 39
AUTO
ECON MODE
ON
MIXED AIR OUT
100 PERCNT
MIXED AIR MIN
30.0 PERCNT
MA DMPR
100 %
MA END SW
ON
NO
MIX AIR SP
51 DEG F
72.1 DEG F
PREHEAT SP
47 DEG F
71.7 DEG F
SUP AIR SP
55 DEG F
54.9 DEG F
OA
NC
5821 CFM
NC
SA
OA DMPR
100 %
OA END SW
OFF
167.9
118.3
57.5
43.2
0 %
21 %
HWR
HWS
CWR
CWS
1.9 IN WC
SUP S SP
1.9 IN WC
SUP DAMPER
ON


Graphics - [VMC.F2.PATHOLOGY]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
2nd Floor - Pathology
OSA
70.09 DEG F
PATH LAB EF ON
Room numbers in white match print
Room numbers in black match signage
N
7-061
STORE ROOM
7-053
LOCKER ROOM
7-052
72.50 DEG F
2H-7-079
2H-7-077
70.00 DEG F
7-062
24 VAC
72.00 DEG F
70.25 DEG F
7-059
7-058
7-045
7-074
7-051
2H-7-078
2H-7-081
2H-7-072
2-0G1B
76.50 DEG F
FLOOR-1
FLOOR-2
FLOOR-3
E_SF-1
VMC


Graphics - [VMC.F2.CT]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
2nd Floor - CT
OSA
70.09 DEG F
TU-3 Setpoint dial controls
TU-3, TU-2, FC-2
TU-1, and FC-1
N
74.25 DEG F
74.00 DEG F
74.00 DEG F
CT II Control Room
CT II Control Room
73.75 DEG F
73.75 DEG F
Dark Room
71.25 DEG F
72.00 DEG F
Reading Call Room
Special Reading Room
TU-6 : "Cooling damper" controls mixed air damper
100% is full cooling, 0% is full heat
100.00 PCT
76.50 DEG F
FLOOR-1
FLOOR-2
FLOOR-3
E_SF-1
VMC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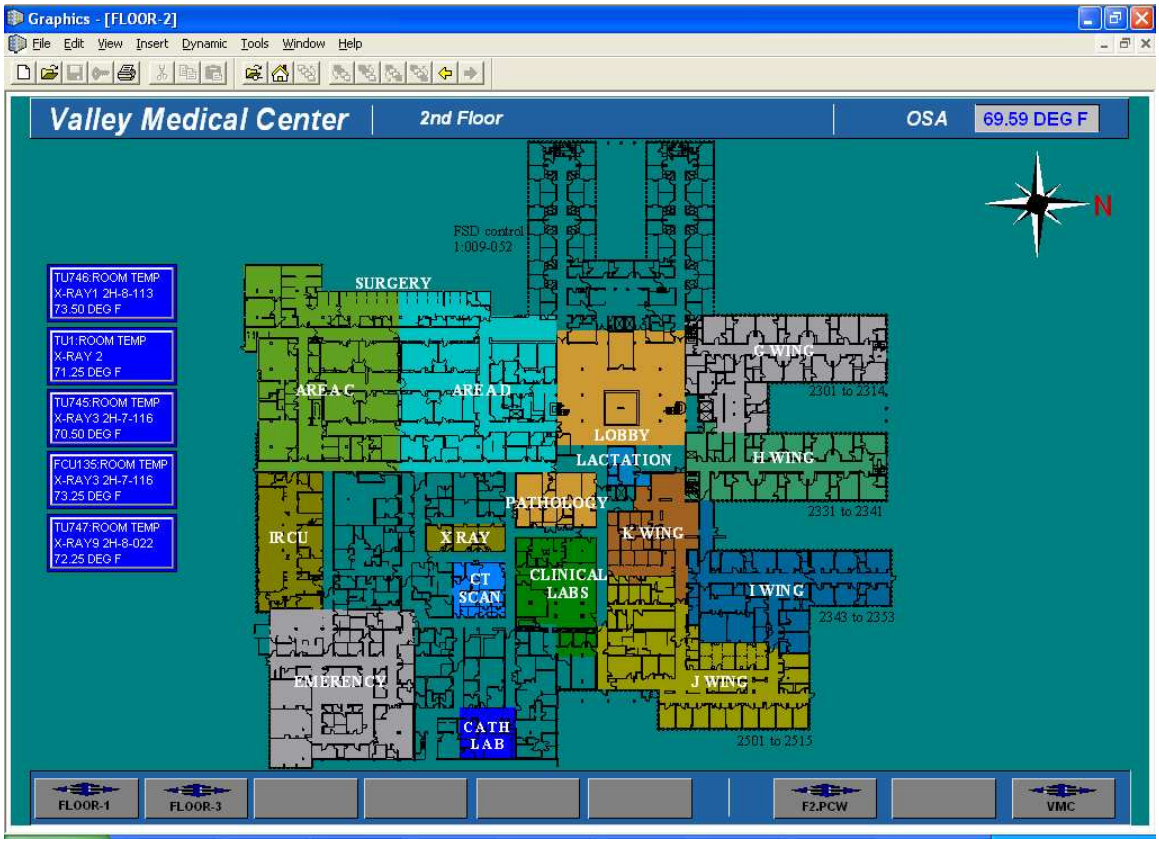
Valley Medical Center
1st Floor
OSA
69.84 DEG F
N
SPD
70.50 DEG F
ELEC
BIO MED
RM1106
71.31 DEG F
1219
1220
TB ISOLATION ROOMS
ADMINISTRATION
DATA
PBX
76.00 DEG F
ELEC
RX
CENTRAL STERILE SOUTH
CENTRAL STERILE NORTH
RESPITORY
CARDIO. PULMONARY
FLOOR-2
FLOOR-3
F1.PCW
VMC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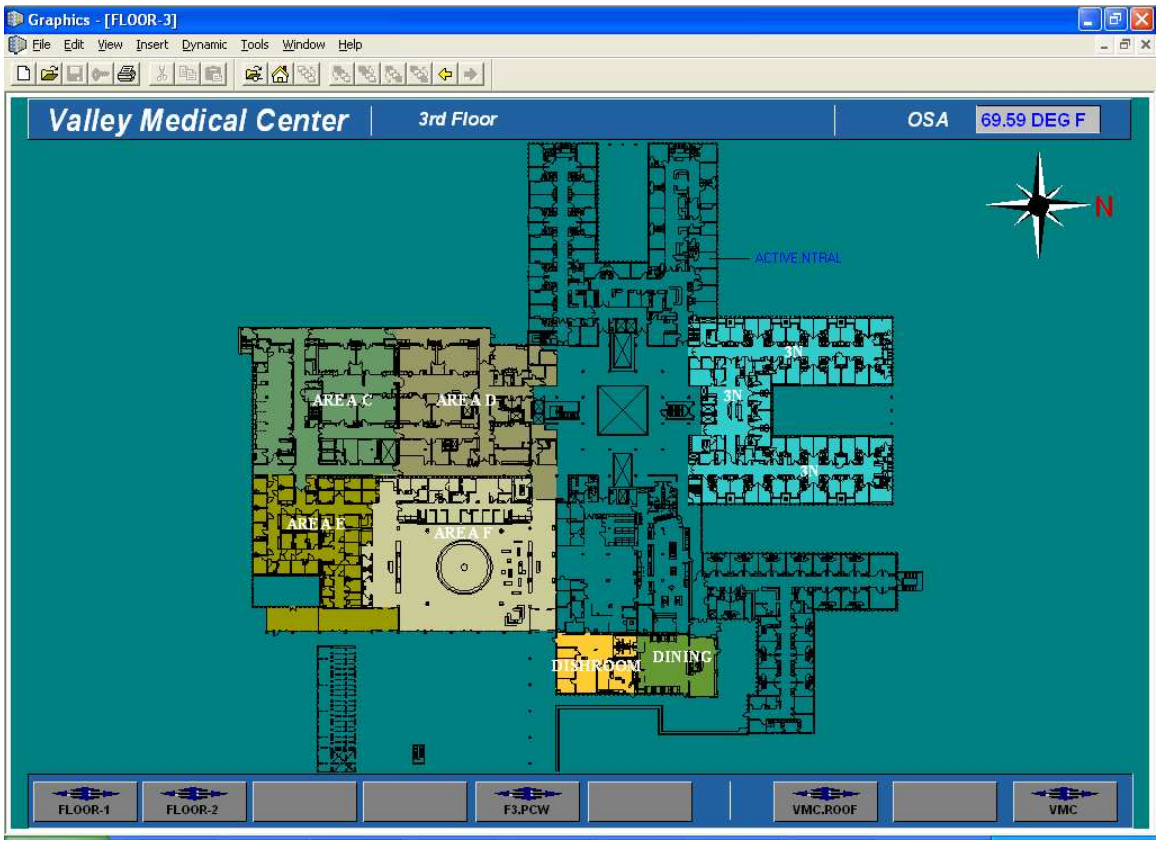
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
2nd Floor
OSA
69.59 DEG F
N
FSD control
1:009-052
TU746:ROOM TEMP
X-RAY1 2H-8-113
73.50 DEG F
TU1:ROOM TEMP
X-RAY 2
71.25 DEG F
TU745:ROOM TEMP
X-RAY3 2H-7-116
70.50 DEG F
FCU135:ROOM TEMP
X-RAY3 2H-7-116
73.25 DEG F
TU747:ROOM TEMP
X-RAY9 2H-8-022
72.25 DEG F
SURGERY
AREA C
AREA D
LOBBY
LACTATION
G WING
2301 to 2314
H WING
2331 to 2341
PATHOLOGY
IRCU
X RAY
K WING
CT SCAN
CLINICAL LABS
I WING
2343 to 2353
EMERENCY
J WING
CATH LAB
2501 to 2515
FLOOR-1
FLOOR-3
F2.PCW
VMC


Graphics - [FLOOR-3]
File Edit View Insert Dynamic Tools Window Help
Valley Medical Center
3rd Floor
OSA
69.59 DEG F
N
ACTIVE NTRAL
ARE A C
ARE A D
3N
3N
ARE A E
ARE A F
DISH ROOM
DINING
FLOOR-1
FLOOR-2
F3.PCW
VMC.ROOF
VMC

Valley Medical Center – Heating Water & Dual Duct AHU Upgrades

Measurement & Verification Report

REPORT 1
31 JANUARY 2013
PREPARED BY: SEAN TARASUK

FOR THE LIFE OF YOUR BUILDING

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3.2 3.01-VMC Dual Duct Unit
3.3 9.01-Various Lighting Upgrades

APPENDICES

A. Savings Summary Table
B. Mechanical Verification Documentation
C. Lighting As-Builts

Executive Summary

Summary of Proposed & Verified Energy & Cost Savings

PROJECT RESULTS

McKinstry is pleased to report that our pre- and post-survey measurements have confirmed that all Facility Improvement Measures (FIMs) are on track to meet or exceed their guaranteed energy savings values, per the Energy Services Proposal (ESP).

As seen below, Valley Medical Center is on track to save an estimated 343,218 kWh of electricity, 266 kW demand, and 14,345 therms of heating. Verified savings were not recalculated since the as-verified key performance indicators were all at or better than the target values during the measurement and verification (M&V) period. Therefore, the verified energy savings is calculated to be the guaranteed energy savings divided by the 90% guarantee factor. Using the pre-retrofit utility rates, as outlined in the Energy Cost Savings Guarantee section of the ESP, we have calculated a projected annual savings of $30,322 for Valley Medical Center solely from energy savings. The Annual Savings Summary (Table 1) attached in Appendix A, provides a breakdown of how the above savings were derived on a FIM basis.

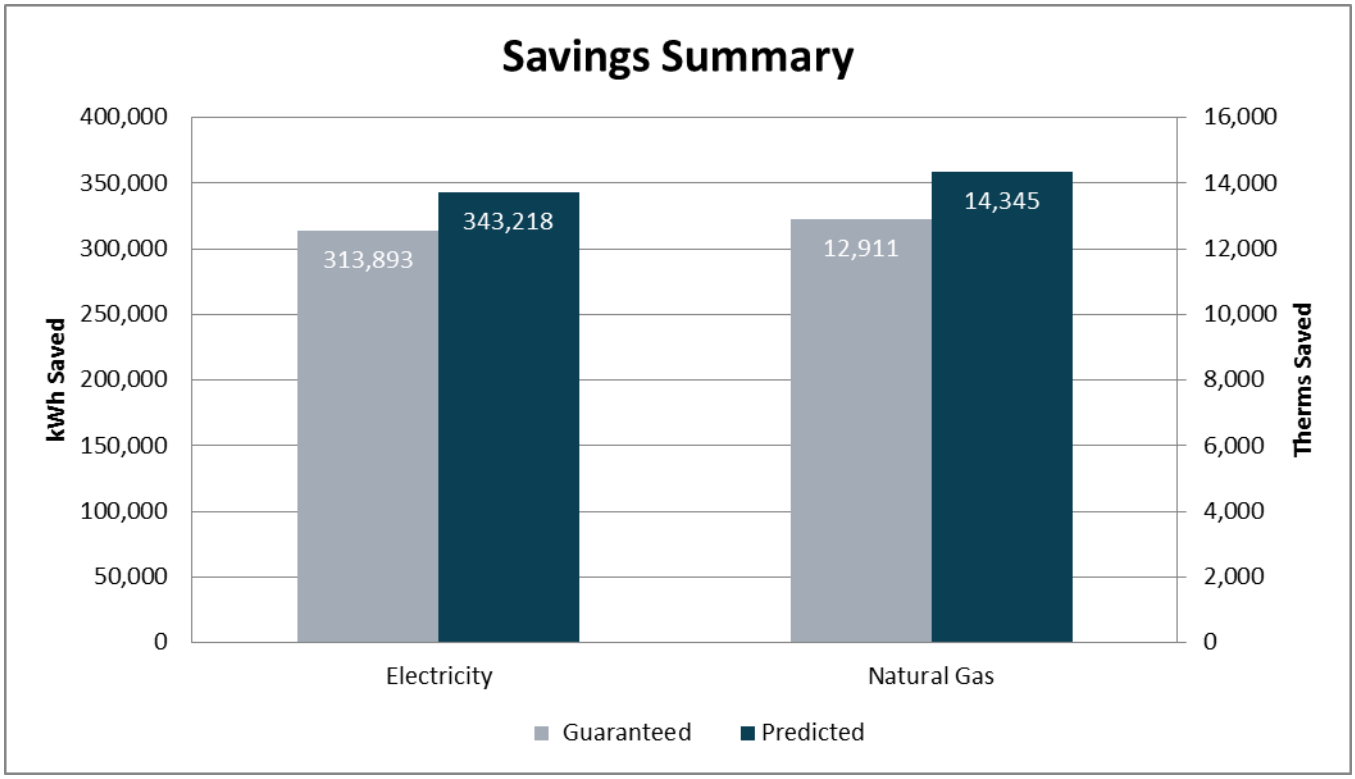


FIGURE 1

Executive Summary

Savings Adjustments

There were no savings adjustments required for this M&V period of reporting.

Performance & O&M Recommendations

The list below is a brief summary of the recommendations identified during the measurement and verification period for this project:

- Maintain setpoints per commissioned values to maintain savings.
- Perform routine maintenance per manufacturer recommended specifications.

Background

Project Background

McKinstry was contracted to perform a Directed Engineering Study (DES) with the intent of developing a performance-contracting project with Valley Medical Center. The final DES was delivered and accepted on May 4th, 2011. A performance contract totaling $2,474,188 (with contingency) was signed on August 15, 2011. Construction for FIMs 1.01-VMC and 3.01-VMC was completed and accepted on March 30th, 2012 with the performance period to follow. The lighting FIMs 9.01-TLB, 9.01-VMC and 9.02-VMC were commenced on August 1, 2012 with the performance period to follow.

Project & FIM Overview

The ESP contract combined FIMs that would generate energy savings without direct input or action from facility personnel and those that would only generate energy savings if the facility strictly adhered to recommended operations and maintenance practices. The following briefly describes all the FIMs that were implemented under this project:

- FIM 1.01-VMC Heating Water Upgrade: The central boilers in the basement mechanical room provide steam to the Valley Medical Center building. This steam serves a heating water converter preheat plant in the South Penthouse and a heating water converter reheat plant in the basement mechanical room. Both plants are out of date and inefficient. Replace the preheat and reheat converters, and install variable volume heating water pumps.

- FIM 3.01-VMC Dual Duct Unit Replacement: The Dual Duct unit in the East Penthouse is approaching end of life. Provide a new dual duct unit with VFDs and which meets Valley Medical Center performance and redundancy specifications. Include 30,000 CFM temporary unit to allow for 24/7 service to prevent service interruption.

- FIM 9.01-TLB Lighting Upgrade: Replace existing HID fixtures located in the Gymnasium and Pool areas with energy efficient fixtures operating T5HO lamps and electronic ballasts. Existing T12 lamps and magnetic ballasts located on the 1st floor will be retrofitted with T8 lamps and electronic ballasts. Pharmacy/Gift shop fixtures will be upgraded using retrofit kits to standardize lamp and ballast quantities per fixture and improve the aesthetics of the space.

- FIM 9.01-VMC Surface Parking Lighting Upgrade: Replace existing 250W and 400W post top metal halide and high pressure sodium area light fixtures located in the main surface parking area with 139W LED fixtures. Budget reflects the use of existing poles. Replace existing sign lighting metal halide fixtures with LED ground mount flood lights. Replace existing metal halide canopy fixtures in the main walkway with vapor tight fixtures operating fluorescent lamps and electronic ballasts.

- FIM 24.01-VMC Solar PV Installation (Still in Construction): Provide an AC grid connected solar PV power system. The PV panels will be pole mounted and installed on the VMC lawn at the entrance to HWY 167. Scope includes “SMA” brand web-based monitoring equipment and software that will make it possible to monitor and display performance data online.

Detailed M&V

FIM 1.01-VMC: Heating Water Upgrade

BRIEF DESCRIPTION OF FIM

The central boilers in the basement mechanical room provide steam to the Valley Medical Center building. This steam serves a heating water converter preheat plant in the South Penthouse and a heating water converter reheat plant in the basement mechanical room. Both plants are out of date and inefficient. Replace the preheat and reheat converters, and install variable volume heating water pumps.

M&V ACTIVITIES CONDUCTED THIS PERIOD

M&V Option A (Partially Measured Retrofit Isolation) was performed on this FIM. The following is a list of activities performed for this FIM:

- Verify converter and corresponding system insulation.
- Review commissioning report.
- Review pump and converter submittal data.
- Review test and balance (TAB) report.

Below is a summary of the key factors and the results of the M&V performed for this report.

Key Performance Indicator	Base/As-Found Condition Measurement	Proposed/As-Built Measurement	As-Commissioned Measurement	1 Year Post Measurement
Converter Size	Preheat system: 19,500 MBH; Reheat System: 4,000 and 13,000 MBH	Preheat system: 10,338 MBH; Reheat System: 14,905 MBH	Preheat system: 10,338 MBH; Reheat System: 14,905 MBH	TBD
Converter Jacket Loss	Preheat: .25%; Reheat: .5%	Preheat: .13%; Reheat: .25%	Preheat: .13%; Reheat: .25%	TBD
Boiler Efficiency	80%	80%	Stipulated	Stipulated
Hours of Operation	24 hours a day, 7 days a week	24 hours a day, 7 days a week	Stipulated	Stipulated
System pump BHP	Preheat: 2 pumps @ 30 HP Reheat: 2 pumps @ 25 HP, 2 pumps @ 10 HP	Preheat: 2 pumps @ 20 HP Reheat: 3 pumps @ 50 HP	Preheat: 2 pumps @ 20 HP Reheat: 3 pumps @ 50 HP	Preheat: 2 pumps @ 20 HP Reheat: 3 pumps @ 50 HP
System pump flow control; load profile	Preheat System: constant volume Reheat System: 1 10 HP pump w/VFD running at constant 8.4 amps, remaining are constant volume	Preheat System: VFDs with Modulation Reheat System: VFDs with Modulation	Preheat System: VFDs with Modulation Reheat System: VFDs with Modulation	Preheat System: VFDs with Modulation Reheat System: VFDs with Modulation

Detailed M&V

Key Performance Indicator	Base/As-Found Condition Measurement	Proposed/As-Built Measurement	As-Commissioned Measurement	1 Year Post Measurement
Average Heating Water Delta T	Preheat System: 10˚F Reheat System: 25˚F	Preheat System: 10˚F Reheat System: 25˚F	Preheat System: 10˚F Reheat System: 25˚F	TBD

The results of the analysis determined that the new hot water system is operating as designed and all key performance indicators are being met. Attached in Appendix B are excerpts from the commissioning report verifying proper testing and startup of the hot water system. For the full report, please refer to the O&M Binder provided at project close out.

VERIFIED SAVINGS CALCULATIONS & METHODOLOGY

Verified savings were not recalculated since the as-verified key performance indicators were all at or better than the target values for the M&V period. Therefore, the verified energy savings is calculated to be the guaranteed energy savings divided by the 90% guarantee factor. The contractual utility rates were applied to the verified energy usage savings in order to show the equivalent avoided costs achieved.

Savings Calculation Method
FIM Savings were determined through a sequential set of BIN calculations detailing each step of the retrofit. Please refer to the calculation details provided in the ESP for further details.

Guaranteed Factor(s)
VFD Operation

New heating hot water system will meet building loads

Stipulated Factor(s)
Insulation Quality of Existing Converters

Building Loads

Weather

Hours of Operation

FIM SAVINGS SUMMARY

	Guaranteed	Verified
Gas Savings (Therms)	8,235	9,150
Electricity Savings (kWh)	166,769	185,299
Demand Reduction (kW)	4	4
Year 1 Avoided Costs At Baseline Rates ($)	$19,175	$21,306

Detailed M&V

DETAILS OF O&M & OTHER SAVINGS (IF APPLICABLE)

During the first year, there was a stipulated $13,625 for this FIM's O&M savings. These first year savings were agreed upon by both McKinstry and Valley Medical Center. The savings were based on the reduced maintenance of the new systems compared to the aging systems.

NOTED DEFICIENCIES

During the M&V Period, there were no noted deficiencies affecting performance and/or savings of this FIM.

RECOMMENDATIONS

The following are the recommendations of McKinstry as a result of the measurement and verification analysis:

Maintain setpoints as commissioned.

Perform routine maintenance per manufacturer recommended specifications.

Detailed M&V

FIM 3.01-VMC: Dual Duct Unit Replacement

BRIEF DESCRIPTION OF FIM

The Dual Duct unit in the East Penthouse is approaching end of life. Provide a new dual duct unit with VFDs and which meets Valley Medical Center performance and redundancy specifications. Include 30,000 CFM temporary unit to allow for 24/7 service to prevent service interruption.

M&V ACTIVITIES CONDUCTED THIS PERIOD

M&V Option A (Partially Measured Retrofit Isolation) was performed on this FIM. The following is a list of activities performed for this FIM:

- Review commissioning report.
- Review submittal data sheets.

Below is a summary of the key factors and the results of the M&V performed for this report.

Key Performance Indicator	Base/As-Found Condition Measurement	Proposed/As-Built Measurement	As-Commissioned Measurement	1 Year Post Measurement
Fan Operation	Fan rides the fan curve	VFD adjusts fan speed to meet static pressure setpoint	VFD adjusts fan speed to meet static pressure setpoint	TBD
Discharge Air Temperature	55°F	DAT Resets between 55 °F and 57 °F based on OAT	Hot Deck: 100°F Cold Deck: 50°F	TBD

The results of the analysis determined that the replacement dual duct RTU is operating as designed. Attached in Appendix B are excerpts from the commissioning report verifying proper testing and startup of the RTU. For the full report, please refer to the O&M Binder provided at project close out.

Detailed M&V

VERIFIED SAVINGS CALCULATIONS & METHODOLOGY

Verified savings were not recalculated since the as-verified key performance indicators were all at or better than the target values during the M&V period. Therefore, the verified energy savings is calculated to be the guaranteed energy savings divided by the 90% guarantee factor. The contractual utility rates were applied to the verified energy usage savings in order to show the equivalent avoided costs achieved.

Savings Calculation Formula
The savings calculation method used in the Energy Services Proposal is repeated here for reference:

To account for the savings associated with improved VFD operation and minimized simultaneous heating and cooling, a true Bin calculation that used TMY3 weather data generated for baseline occupied, baseline unoccupied, proposed occupied, and proposed unoccupied time schedules was used. This Bin Calculation accounts for internal heat gains, building insulation values, infiltration, solar loads, night setback with or without HVAC fan and outside air damper shut down economizer operation, reheat systems such as VAV, fuel type, heating and cooling efficiency, and fan energy, and compares the baseline versus the proposed scenario inputs, and outputs all savings associated between the two scenarios.

Guaranteed Factor(s)
New fan will properly ventilate space

Stipulated Factor(s)
Scheduled occupancy hours

Internal Building Loads

Weather

FIM SAVINGS SUMMARY

	Guaranteed	Verified
Electricity Savings (kWh)	52,188	57,987
Gas Reduction (Therms)	4,676	5,195
Year 1 Avoided Costs At Baseline Rates ($)	$8,114	$9,016

DETAILS OF O&M & OTHER SAVINGS (IF APPLICABLE)

During the first year, there was a stipulated $12,095 for this FIM's O&M savings. These first year savings were agreed upon by both McKinstry and Valley Medical Center. The savings were based on the reduced maintenance and parts associated with repairing the aging equipment prior to retrofit.

NOTED DEFICIENCIES

During the Year 1 M&V, there were no noted deficiencies affecting performance and/or savings of this FIM.

RECOMMENDATIONS

The following are the recommendations of McKinstry as a result of the measurement and verification analysis:

Maintain setpoints as commissioned.

Perform routine maintenance per manufacturer recommended specifications.

Detailed M&V

FIM 9-Various: Lighting Upgrades

BRIEF DESCRIPTION OF FIM

These FIMs included upgrades of lighting at the Talbot Center and Surface Parking at the valley medical center building.

M&V ACTIVITIES CONDUCTED THIS PERIOD

M&V Option A (Partially Measured Retrofit Isolation) was performed on this FIM. The following is a list of activities performed for this FIM:

- Review of Lighting As-Builts.

Results from lighting as-built review showed the installed lighting met the proposed scope of work. Please see the lighting as-builts in Appendix C for the verification of energy savings.

VERIFIED SAVINGS CALCULATIONS & METHODOLOGY

Verified savings were not recalculated since the as-verified key performance indicators were all at or better than the target values during the M&V period. Therefore, the verified energy savings is calculated to be the guaranteed energy savings divided by the 95% guarantee factor. The contractual utility rates were applied to the verified energy usage savings in order to show the equivalent avoided costs achieved.

Savings Calculation Formula
Equation 1: $\boldsymbol{kWh = Equipment\ kW\ x\ Hours\ of\ Operation}$

Guaranteed Factor(s)
kW of retrofitted light fixtures

Stipulated Factor(s)
Hours of Operation

Detailed M&V

FIM SAVINGS SUMMARY

	Guaranteed	Verified
Electricity Savings (kWh)	94,935	99,932
Load Reduction (kW)	253	266
Year 1 Avoided Costs At Baseline Rates ($)	$7,434	$7,825

DETAILS OF O&M & OTHER SAVINGS (IF APPLICABLE)

During the first year, there was a stipulated $6485 for this FIM's operational and maintenance (O&M) savings. These first year savings were agreed upon by both McKinstry and Valley Medical Center. The savings were based on the fact that previous systems were experiencing burn outs, and increased replacement rates.

NOTED DEFICIENCIES

There were no noted deficiencies during the Measurement and Verification process.

RECOMMENDATIONS

The following are the recommendations of McKinstry as a result of the measurement and verification analysis:

Maintain lamps and ballasts per manufacturer recommended specifications.

Appendix A
Savings Summary Table

Table 1 - Annual Savings Summary

1) Proposed $ = Guaranteed (kW, kWh, Therms, etc.) x Utility Rates Stipulated in ESP.
2) Predicted $ = Predicted (kW, kWh, Therms, etc.) x Utility Rates Stipulated in ESP.

Project	Valley Medical Center Upgrades
Date	15-Nov-12

			Natural Gas (Therms)		Electricity (kWh)		Electricity Demand (kW)		Total Proposed $	Total Predicted $
FIM ID	FIM Name	Guarantee	Guaranteed	Predicted	Guaranteed	Predicted	Guaranteed	Predicted		
6900	03.01-VMC Dual Duct Unit	90%	4,676	5,195	52,188	57,987			$8,114	$9,016
6847	01.01-VMC Heating Water	90%	8,235	9,150	166,769	185,299	4	4	$19,175	$21,306
6817	09.01-VMC Surface Parking	95%			64,929	68,346	146	154	$4,952	$5,212
6651	09.01-TLB Lighting Upgrade	95%			30,007	31,586	106	112	$2,482	$2,613
Grand Total			**12,911**	**14,345**	**313,893**	**343,218**	**256**	**270**	**$34,724**	**$38,147**

Appendix B
Commissioning Excerpts

a HHW Functional Performance Test Excerpt

b RTU Functional Performance Test Excerpt

Appendix B

Commissioning Report Excerpts

HHW FUNCTIONAL PERFORMANCE TESTS

Results

The following pages show the heating hot water system was properly tested during commissioning.

VMC HWS Upgrades – Preheat System

The system is located in the South-1 Penthouse Mechanical Room and generates Heating Hot Water for the system serving the AHU preheat coils throughout the Hospital and Emergency Services Tower. The system consists of two steam heat exchangers each sized for 60% of the load and two pumps each sized for 60% of the load. The schedule of operation is 24/7. There are two locations where the HWS & HWR differential pressures are monitored 1) Emergency Services Tower 7th floor mechanical room, and the Hospital 2nd NW Penthouse mechanical room.

SETPOINTS AND SCHEDULE:

Setpoint	Value
HWS Temperature Reset	20 deg OAT = 180 deg 40 deg OAT = 140 deg

	Scheduled ON	Scheduled OFF
Mon - Sun	24/7	None

*Notes:

TEST 1 PUMP LEAD/LAG & HEAT EXCHANGER LEAD/LAG

The operation of the Lead Pump and Heat Exchanger, the Lag Pump and Lag Heat Exchanger will be determined by the Building Automation System (BAS).

Pumps; HWP-S1-1, HWP-S1-2
Heat exchangers; HX-S1-1, HX-S1-2

1. If the Lead Pump fails, an alarm will be sent to the Operators Work Station and the Lag Pump will be started.
2. With one pump and heat exchanger in operation the following conditions will exist:
   2.1. Pump speed will be controlled by the differential pressure (DP) sensor with most deviation from setpoint. The differential pressure setpoints were determined by a survey of PH Coil control valve positions and reducing the DP setpoint so the highest demand terminal is ≤ 90% (OAT at time of survey = 34 deg).
   2.2. When the Lead Pump reaches 100% speed for greater than 1-hour, the BAS will initiate the start of the Lag Pump & Lag Heat Exchanger to run in paralled with the Lead Pump & Lead Heat Exchanger. The Lag Pump is started and its speed gradually is increased as the Lead pump speed is decreased until the differential pressure setpoint is reached.
3. With two pumps and two heat exchangers in operation the following condition will exist.
   3.1. When the speed signal to the pumps decreases to 40% the system will revert to single pump and single heat exchanger operation.
4. Lead/Lag Switchover (Run Time Equalization)
   4.1. Lead/Lag, Pump & Heat Exchanger Switchover Schedule, pump run time hours are compared and the pump with the lesser value is switched to the Lead, Pump & Heat Exchanger are switched.

Test Procedure:

1. Fail the lead pump by simulating a loss of utility power.
   1.1. Verify the lag pump starts
   1.2. Verify the pump Fail Alarm is sent to the operators work station
2. Simulate a 100% pump speed signal to the lead pump (modified scaling of output to simulate)
   2.1. Verify that the lag pump starts
   2.2. Verify DP sensor with the most deviation from setpoint is referenced as the process variable
   2.3. Verify that system performance is acceptable in the transition to parallel pump operation
3. Simulate a 40% speed signal to the lead/lag pumps
   3.1. Verify that the lag pump stops
   3.2. Verify that system performance is acceptable in the transition to single pump operation
4. Lead/Lag Switchover Schedule
   4.1. Verify function of the Lead/Lag Switchover Schedule

Test #1	Observations
1.1	Lag pump started,
1.2	Alarm was sent to the BAS operators work station.
2.1	Lag pump started,
2.2	Pump performance during transition was acceptable,
2.3	Pump speed signal referenced the DP sensor with the greatest deviation from setpoint
3.1	Lag pump stopped,
3.2	Pump performance during transition was acceptable,
4.1	Lead/Lag Schedule – Pump & Heat Exchanger switchover, verified functional

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 11-30-11
Comments:

- Heat Exchanger HHW isolation valves, open stroke time = 30 seconds, closed Stroke time = 90 seconds.
- Heat Exchanger HHW isolation valves do not have end switches
- Stage-Up/Stage-Down timer started when pump speed command was 30%

TEST 2 TEMPERATURE CONTROL

The BAS will modulate the 1/3 and 2/3 steam control valves to achieve the HWS temperature setpoint, V-3 and V-8 (HX-BR-1), V-5 and V-6 (HX-BR-2). The HWS setpoint is linearly reset based on the OAT, when OAT=20 deg HWS setpoint=180 degrees, when OAT=40 deg HWS setpoint = 140 deg.

Test Procedure 2.1: Heating

1. Verify temperature control is functional and operation is stable.
2. Verify HWS Temperature Setpoint Reset is functional

Test	Observations
2.1	Temperature Control is functional and stable
2.2	Temperature Control Reset is functional

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 11-30-11
Comments: 1/3 steam valve = 0-100% signal, 2/3 steam valve = 0-100% signal

TEST 3 ALARMS & SAFTIES

a. The BAS shall monitor the HWS temperature for excessive high or low temeratures.

Test Procedure 3.2: Alarms & Safeties

1. HWS High Temperature limit
    a. If the HWS temperature reaches 200 degrees and is maintained for greater than 90 seconds the BAS shall send an alarm to the Operators Work Station.
2. HWS Low Temperature Limit
    a. If the HWS temperature reaches 120 degrees and is maintained for greater than 90 seconds the BAS shall send an alarm to the Operators Work Station.
3. Steam Control Valve Lockout

a. If no proof of pump operation exists, the heat exchanger will be disabled.
b. If V-3 or V-5 (1/3 CV's) is in Operator Override and <20% open and V-4 or V-6 is closed the heat exchanger will be disabled.

Test Procedure: Alarms & Safeties

Test #3	Observations 11-30-11 BM
3.1	Functioned as described
3.2	Functioned as described
3.3	Functioned as described
3.2	Functioned as described

VMC HWS Upgrades – Reheat System

The system is located in the Basement Boiler Room and generates Heating Hot Water for the system serving the terminal unit reheat coils throughout the Hospital and Emergency Services Tower. The system consists of two steam heat exchangers each sized for 100% of the load and three pumps each sized for 50% of the load (Lead/Lag/Standby). The schedule of operation is 24/7. There are three locations where the HWS & HWR differential pressures are monitored 1) Emergency Services Tower 7th floor MER, and the Hospital 2nd Nutrition room, and Hospital D-wing 3rd floor Soiled Utility room.

SETPOINTS AND SCHEDULE:

Setpoint	Value
HWS Temperature	180 deg
Pump Switchover	
HX Switchover	Tue 8:15am
DP-1	35 psi
DP-2	28 psi
DP-3	34 psi
HWS High Temp Alarm	195
HWS Low Temp Alarm	110

	Scheduled ON	Scheduled OFF
Mon - Sun	24/7	None
Tue	8:00am	DNA
Tue	8:15am	DNA
DNA		
DNA		
DNA		
DNA		
DNA		

*Notes:

TEST 1 PUMPS LEAD/LAG/STANDBY & HEAT EXCHANGERS LEAD/STANDBY

The operation of the Lead Pump and Heat Exchanger, the Lag Pump and Standby Heat Exchanger will be determined by the Building Automation System (BAS).

Pumps; HWP-BR-1, HWP-BR-2, HWP=BR-3
Heat exchangers; HX-BR-1, HX-BR-2

1. If the Lead Pump fails (1-pump running), an alarm will be sent to the Operators Work Station and the Lag Pump will be started.
2. If the Lead Pump fails (2-pumps running), an alarm will be sent to the Operators Work Station and the Standby Pump will be started.
3. If the Lag Pump fails (2-pumps running), an alarm will be sent to the Operators Work Station and the Standby Pump will be started.
4. With one pump and heat exchanger in operation the following conditions will exist:
   4.1. Pump speed will be controlled by the differential pressure (DP) sensor with most deviation from setpoint. The differential pressure setpoints (3-Sensors) were determined by a survey of RH Coil control valve positions and reducing the DP setpoint so the highest demand terminal is ≤ 90%.
   4.2. When the Lead Pump reaches 90% (TIMER= 5 min), the BAS will initiate the start of the Lag Pump to run in paralled with the Lead Pump. The Lag Pump is started and its speed gradually is increased as the Lead pump speed is decreased until the differential pressure setpoint is reached (ramp up time = xxx sec).
5. With two pumps and one heat exchanger in operation the following condition will exist.
   5.1. When the speed signal to the pumps decreases to 30% (TIMER= 5 min) the system will revert to single pump operation.
   5.2. .
   5.3. If either the Lead or Lag Pump fails the standby pump will be started.
6. Lead/Lag Switchover - Pump(Run Time Equalization)
   6.1. Lead/Lag & Standby Pump Switchover Schedule, switchover is based on Date & Time (Day =Tue @ 8:00am), Pump are switched.
7. Standby Heat Exchanger Switchover (Run Time Equalization)
   7.1. Standby Heat Exchanger Switchover Schedule, switchover is based on Date & Time (Day= Tue @ 8:15am), Pump & Heat Exchanger are switched.

VMC HWS Upgrades – Reheat System

Test Procedure:

1. Fail the lead pump by simulating a loss of utility power (1-pump running).
   1.1. Verify the lag pump starts
   1.2. Verify Heat Exchangers are disabled
   1.3. Verify the pump Fail Alarm is sent to the operators work station
2. Fail the lag pump by simulating a loss of utility power (2-pumps running).
   2.1. Verify the Standby pump starts
   2.2. Verify the pump Fail Alarm is sent to the operators work station
3. Simulate a 90% pump speed signal to the lead pump (modified scaling of output)
   3.1. Verify that the lag pump starts
   3.2. Verify DP sensor with the most deviation from setpoint is referenced as the process variable
   3.3. Verify that system performance is acceptable in the transition to parallel pump operation
4. Simulate a 30% speed signal to the lead/lag pumps
   4.1. Verify that the lag pump stops
   4.2. Verify that the standby pump starts when either the Lead or Lag Pump is failed
   4.3. Verify that system performance is acceptable in the transition to single pump operation
5.
   5.1. Verify function of the Pump Switchover Schedule
   5.2. Verify function of the Heat Exchanger Switchover Schedule

Test #1	Observations
1.1	Lead pump failed and Heat Exchanger steam valve was disabled (closed),
1.2	Lag pump started, and steam valve was enabled
1.3	Alarm was sent to the BAS operators work station.
2.1	Standby pump started,
2.2	Alarm was sent to the BAS operators work station.
3.1	Lag pump started,
3.2	Pump performance during transition was acceptable,
3.3	Pump speed signal referenced the DP sensor with the greatest deviation from setpoint
4.1	Lag pump stopped,
4.2	Standby pump started when either the Lead or Lag pump was failed
4.3	Pump performance during transition was acceptable,
5.1	Lead/Lag Schedule – Pump, verified functional
5.2	Lead/Lag Schedule – Heat Exchanger, verified functional

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 1-4-12

Comments:

1. One pump must be in operation, if not Heat Exchangers are disabled.
2. Heat Exchanger HHW isolation valves, open stroke time = 30 seconds, closed Stroke time = 90 seconds.
3. Heat Exchanger HHW isolation valves do not have end switches

TEST 2 TEMPERATURE CONTROL

The BAS will modulate the 1/3 and 2/3 steam control valves to achieve the HWS temperature setpoint, V-3 and V-8 (HX-BR-1), V-5 and V-6 (HX-BR-2), setpoint initially set to 180 degrees.

Test Procedure: Heating

1. Verify temperature control is functional and operation is stable.

Test #2	Observations
2.1	Temperature Control is functional and stable

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 1-4-12
Comments: 1/3 steam valve = 0-30% signal, 2/3 steam valve = 35-100% signal

TEST 3 ALARMS & SAFTIES

The BAS shall monitor the HWS temperature for excessive high or low temeratures.

1 HWS High Temperature Alarm setpoint
   a. If the HWS temperature reaches 195 degrees and is the BAS will send an alarm to the Operators Work Station, alarm auto clears.

2. HWS Low Temperature Alarm Setpoint
   a. If the HWS temperature reaches 100 degrees the BAS will send an alarm to the Operators Work Station, alarm auto clears.

3. Steam Control Valve Lockout
   a. If no proof of pump operation exists, the heat exchanger will be disabled.
   b. If V-3 or V-5 (1/3 CV's) is in Operator Override and <20% open and V-4 or V-6 is closed the heat exchanger will be disabled.
   c. Heat Exchanger HWS & HWR isolation valves, if in operator override at ≤ 25% a switchover to the Standby Heat Exchanger is initiated

4. DP Sensor Failure- at 3 Locations in Distribution Loop,
   a. Three system DP sensors exist, 1 of 3 with highest deviation from setpoint is loop input, if one DP sensor fails 1 of 2 with highest deviation from setpoint becomes loop input, if two sensors fail 1 of 1 with highest deviation from setpoint becomes loop input, if all 3 sensors fail the pump speed signal defaults to 60%.
   b. The BAS will send an alarm to the operators work station, auto clears

5. Heat Exchanger HWS Sensor Failure
   a. Upon Failure of the HWS temperature sensor of the enabled heat exchanger, switchover to the HWS loop temperature sensor is initiated.
   b. Upon Failure of the HWS temperature sensor of the enabled heat exchanger the BAS will send an alarm to the operators work station

Test Procedure: Alarms & Safeties

Test #3	Observations 1-4-12 BM
3.1	Functioned as described
3.2	Functioned as described
3.3	Functioned as described
3.4	Functioned as described
3.5	Functioned as described

Appendix B

SF-01 FUNCTIONAL PERFORMANCE TESTS

Results

The following pages show the new dual duct fan system was properly tested during commissioning.

VMC East Penthouse Dual Duct AHU Replacement

System Description

The system consists of a AHU-EP-SF01 Dual Duct AHU with (2) variable speed Hot Deck supply fans (Lead/Lag), (2) variable speed Cold Deck supply fans (Lead/Lag), supply fan inlet isolation dampers, with hot water preheat and hot deck coils and a CHW cold deck coil. AHU-EP-SF01 operates 24/7, is a 100% outside air unit, and serves terminal units with both DDC and pneumatic control.

AHU-EP-SF01 SETPOINTS

Setpoint	Value
AHU Hot Deck DAT	100
AHU Cold Duct DAT	50
AHU Hot Duct Static Pressure	2.3
AHU Cold Duct Static Pressure	2.3

TEST 1 SYSTEM DISABLE/ENABLE MODE

AHU-EP-SF01 when in DISABLE mode the SF's are off, SF inlet dampers are closed, preheat coil and hot/cold deck coil control valves are closed. The AHU DISABLE/ENABLE point is not associated with a schedule AHU operation is 24/7. The SF enable signal starts the Lead Hot/Cold Deck SF with the Isolation damper closed, the damper opens after a 30 second time delay. The Lag Hot/Cold Deck SF starts when the Lead SF speed reachs 90% for 15 minutes, and when both the Lead & Lag fans running if the speed falls below 33% for 30 minutes the Lag fan will stop.

Test Procedure 1:

1. Override the DISABLE/ENABLE point to place the AHU to place it in DISABLE mode. Verify the SF's are off, and SF inlet dampers and control valves are closed.
2. Modify the terminal unit schedule to place the terminal units to unoccupied mode. Verify temperature and air flow set points adjust to unoccupied values.

Test	Supply Fans Status	SF Inlet Dampers Position	PH Control Valve Position	HD HHW Control Valve Position	CD CHW Control Valve Position
1.1	OFF	CLOSED	CLOSED	CLOSED	CLOSED

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 12-20-12
Comments:

Test Procedure 1.2: Override the ENABLE/DISABLE point to place the AHU to place it in ENABLE mode. Verify the SF's are enabled and start, and the SF Inlet damper and control valves are released to automatic control.

Test	HD & CD Supply Fan Status	HD & CD SF Inlet Dampers Position	PH Control Valve Position	HD HHW Control Valve Position	CD CHW Control Valve Position
1.2	RUNNING/ NORMAL	OPEN	CONTROLLING	CONTROLLING	CONTROLLING

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 12-20-12
Comments:

TEST 2 SUPPLY FAN DUCT STATIC PRESSURE CONTROL

Test Procedure 2: Supply Fan Duct Static Pressure Control
The Hot Deck and Cold Deck both have dual fans with each fan speed is VFD controlled to maintain the duct static pressure setpoint. In the event that 1 of the 2 fans fails the remaining fans will maintain the static pressure setpoint (speed increases), and the failed fan inlet damper will close.

The BAS monitors VFD status and alarm points via a FLN commuinications link.

1. Verify that the static pressure control is functional and performance is acceptable.
2. Adjust (increase/decrease) the SP setpoint, fan speed should ramp up/down within an acceptable time period and maintain a stable fan speed and duct pressure.
3. Verify with 1-fan failed that the remaining fan speed increases to maintain the duct pressure setpoint

Test	Vary Duct Static Pressure Setpoint, Verify Control is Responsive and Stable	Operation with 1-Fan Failed, Verify Control is Responsive and Stable, and SF isolation damper closes	FLN Comm w/VFD
2.1	RESPONSIVE & STABLE	RESPONSIVE & STABLE	YES

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 12-20-12
Comments: Fan Fail Alarm is via FLN

TEST 3 TEMPERATURE CONTROL

Test Procedure 3: Temperature Control
AHU-EP-SF01 is a 100% OSA unit with a preheat coil, a Hot Deck Coil, and a Cold Deck coil (DAT setpoint is 50 degrees). Control should be responsive and maintain the setpoint with stability. If the outside air temperature is below 60 degrees the preheat coil will be used to provide a false load.

1. Verify preheat coil temperature control, adjust DAT setpoint to 5 degrees above the actual outside air temperature. Allow temperature to stabilize, verify response time and control stability.
2. Reset to the original temperature setpoint.
3. Verify Hot Deck Coil Temperature control , adjust DAT setpoint to 5 degrees above the coil entering air temperature. Allow temperature to stabilize, verify response time and control stability.
4. Verify Cold Deck Coil Temperature control , adjust DAT setpoint to 5 degrees below the coil entering air temperature. Allow temperature to stabilize, verify response time and control stability.
5. Reset to the original temperature setpoint.

Test	Preheat Coil Temperature Control	Hot Deck Coil Temperature Control	Cold Deck Coil Temperature Control
3.1	RESPONSIVE & STABLE	RESPONSIVE & STABLE	RESPONSIVE & STABLE

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

VMC East Penthouse Dual Duct AHU Replacement

Verified By: Bill Macan Date: 12-20-12
Comments:

TEST 5 SAFETIES, ALARMS, NOTIFICAIONS

Alarms will be generated by the DDC system if a freeze stat trips or supply fan flow switch is not proofed.

Test Procedure 4: Safeties, Alarms, Notifications

1. Manually trip the low limit thermostat using mechanical means or an ice-pack. Verify an alarm is initiated, SF's turns off, preheat valve opens 100%, and the HD/CD valves close.
2. Disable each SF CT to simulate a supply fan failure. Verify an alarm is initiated.
3. Change temperature and pressure alarm setpoints to same as actual to test
4. Test smoke detector alarm, FACP alarm genral alarm, verify SF is disabled and OSA damper closes, fire alarm contractor performed test verification.

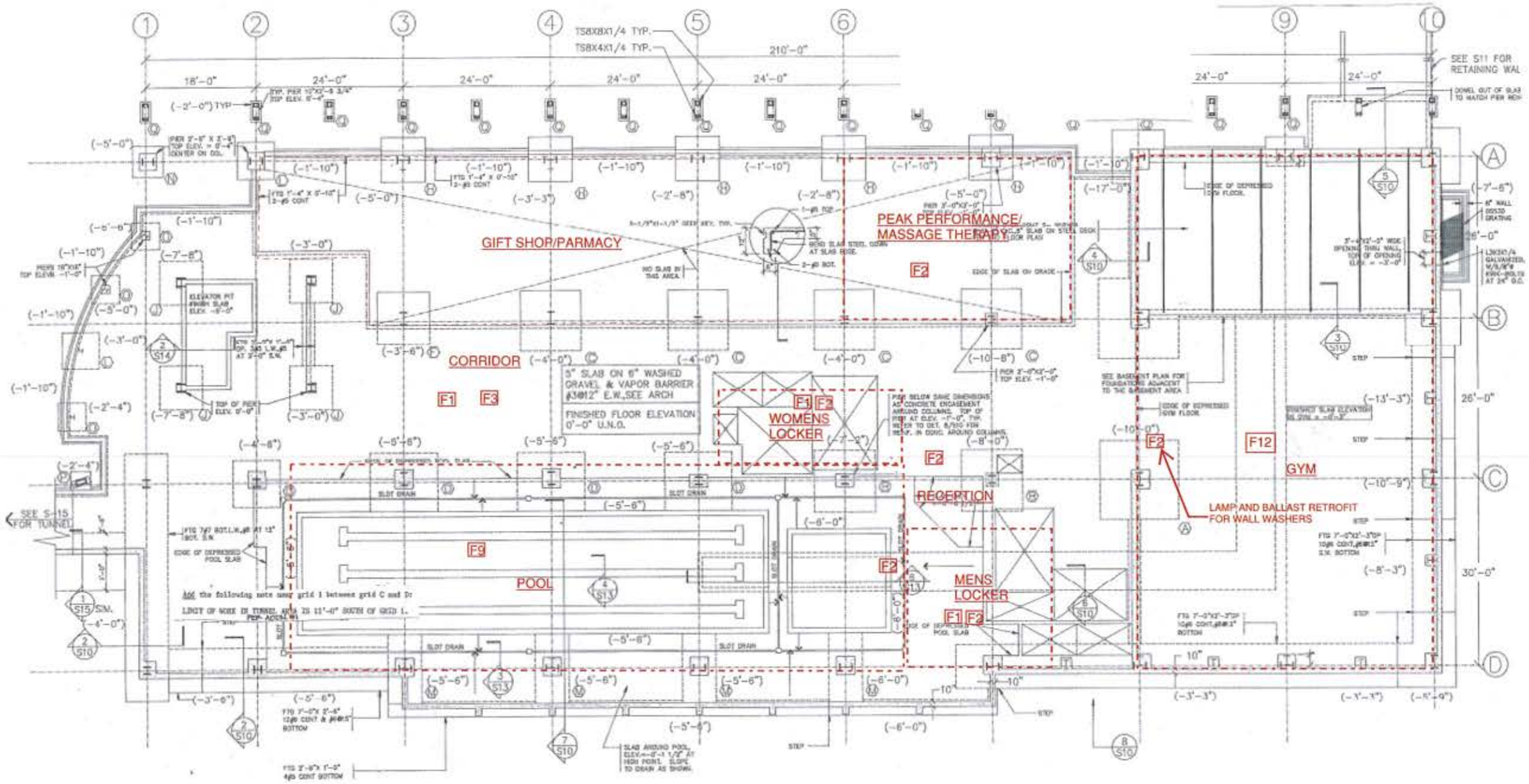
Test	SF Status	Smoke Detector	Freeze Stat	HHW DP	CHWS Temp	CHWR Temp	PHWS Temp	PHWR Temp	Filter Status
5.1 Functional Yes/No	YES	YES	YES	YES	YES	YES	YES	YES	YES

[X] Overrides released.
[X] Tests are complete and performance is acceptable.

Verified By: Bill Macan Date: 12-20-12
Comments:

Appendix C
Lighting As-Builts

TALBOT CENTER LIGHTING CUTSHEETS



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503-331-0234

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PROJECT:

VMC
TALBOT CENTER

RENTON WA

REGISTRATION:

REVISIONS:
XX/XX/XX XX

NO.	DATE	DESCRIPTION

McKINSTRY DIVISION:

DESIGNED BY:
DRAWN BY:
CHECKED BY: X
JOB NUMBER:
DATE:
SCALE:

SHEET TITLE:

SHEET NUMBER:

NOT FOR CONSTRUCTION

¯LllLlm Data

Customer: VallAB CADEFal CAntAr

				Existing						Proposed			
ID	BuEDEng NamA	FlLllLlt	LlLlFatELlh	# Llf FExturAs	CLlLlntEng	DAsFrEptELlh	Watts pAr FExturA	pAratEng ! Llurs	FExturA ID	# Llf FExturAs "EF DEffArAnt frLlm AxEstEng#	DAsFrEptELlh	FF $AnsLlt %BpA	# Llf $AnsLlts
&	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	- BmnasEum	).	$urfaFA	$+LlA/ Llx 0 C! .((W 0! ID CagnAtEF	. 12	3) 4&	**F12**	).	! ID rAplaFAmAnt 5 0". #%1! lamps6 lAns En DLllLlt framA'	W$ CC "! Eg+ BaB#	.
)(	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	- BmnasEum	4.	Wall	. 7$trEp 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	4.	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
))	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	=LlLll	) 2	¯AFAssAD	4x4 =rEsmatEF 0 CV 41(W 0! ID CagnAtEF	421	3) 4&	**F9**	) 2	4x. =rEsmatEF6"4#1. W %1! Lamps6 9lAFtrLlhEF Ballast		
)4	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	=LlLll	4	Wall	Wall BraF>At 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	4	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
)3	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	CAns LlLlF>Ar ¯LlLllm	4	$urfaFA	. 7? FrBlLEF Wrap 0 3. W FluLlt AsFAnt6. 7* (8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	4	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'	W$ CC	3
).	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	CAns LlLlF>Ar ¯LlLllm	3	Wall	VanEtB 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	. 3	3) 4&	**F1**	3	Lamp < Ballast rAtrLlfE6") #34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
)1	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	CAns LlLlF>Ar ¯LlLllm	@	$urfaFA	WAt LlLlFatELlh 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	. 3	3) 4&	**F2**	@	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
)@	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	WLlmAns LlLlF>Ar ¯LlLllm	&	$urfaFA	WAt LlLlFatELlh 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	&	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'	W$ CC	3
);	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	WLlmAns LlLlF>Ar ¯LlLllm	3	$urfaFA	VanEtB 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	. 3	3) 4&	**F1**	3	Lamp < Ballast rAtrLlfE6") #34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
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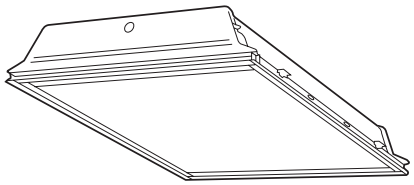
4)	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	WLlmAns ¯AstrLlLllm	)	Wall	. 7$trEp 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	)	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'	W$ C$	)
44	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	=Aa> =ArfLlt manFA	@	¯AFAssAD	4x. =ara/ LlLlEF 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	3) 4&	**F2**	@	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
43	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	CassagA %+ArapB	4	¯AFAssAD	4x. =ara/ LlLlEF 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	) 1@	**F2**	4	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
4.	&'( ) *%&B LEg+tEng , pgraDA	FEirst FlLllLlt	$tLlt agA	3	$urfaFA	. 7InDustrEal 5 0rAflAFtLlts 0 3. W FluLlt AsFAnt6. 7*(8 %) 4 0 9nArgB $a: Engs CagnAtEF6 %) 4	; 4	)(. 3	**F2**	3	Lamp < Ballast rAtrLlfE6"4#34W %2 < lLl5 / allast faFtLlt AlAFtrLlhEF / allast'		
Total	**16**			**121**						**121**			**15**

LITHONIA LIGHTING®

Catalog Number	
2WRT G 2 CF40 A12125 MVOLT GEB10IS	
Notes Talbot Pool Light Fixture	Type F9

Recessed Wet Location Troffer

WRT 2' X 2'



2, 3 OR 4 LAMPS

FEATURES & SPECIFICATIONS

INTENDED USE

General illumination for indoor and outdoor, covered ceiling locations. Ideal for showers, locker rooms, recreational facilities and other applications calling for a wet location listing.

CONSTRUCTION

Available for lay-in grid ceilings or with mitered flanged trim with swing-out hangers.

Code gauge steel housing formed from cold rolled steel. Closed-cell neoprene gasketing between the lens, doorframe, housing and mounting surface. Extruded aluminum doorframe features mitered corners. Cam latches on doorframe ensure a positive seal. Lenses available to meet a variety of lighting needs and features 100% UV stabilized acrylic. Lenses feature optional internal prisms to maintain a smooth, easy-to-clean outer surface.

Finish: All metal parts are finished with electrostatically deposited, thermally set, polyester powder paint after fabrication.

ELECTRICAL

Thermally protected, resetting, Class P, HPF, non-PCB, UL listed, CSA certified ballast is standard. Energy saving and electronic ballasts are sound rated A. Standard combinations conform to UL 935. Tested in compliance with Federal Standard 209E by independent lab.

LISTINGS

UL Listed (standard). CSA Certified or NOM Certified (see Options). UL Listed for wet locations.

WARRANTY

Guaranteed for one-year against mechanical defects in manufacture.

NOTE: Specifications subject to change without notice.

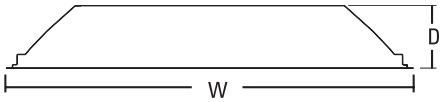
Specifications

Length: 24 (61.0)

Width: 24 (61.0)

Depth: 3-3/4 (9.5)

Weight: 15 lbs (7 kg)



All dimensions are inches (centimeters) unless otherwise specified.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**

Example: 2WRT G 2 U31 A12125 MVOLT GEB10IS

2WRT	G	2	CF40		A12125	MVOLT	GEB10IS
Series	Trim type	Lamps[1]	Lamp type	Door frame	Diffuser type[4]	Voltage	Options
2WRT Recessed wet location troffer, 2' wide	**G Lay-in grid trim** F Overlapping flanged trim	**2** **3** **4**[2]	**17 Nominal 17W T8 (24")** U31 Nominal 31W T8 U-lamp (24") U316 31W T8 U-lamp (24", 6"legspacing)[3] CF40 40W T5 (24")	(blank) **Flush aluminum, white** FN Flush aluminum, natural FM Flush aluminum, matte black	**A12125 #12 pattern acrylic, .125" thick** A15 #15 pattern acrylic, .2" thick A19 #19 pattern acrylic, .156" thick	120 277 347 **MVOLT**[5]	Shipped installed in fixture GEB Electronic ballast(s) ≤20% THD **GEB10IS Electronic ballast(s) ≤10% THD, instant start** GEB10PS Electronic ballast(s) ≤10% THD, program rapid start ELDW Emergency battery pack (nominal 300 lumens)[7,8] EL5DW Emergency battery pack (nominal 500 lumens)[7,8] EL6DW Emergency battery pack (nominal 600 lumens)[7,8] EL14DW Emergency battery pack (nominal 1400 lumens)[7,8] GLR Internal fast-blow fuse[8] GMF Internal slow-blow fuse[8] PWS1836 Pre-wire system, 18-gauge, three-wire (one circuit), 6' length (others available) SW Palletized and stretch-wrapped CSA CSA Certified NOM NOM Certified

NOTES:

1 Lamps not included.

2 Straight lamps with standard ballasts or compact lamps with electronic ballasts only.

3 Not available with 3- or 4-lamp fixtures; use U31.

4 Add the suffix V for inverted prisms. Example: A15V

5 Electronic ballast 120-277V only.

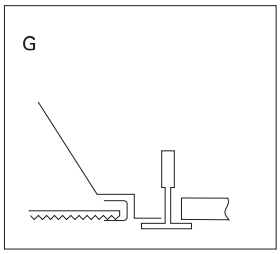
6 Not available for MVOLT.

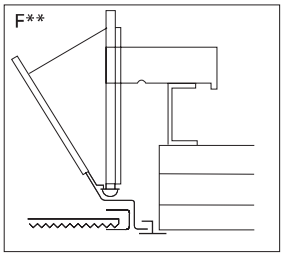
7 Available 120 or 277V only.

8 Must specify voltage.

WRT 2 x 2 Recessed Wet Location Troffer

MOUNTING DATA





** Recommended rough-in dimensions for F trim fixtures: 24" x 24" (Tolerance is + 1/4" or -0").
Swing-gate range: 11/16" — 3-1/4", span 22" — 26-3/4".

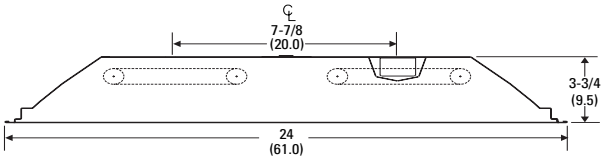
DIMENSIONS

All dimensiunos are inches (centimeters) unless otherwise specified. Specifications subject to change without notice.

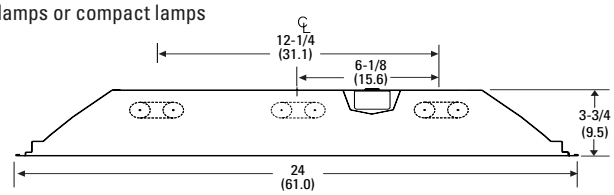
Example: **2WRT F 2 U31 FW A12123 120 GEB**

Length: 24 (61.0)

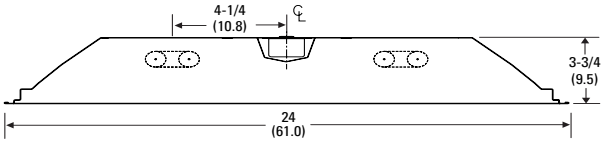
Weight: 22 lbs (10 kg)



2 U-lamps or compact lamps



3 U-lamp, compact, or straight lamps



4 compact or straight lamps

PHOTOMETRICS

Calculated using the zonal cavity method in accordance with IESNA LM41 procedure. Floor reflectances are 20%. Lamp configurations shown are typical. Full photometric data on these and other configurations available upon request.

2WRT3 17 A12125

Test No. LTL 9799

COEFFICIENT OF UTILIZATION

r^f					20%			
r^c	80%				50%			0%
r^w	70%	50%	30%	10%	50%	30%	10%	0%
0	79	79	79	79	74	74	74	66
1	73	70	68	65	66	64	62	57
2	67	62	58	55	59	56	53	49
3	62	55	50	47	52	49	45	42
4	57	50	44	40	47	43	39	37
5	53	45	39	35	43	38	35	32
6	49	40	35	31	39	34	31	29
7	45	37	31	28	35	31	27	26
8	42	34	28	25	32	28	25	23
9	40	31	26	22	30	25	22	21
10	37	29	24	20	28	23	20	19

ZONAL LUMENS SUMMARY

Zone	Lumens	% lamp
0^0-30^0	881	21.8
0^0-40^0	1448	35.8
0^0-60^0	2345	57.9
0^0-90^0	2684	66.3
90^0-180^0	0.0	0.0
0^0-180^0	2684	*66.3

*Fixture efficiency

2WRT 3 U 31 A12125

Test No. LTL 9802

COEFFICIENT OF UTILIZATION

r^f					20%			
r^c	80%				50%			0%
r^w	70%	50%	30%	10%	50%	30%	10%	0%
0	74	74	74	74	69	69	69	62
1	69	66	64	62	62	60	59	54
2	63	59	55	52	55	53	50	47
3	58	52	48	44	50	46	43	40
4	54	47	42	38	45	41	37	35
5	50	42	37	33	40	36	33	31
6	46	38	33	29	37	32	29	27
7	43	35	30	26	34	29	26	24
8	40	32	27	24	31	26	23	22
9	37	29	25	21	28	24	21	20
10	35	27	23	19	26	22	19	18

ZONAL LUMENS SUMMARY

Zone	Lumens	% lamp
0^0-30^0	1745	20.8
0^0-40^0	2872	34.2
0^0-60^0	4632	55.1
0^0-90^0	5237	62.3
90^0-180^0	0.0	0.0
0^0-180^0	5237	*62.3

*Fixture efficiency

Energy Data: 2WRT 3 17 A12125 Instant Start T8

Energy (Calculated in accordance with NEMA Standard LE-5)

LER.FL	ANNUAL* ENERGY COST	LAMP DESCRIPTION	LAMP LUMENS	BALLAST FACTOR	INPUT WATTS
47	$5.08	FO17T8	1,350	0.95	54

*Based on 3000 hrs./year at .08/kwh

LITHONIA LIGHTING®

An AcuityBrands Company

Lithonia Lighting
Industrial
One Lithonia Way, Conyers, GA 30012
Phone: 800-315-4963
www.lithonia.com

Sheet #: WRT 2x2

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PRECISION PARAGON
EFFICIENCY, ECONOMY, SUSTAINABILITY.

www.P-2.com

(714) 386-5550 CA
(715) 381-2971 WI
(352) 692-5900 FL

HBX – Retail Pendant, Hi-Bay Biax

Application

- Indoor applications where a 2x2 footprint and a high lumen energy efici ent package is necessary.
- Order with custom color in ish and deep cell louvers for retail.
- Order basic white with clear acrylic lens, or open, for industrial.
- EA rele ctor ideal for Hi-Bay.
- WA rele ctor ideal for Lo-Bay.

Construction

- Post production powder coated 20 gauge steel body.
- Thoroughly ventilated body and rele ctor for maximum performance.
- Tool-less ballast access for ease of service.
- Mounts on 3/4" threaded hub.

Our Experience

- We've been focused on nothing but supporting energy efici ent re-lighting projects since 1992. Hit a dead end? Give our application support team a try.

HBX – Retail Pendant

HBX-2X2-4L-TT50-UL1-BXH-PS-OSRAM-WA-BW-WG-OSRAM-FT50DL/841/RS/ECO

~~HBX – 2x2 – 4L – TT50 – UL1 – BXH – PS – ST – MM – RAL22 – 33~~

HBX	2x2	4l	TT50	UL1	BXH	PS	ST	MM	RAL22	33	SS	
Model	Fixt Size	Lamp Qty	Lamp Type	Voltage	Ballast Factor	Ballast Starting	Ballast Grade	Rel ector Material	Fixture Finish	Louver	Louver Finish	Other

Fixture Model
HBX

Fixture Size
2x2 = 2x2 nominal

Lamp Qty
xL = x Indicates quantity of lamps

Lamp Type
TT40 = Twin Tube T5 Biax 40W
TT50 = Twin Tube T5 Biax 50W
TT55 = Twin Tube T5 Biax 55W

Voltage (1)
UL1 = Universal 120-277
(4x50 and 4x55)
UL2 = Universal 120-277
(4x40, 5x50 and 5x55)

Ballast Factor
BXL = Biax .90 (TT55)
BXN = Biax .95 (TT40)
BXH = Biax 1.10 (TT50)

Ballast Starting
PS = Programmed Start

Ballast Grade
ST = Standard Grade

Rele ctor Material
EA = Enhanced Aluminum 93-94%
MM = Micro Matte 91-93%
WA = White Aluminum Rel ector 90-91%

Fixture Finish
BB = Black
BW = White
BZ = Bronze
RAL = RALxxxx (Custom RAL Spec)

Louver/Lens
33 = 9 Cell Parabolic 2x2
CA = Clear Acrylic
WG = Wireguard

Louver Finish
SC = Specular
SS = Semi-Specular
WH = Hi-Ref White
NA = No Louver

Other
LF = Factory Lamps
(Lamp spec elsewhere)

Numeric Footnotes
(1) Numeral indicates number of ballasts per ix ture.

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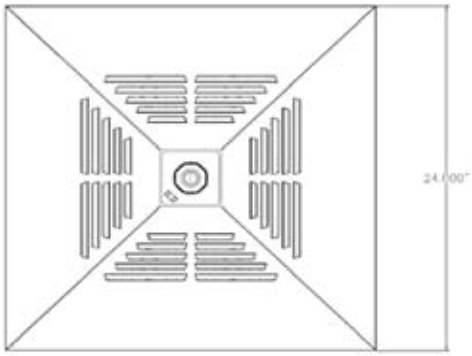
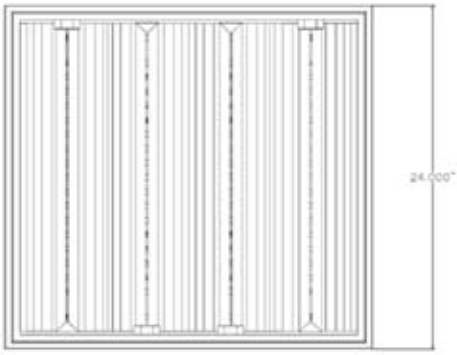
HBX – Retail Pendant, Hi-Bay Biax

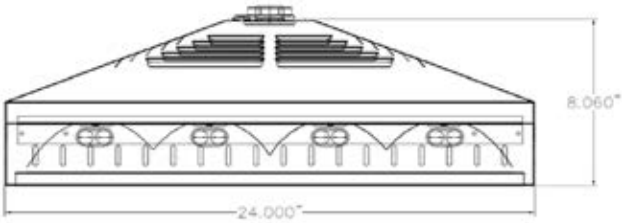
Top Plan View



Bottom Plan View



4 Lamp Cross Section



Existing System

Existing Hi-Bay System	Lamp Qty & Type		Initial Lamp Lumens	Lumen Maintenance	EOL(1) Lumens All Lamps	Total Fixture Lumens	Ballast Factor	Fixture Efici ency	EOL(1) Lumens Per Fixt	S/P (2) Ratio	Net (3) EOL Lumens	Fixt Input Watts
MH250	1	Std MH250	20,500	58%	11,890	11,890	1.00	0.75	8,918	1.49	12,171	295
MH320PS	1	PS MH320	31,700	62%	19,654	19,654	1.00	0.75	14,741	1.49	20,119	368
MH400	1	Std MH400	38,000	58%	22,040	22,040	1.00	0.75	16,530	1.49	22,561	458
HPS400	1	Std HPS400	50,000	70%	35,000	35,000	1.00	0.75	26,250	0.62	18,080	464

Re-Lighting Options

Proposed Hi-Bay System	Lamp Qty & Type		Initial Lamp Lumens	Lumen Maintenance	EOL(1) Lumens All Lamps	Total Fixture Lumens	Ballast Factor	Fixture Efici ency	EOL(1) Lumens Per Fixt	S/P (2) Ratio	Net (3) EOL Lumens	Fixt Input Watts
4L-FT40 BIAX	4	FT40DL841	3,150	93%	2,930	11,718	0.95	0.89	9,908	1.62	14,434	156
4L-FT50 BIAX	4	FT50DL841	4,300	93%	3,999	15,996	1.10	0.89	15,660	1.62	22,815	230
5L-FT50 BIAX	5	FT50DL841	4,300	93%	3,999	19,995	1.10	0.89	19,575	1.62	28,518	290
4L-FT55 BIAX	4	FT55DL841	4,800	93%	4,464	17,856	0.90	0.89	14,303	1.62	20,837	217
5L-FT55 BIAX	5	FT55DL841	4,800	93%	4,464	22,320	0.90	0.89	17,878	1.62	26,046	285

(1) EOL = End of Life (2) S/P Ratio = Scotopic to Photopic Lumens (3) Net EOL Lumens = EOL Lumens Per Fixture x (S/P).78 [.78 exponent]

General Notes

- Lamp/ballast system values shown are a general reference intended to supply a quick comparison of several common lamp/ballast systems, the associated energy consumption, and net lumen output. Based on Advance/Philips 2008 ballast/lamp catalog speciica tions.
- Values shown are based on normal operating temperatures (25c T5BX) and at 277 volts.
- Fixture efici ency percentages are generally representative of each system type, actual values will vary.
- There are many operating variables that affect system output, in addition to rating variances from brand to brand.
- Please consult the lamp/ballast manufacturer's catalogs for the detailed information required to model your system.

Dual Technology Wall Mount Occupancy Sensor

NOTE: Occupancy sensor for Talbot Gym

The LOS-WDT Series wall-mount dual-technology sensors are used to control lighting in spaces that have pendant fixtures, ceiling fans, or high ceilings (more than 12 ft./ 3.7 m), where ceiling-mount occupant sensors would not function reliably. The adaptive technology eliminates manual sensitivity and timer adjustments during installation and over the life of the product.

Features

- Intelligent, continually adapting sensor
- Ultrasonic (US) combined with passive infrared (PIR) sensing provide high sensitivity, high noise immunity, and excellent false tripping immunity
- Suited for complex environments that are difficult to control with single-technology sensors
- Flexible base mounting on wall or ceiling
- Aim and lock: base mount permits fast alignment
- Non-Volatile Memory: settings saved in protected memory are not lost during power outages
- 1600 sq.ft. (488 m^2) of coverage when used where the ceiling height is between 8 - 12 ft. (2.4 - 3.7 m)
- Affords choice of turning lights off or dimming to a preset level in the unoccupied state when integrated with a Lutron system.

Models Available

Cat. No.	Color	Coverage	Field of View
LOS-WDT-WH	White	1600 sq.ft. (488 m^2)	110°
LOS-WDT-R-WH	White	1600 sq.ft. (488 m^2)	110°

Self-Adaptive Feature

The LOS-WDT Series wall-mount occupancy sensors combine both ultrasonic (US) motion detection for maximum sensitivity and passive infrared (PIR) motion detection for false triggering immunity. The self-adapting internal microprocessor analyzes the composite sum of both signals to eliminate time-consuming adjustments and callbacks found in non-intelligent sensors.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Timer Settings

- Automatic mode: Continually adapting sensor automatically adjusts settings to the space
- Manual mode: 4 to 30 minutes
- Test mode: 8 seconds

LED Lamp

- Red: infrared motion
- Green: ultrasonic motion

Housing

- High-impact, injection molded plastic housing
- 6 in. (15 cm) color-coded lead wires

Power

- Operating voltage: 20 - 24 V⎓, Class 2 (PELV) low-voltage
- Operating current: 33 mA nominal
- Control output: 20 - 24 V⎓ active high logic control signal with short-circuit protection, open collector when unoccupied
- UL and CUL listed

Operating Environment

- Temperature: 32 to 104 °F (0 to 40 °C)
- Relative humidity: 0% to 95%, non-condensing
- For indoor use only

Contact Rating (R Models only)

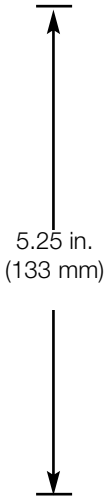
- SPDT 500 mA rated at 24 V⎓ isolated relay

Photo Cell (R Models only)

- Prevents light from turning on when there is sufficient natural light
- Sensitivity: 20 - 3,000 LUX adjustable

Dimensions

Front View



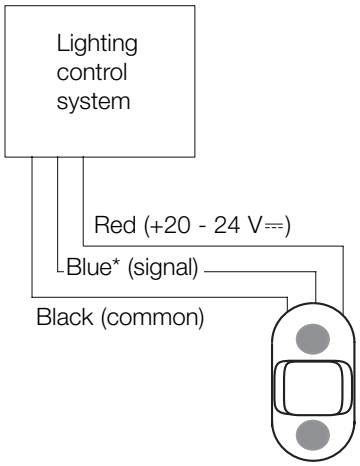
Side View

Job Name:	Model Numbers:	
Job Number:		

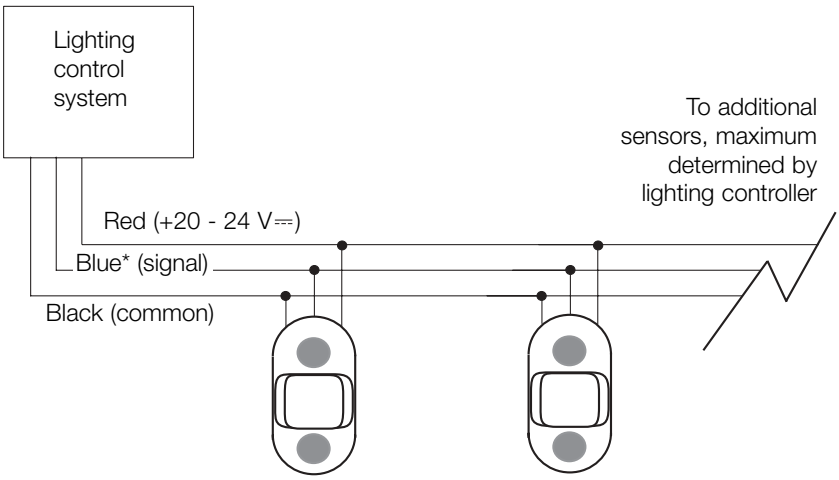
Wiring

Note: Power pack may be required when interfaced to lighting control system; see below.

Single Sensor to System



2 or More Sensors to System



*Note: Use gray wire for -R model.

Power Supply Options

Lutron Lighting Control System	Power Pack Required?
Digital microWATT™	No
EcoSystem®	No
GRAFIK 5000 / 6000 / 7000	No, when used with seeTouch® wallstations with occupant sensor connections.
GRAFIK Eye® 3000 / 4000	Yes
HomeWorks®	Yes
LCP128™	No, when used with *seeTouch* wallstations with occupant sensor connections.
microWATT®	No
RadioRA®	Yes
RadioTouch®	No
Softswitch128®	No, when used with *seeTouch* wallstations with occupant sensor connections.

Job Name:	Model Numbers:	
Job Number:		

Dual Technology Ceiling Mount Sensor

The LOS-CDT Series ceiling-mount dual-technology sensors can integrate into Lutron systems or function as stand-alone controls using a Lutron power pack. The technology eliminates manual sensitivity and timer adjustments during installation and over the life of the product.

Features

- Intelligent, continually adapting sensor
- Ultrasonic (US) combined with passive infrared (PIR) sensing provide high sensitivity, high noise immunity, and excellent false tripping immunity
- Suited for complex environments that are difficult to control with single-technology sensors
- Snap-locks to ceiling-mounted cover plate
- Non-Volatile Memory: settings saved in protected memory are not lost during power outages
- 500 to 2000 sq.ft. (46 to 186 m^2) coverage when mounted on an 8 - 12 ft. (2.4 to 3.7 m) ceiling; 180° and 360° field of view
- Affords choice of turning lights off or dimming to a preset level in the unoccupied state when integrated with a Lutron system.

Models Available

Cat. No.	Color	Coverage	Field of View
LOS-CDT-500-WH	White	500 sq.ft. (46 m^2)	180°
LOS-CDT-500R-WH	White	500 sq.ft. (46 m^2)	180°
LOS-CDT-1000-WH	White	1000 sq.ft. (93 m^2)	180°
LOS-CDT-1000R-WH	White	1000 sq.ft. (93 m^2)	180°
LOS-CDT-2000-WH	White	2000 sq.ft. (186 m^2)	360°
LOS-CDT-2000R-WH	White	2000 sq.ft. (186 m^2)	360°

Self-Adaptive Feature

The LOS-CDT Series ceiling-mount occupant sensors combine both (US) motion detection for maximum sensitivity and passive infrared (PIR) motion detection for false triggering immunity. The self-adapting internal microprocessor analyzes the composite sum of both signals to eliminate time-consuming adjustments and callbacks found in non-intelligent sensors.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Timer Adjustment

- Automatic mode: Continually adapting sensor automatically adjusts settings to the space
- Manual mode: 8 to 30 minutes
- Test mode: 8 seconds

LED Lamp

- Red: infrared motion detected
- Green: ultrasonic motion detected

Housing

- Rugged, high-impact, injection-molded plastic
- Color-coded leads 6 in. (15 cm)

Power

- Operating voltage: 20 - 24 V⎓, PELV (Class 2: USA) low-voltage
- Operating current: 33 mA nominal
- Control output: 20 - 24 V⎓ active high logic control signal with short-circuit protection, open collector when unoccupied

Operating Environment

- Temperature: 32 to 104 °F (0 to 40 °C)
- Relative humidity: less than 95%, non-condensing
- For indoor use only

Adaptive Functions

- Installation: 60 minutes
- Learning: 4 weeks for response to error conditions, air current adaptation, and timer optimization
- Post-learning occupancy periods
  - —24-hour circadian occupancy periods learned
  - —Weekly occupancy periods learned
- Adjustments in post-learning period
  - —Generally occupied periods (threshold = high-sensitivity mode)
  - —Generally unoccupied periods (threshold = miser mode)

Contact Rating (R Models only)

- SPDT 500 mA rated at 24 V⎓ isolated relay

Photo Cell (R Models only)

- Prevents light from turning on when there is sufficient natural light
- Sensitivity: 0 - 1,000 LUX adjustable

Dimensions

Front View

Side View

4.5
(114)

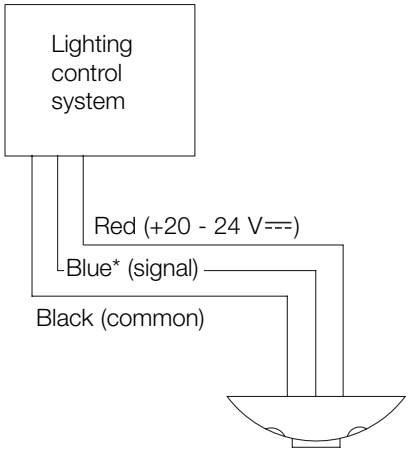
Measurements are in inches (mm)

Job Name:	Model Numbers:	
Job Number:		

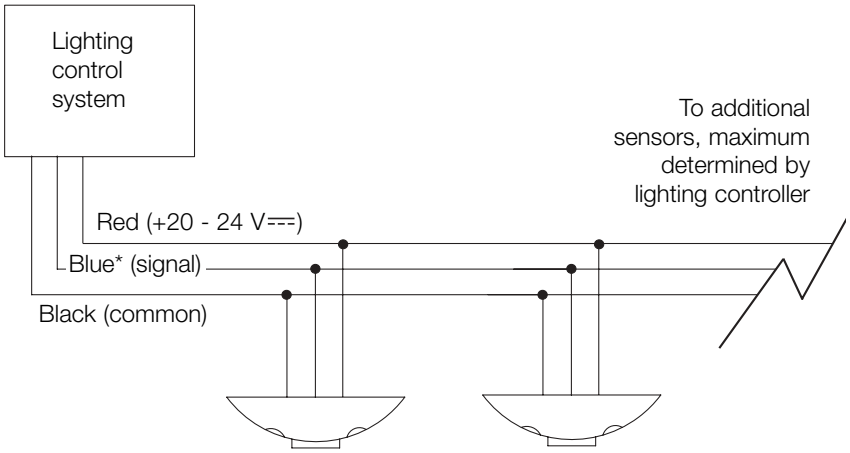
Wiring

Note: Power pack may be required when interfaced to lighting control system; see below.

Single Sensor to System



2 or More Sensors to System



*Note: Use gray wire for -R model.

Power Supply Options

Lutron Lighting Control System	Power Pack Required?
Digital microWATT™	No
EcoSystem®	No
GRAFIK 5000 / 6000 / 7000™	No, when used with seeTouch® wallstations with occupant sensor connections.
GRAFIK Eye® 3000 / 4000	Yes
HomeWorks®	Yes
LCP128™	No, when used with *seeTouch* wallstations with occupant sensor connections.
microWATT®	No
RadioRA®	Yes
RadioTouch®	No
Softswitch128®	No, when used with *seeTouch* wallstations with occupant sensor connections.

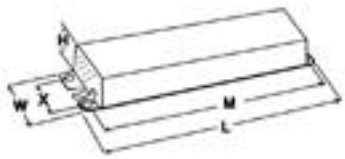
Job Name:	Model Numbers:	
Job Number:		

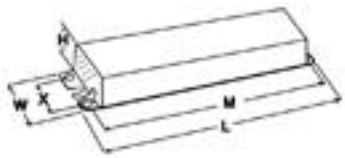
GE Lighting

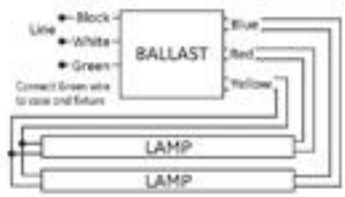
96714 - GE232-MVPS-N

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- < 10% THD, > 99% power factor
- A new generation of ultra-efficient Programmed Start ballasts (> 90% efficiency).
- Anti-striation circuitry reduces striations with energy saving lamps
- Extends lamp life in frequently switched applications (> 100,000 on/off cycles)
- Multi-Voltage Technology handles voltage from 120 to 277V
- Starting time visually the same as instant start







GENERAL CHARACTERISTICS

Application	2 or 1 F32T8 120V-277V Normal Light .88 BF<10% THD UltraStart
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10.0 %
Case Temperature (MAX)	70.0 °C
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Anti-striation control/Thermally protected/Universal voltage
Primary Application	Standard

PRODUCT INFORMATION

Product Code	96714
Description	GE232-MVPS-N
Standard Package	Case
Standard Package GTIN	10043168967140
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168967143

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(29.97 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	8.9 in(225.81 mm)
Mount Width (X or F)	1.1 in(28.70 mm)
Mount Slots (MS)	0.3 in(7.92 mm)
Weight	1.65 lb
Exit Type	Side
Remote Mounting Distance	18.0 ft
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left	25.0 (635mm)
White	1	Left	25.0 (635mm)
Blue	2	Right	33.0 (838mm)
Red	2	Right	33 in (NaNmm)
Yellow	2	Right	47.0 (1194mm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency (MIN)	50.0 Hz/60.0 Hz
Supply Current Frequency	60.0 Hz

SAFETY & PERFORMANCE

- ANSI - C62.41
- cUL Listed
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type HL
- RoHs Compliant
- NEMA Premium®

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F32T8/WM	1	120	34	0.29 A	1.02	3.00	98	1.7	10.0	60.0 °F / NaN
F32T8/WM	1	277	34	0.13 A	1.02	3.00	93	1.7	10.0	60.0 °F / NaN
F32T8/WM	2	120	55	0.45 A	0.88	1.60	99	1.7	10.0	60.0 °F / NaN

F32T8/WM	2	277	54	0.2 A	0.88	1.63	96	1.7	10.0	60.0 °F / NaN
F32T8/25W	1	120	24		1.00	4.17	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	1	277	24		1.00	4.17	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	2	120	45		0.86	1.91	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	2	277	44		0.86	1.95	98	1.7	10.0	60.0 °F / NaN
F32T8	1	120	37	0.31 A	1.05	2.84	98	1.7	10.0	0.0 °F / NaN
F32T8	1	277	37	0.14 A	1.05	2.84	93	1.7	10.0	0.0 °F / NaN
F32T8	2	120	59	0.49 A	0.89	1.51	99	1.7	10.0	0.0 °F / NaN
F32T8	2	277	58	0.21 A	0.89	1.53	96	1.7	10.0	0.0 °F / NaN
F28T8	1	120	32	0.27 A	1.00	3.12	98	1.7	10.0	60.0 °F / NaN
F28T8	1	277	32	0.13 A	1.00	3.12	92	1.7	10.0	60.0 °F / NaN
F28T8	2	120	51	0.42 A	0.88	1.73	99	1.7	10.0	60.0 °F / NaN
F28T8	2	277	50	0.19 A	0.88	1.76	95	1.7	10.0	60.0 °F / NaN
F25T8	1	120	30	0.25 A	1.09	3.63	98	1.7	10.0	0.0 °F / NaN
F25T8	1	277	30	0.11 A	1.09	3.63	91	1.7	10.0	0.0 °F / NaN
F25T8	2	120	47	0.39 A	0.94	2.00	99	1.7	10.0	0.0 °F / NaN
F25T8	2	277	46	0.17 A	0.94	2.04	95	1.7	10.0	0.0 °F / NaN
F17T8	1	120	22	0.18 A	1.06	4.82	98	1.7	10.0	0.0 °F / NaN
F17T8	1	277	22	0.09 A	1.06	4.82	88	1.7	10.0	0.0 °F / NaN
F17T8	2	120	33	0.27 A	0.91	2.76	99	1.7	10.0	0.0 °F / NaN
F17T8	2	277	33	0.13 A	0.91	2.76	93	1.7	10.0	0.0 °F / NaN

WARRANTY INFORMATION

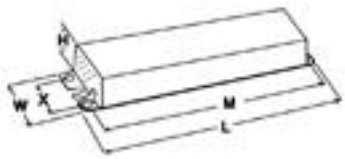
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

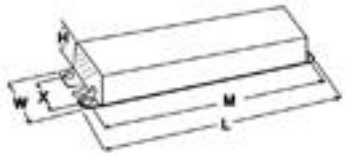
GE Lighting

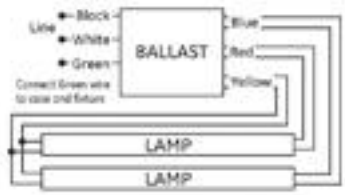
96720 - GE232-MVPS-L

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- A new generation of ultra-efficient Programmed Start ballasts (> 90% efficiency).
- Anti-striation circuitry reduces striations with energy saving lamps
- Extends lamp life in frequently switched applications (> 100,000 on/off cycles)
- Multi-Voltage Technology handles voltage from 120 to 277V
- Parallel lamp operation means system maintenance is easier to manage
- Starting time visually the same as instant start







GENERAL CHARACTERISTICS

Application	2 or 1 F32T8 120V-277V Low Watts .71 BF <10% THD UltraStart
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10.0 %
Case Temperature (MAX)	70.0 °C
Ballast Factor	Low-PS (.71)
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Anti-striation control/Thermally protected/Universal voltage
Primary Application	Standard

PRODUCT INFORMATION

Product Code	96720
Description	GE232-MVPS-L
Standard Package	Case
Standard Package GTIN	10043168967201
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168967204

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(29.97 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	8.9 in(225.81 mm)
Mount Width (X or F)	1.1 in(28.70 mm)
Mount Slots (MS)	0.3 in(7.92 mm)
Weight	1.65 lb
Remote Mounting Distance	18.0 ft
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left	25.0 (635mm)
White	1	Left	25.0 (635mm)
Yellow	2	Right	47.0 (1194mm)
Blue	2	Right	33.0 (838mm)
Red	2	Right	33 in (NaNmm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency (MIN)	50.0 Hz/60.0 Hz
Supply Current Frequency	60.0 Hz

SAFETY & PERFORMANCE

- ANSI - C62.41
- cUL Listed
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type HL
- RoHs Compliant
- NEMA Premium®

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F32T8/WM	1	120	28	0.26 A	0.79	2.82	98	1.7	10.0	60.0 °F / NaN
F32T8/WM	1	277	28	0.11 A	0.79	2.82	90	1.7	10.0	60.0 °F / NaN
F32T8/WM	2	120	44	0.37 A	0.71	1.61	99	1.7	10.0	60.0 °F / NaN

F32T8/WM	2	277	44	0.17 A	0.71	1.61	95	1.7	10.0	60.0 °F / NaN
F32T8/25W	1	120	21		0.77	3.67	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	1	277	21		0.77	3.67	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	2	120	37		0.65	1.76	98	1.7	10.0	60.0 °F / NaN
F32T8/25W	2	277	36		0.65	1.81	98	1.7	10.0	60.0 °F / NaN
F32T8	1	120	30	0.28 A	0.81	2.70	98	1.7	10.0	0.0 °F / NaN
F32T8	1	277	30	0.12 A	0.81	2.70	90	1.7	10.0	0.0 °F / NaN
F32T8	2	120	47	0.4 A	0.71	1.51	99	1.7	10.0	0.0 °F / NaN
F32T8	2	277	47	0.18 A	0.71	1.51	95	1.7	10.0	0.0 °F / NaN
F28T8	1	120	26	0.25 A	0.77	2.96	98	1.7	10.0	60.0 °F / NaN
F28T8	1	277	26	0.1 A	0.77	2.96	90	1.7	10.0	60.0 °F / NaN
F28T8	2	120	41	0.34 A	0.71	1.73	99	1.7	10.0	60.0 °F / NaN
F28T8	2	277	41	0.15 A	0.71	1.73	94	1.7	10.0	60.0 °F / NaN
F25T8	1	120	24	0.24 A	0.86	3.58	97	1.7	10.0	0.0 °F / NaN
F25T8	1	277	25	0.1 A	0.86	3.44	85	1.7	10.0	0.0 °F / NaN
F25T8	2	120	37	0.31 A	0.73	1.97	99	1.7	10.0	0.0 °F / NaN
F25T8	2	277	38	0.14 A	0.73	1.92	94	1.7	10.0	0.0 °F / NaN
F17T8	1	120	17	0.2 A	0.83	4.88	95	1.7	10.0	0.0 °F / NaN
F17T8	1	277	19	0.08 A	0.83	4.37	80	1.7	10.0	0.0 °F / NaN
F17T8	2	120	27	0.22 A	0.71	2.63	98	1.7	10.0	0.0 °F / NaN
F17T8	2	277	27	0.11 A	0.71	2.63	91	1.7	10.0	0.0 °F / NaN

WARRANTY INFORMATION

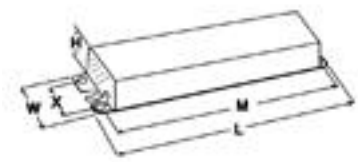
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

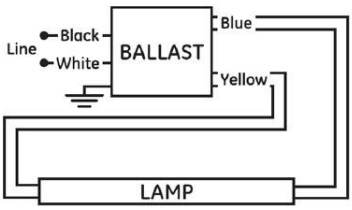
GE Lighting

75952 - GE132-MVPS-L

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- A new generation of ultra-efficient Programmed Start ballasts (> 90% efficiency).
- Extends lamp life in frequently switched applications (> 100,000 on/off cycles)
- Multi-Voltage Technology handles voltage from 120 to 277V
- Starting time visually the same as instant start
- Anti-striation circuitry reduces striations with energy saving lamps





GENERAL CHARACTERISTICS

Application	1 F32T8 120V-277V Low Watts .71 BF <10% THD UltraStart
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10.0 %
Case Temperature (MAX)	70.0 °C
Ballast Factor	Low-PS (.71)
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Anti-striation control/Thermally protected/Universal voltage
Primary Application	Standard

PRODUCT INFORMATION

Product Code	75952
Description	GE132-MVPS-L
Standard Package	Case
Standard Package GTIN	10043168759523
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168759526

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(29.97 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	8.9 in(225.81 mm)
Mount Width (X or F)	1.1 in(28.70 mm)
Mount Slots (MS)	0.3 in(7.92 mm)
Weight	1.65 lb
Remote Mounting Distance	18.0 ft
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left	25.0 (635mm)
White	1	Left	25.0 (635mm)
Blue	2	Right	33.0 (838mm)
Yellow	2	Right	48.0 (1219mm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency (MIN)	50.0 Hz/60.0 Hz

SAFETY & PERFORMANCE

- ANSI - C62.41
- cUL Listed
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type HL
- RoHs Compliant
- NEMA Premium®

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
FE15T8	1	120	12	0.1 A	0.66	5.50	99	1.7	10.0	0.0 °F / NaN
FE15T8	1	277	13	0.1 A	0.66	5.08	86	1.7	10.0	0.0 °F / NaN
F40T8	1	120	29	0.25 A	0.71	2.45	99	1.7	10.0	0.0 °F / NaN
F40T8	1	277	29	0.11 A	0.71	2.45	97	1.7	10.0	0.0 °F / NaN
F32T8/WM	1	120	23	0.2 A	0.71	3.09	99	1.7	10.0	50.0 °F / NaN
F32T8/WM	1	277	23	0.09 A	0.71	3.09	95	1.7	10.0	50.0 °F / NaN

F32T8/25W	1	120	20	0.18	A	0.71	3.55	99	1.7	10.0	50.0 °F / NaN
F32T8/25W	1	277	21	0.08	A	0.71	3.38	94	1.7	10.0	50.0 °F / NaN
F32T8	1	120	25	0.22	A	0.72	2.88	99	1.7	10.0	0.0 °F / NaN
F32T8	1	277	25	0.1	A	0.72	2.88	96	1.7	10.0	0.0 °F / NaN
F28T8	1	120	22	0.19	A	0.71	3.23	99	1.7	10.0	50.0 °F / NaN
F28T8	1	277	22	0.09	A	0.71	3.23	94	1.7	10.0	50.0 °F / NaN
F25T8/WM	1	120	17	0.15	A	0.71	4.18	99	1.7	10.0	50.0 °F / NaN
F25T8/WM	1	277	18	0.07	A	0.71	3.94	92	1.7	10.0	50.0 °F / NaN
F25T8	1	120	19	0.17	A	0.73	3.84	99	1.7	10.0	0.0 °F / NaN
F25T8	1	277	20	0.08	A	0.73	3.65	93	1.7	10.0	0.0 °F / NaN
F25T12	1	120	20	0.18	A	0.72	3.60	99	1.7	10.0	0.0 °F / NaN
F25T12	1	277	21	0.08	A	0.72	3.43	94	1.7	10.0	0.0 °F / NaN
F17T8/WM	1	120	13	0.11	A	0.74	5.69	99	1.7	10.0	50.0 °F / NaN
F17T8/WM	1	277	13	0.06	A	0.74	5.69	87	1.7	10.0	50.0 °F / NaN
F17T8	1	120	14	0.12	A	0.75	5.36	99	1.7	10.0	0.0 °F / NaN
F17T8	1	277	15	0.06	A	0.75	5.00	89	1.7	10.0	0.0 °F / NaN

WARRANTY INFORMATION

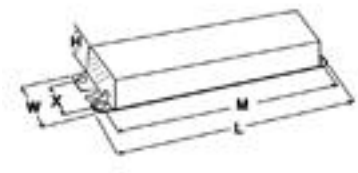
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

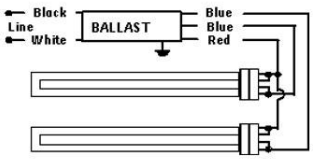
GE Lighting

71435 - GEC240MAX-A

GE CFL UltraMax™ High Lumen Biax™ Electronic Multivolt Instant Start Ballast

- Multi-Voltage Technology handles voltage from 120 to 277V
- Energy saving high efficiency instant start electronic ballast (> 90%)
- Instant start electronic ballast for long lamp starting cycles and low initial cost
- Anti-Striation Control for better light quality, with no striations.
- Lamp End-of-Life Safety Shutdown Circuit with Re-Lamping Auto-reset





GENERAL CHARACTERISTICS

Application	2 or 1-FT40W-25W/2G11 Biax-120-277V UltraMax Instant Start
Category	Compact Fluorescent
Ballast Type	Electronic - Multivolt Instant Start
Starting Method	Instant start
Line Voltage Regulation (+/-)	10.0 %
Case Temperature (MAX)	70.0 °C
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/Inherent thermal protection/Lamp End-of-Life Safety Shutdown Circuit/ Parallel Lamp Operation/Anti-striation control

PRODUCT INFORMATION

Product Code	71435
Description	GEC240MAX-A
Standard Package	Case
Standard Package GTIN	10043168714355
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168714358

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(29.97 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	8.9 in(225.81 mm)
Mount Width (X or F)	1.1 in(28.70 mm)
Mount Slots (MS)	0.3 in(7.92 mm)
Weight	1.4 lb
Exit Type	Side
Remote Mounting Distance	18.0 ft
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left	25 (635mm)
Red	1	Right	31 (787mm)
White	1	Left	25 (635mm)
Blue	2	Right	31 (787mm)

SAFETY & PERFORMANCE

- cUL Listed
- Type HL
- UL Type HL
- RoHs Compliant
- No PCB's

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
FT40W/4P	1	120	42	0.35 A	1.00	2.38	99	1.7	10.0	0.0 °F / NaN
FT40W/4P	1	277	42	0.16 A	1.00	2.38	95	1.7	15.0	0.0 °F / NaN
FT40W/4P	2	120	69	0.58 A	0.90	1.30	99	1.7	10.0	0.0 °F / NaN
FT40W/4P	2	277	68	0.25 A	0.90	1.32	95	1.7	10.0	0.0 °F / NaN
FT40W/28W/4P	1	120	38	0.32 A	1.11	2.92	99	1.7	10.0	0.0 °F / NaN
FT40W/28W/4P	1	277	38	0.14 A	1.11	2.92	95	1.7	15.0	0.0 °F / NaN
FT40W/28W/4P	2	120	63	0.54 A	1.00	1.59	99	1.7	10.0	0.0 °F / NaN
FT40W/28W/4P	2	277	62	0.23 A	1.00	1.61	95	1.7	10.0	0.0 °F / NaN
FT40W/25W/4P	1	120	35	0.29 A	1.15	3.29	99	1.7	10.0	0.0 °F / NaN
FT40W/25W/4P	1	277	35	0.13 A	1.15	3.29	95	1.7	15.0	0.0 °F / NaN
FT40W/25W/4P	2	120	58	0.5 A	1.00	1.72	99	1.7	10.0	0.0 °F / NaN
FT40W/25W/4P	2	277	57	0.21 A	1.00	1.75	90	1.7	10.0	0.0 °F / NaN
F32T8	1	120	38	0.32 A	1.08	2.84	99	1.7	10.0	0.0 °F / NaN
F32T8	1	277	38	0.14 A	1.08	2.84	95	1.7	15.0	0.0 °F / NaN

F32T8	2	120	63	0.14	A	1.08	1.71	95	1.7	15.0	0.0 °F / NaN
F32T8	2	277	62	0.23	A	0.94	1.52	95	1.7	10.0	0.0 °F / NaN
F28T5/HE	1	120	41	0.35	A	1.26	3.07	99	1.7	10.0	0.0 °F / NaN
F28T5/HE	1	277	41	0.15	A	1.26	3.07	95	1.7	15.0	0.0 °F / NaN
F28T5/HE	2	277	68	0.25	A	1.10	1.62	95	1.7	10.0	0.0 °F / NaN
F28T5/HE	2	120	69	0.59	A	1.10	1.59	99	1.7	10.0	0.0 °F / NaN

CAUTIONS & WARNINGS

Caution

•

NOTES

• For 1 lamp application, cap unused blue lead, insulate for 600 Vrms

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

GE Lighting

20900 - F50BXSPX41RS10PK

GE Biax® T5 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

Rendering

High Color

Photo Not Available

GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T5
Base	4-Pin (2G11)
Rated Life	20000.0 hrs
Starting Temperature (MIN)	10.0 °C
LEED-EB MR Credit	147 picograms Hg per mean lumen hour
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	4000.0
Mean Lumens	3400.0
Nominal Initial Lumens per Watt	80
Color Temperature	4100.0 K
Color Rendering Index (CRI)	82.0

ELECTRICAL CHARACTERISTICS

Wattage	50.0
Voltage	120.0
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	22.5000 in(571.5 mm)
Nominal Length	22.500 in(571.5 mm)

PRODUCT INFORMATION

Product Code	20900
Description	F50BXSPX41RS10PK
Standard Package	Case
Standard Package GTIN	10043168209004
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168209007

GE Lighting

16954 - F40/30BX/SPX41

GE Biax® T5 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color

GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T5
Base	4-Pin (2G11)
Rated Life	20000.0 hrs
Starting Temperature (MIN)	10.0 °C
LEED-EB MR Credit	176 picograms Hg per mean lumen hour
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3150.0
Mean Lumens	2840.0
Nominal Initial Lumens per Watt	78
Color Temperature	4100.0 K
Color Rendering Index (CRI)	82.0

ELECTRICAL CHARACTERISTICS

Wattage	40.0
Voltage	126.0
Lamp Current	0.32 A
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	22.5000 in(571.5 mm)
Nominal Length	22.500 in(571.5 mm)

PRODUCT INFORMATION

Product Code	16954
Description	F40/30BX/SPX41
ANSI Code	60901-IEC-6240-2
Standard Package	Case
Standard Package GTIN	10043168169544
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168169547

GE Lighting

25613 - F32T8/SPX41/ECO

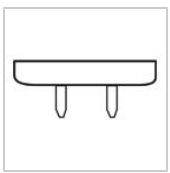
GE Ecolux® Starcoat® T8

• Passes TCLP, which can lower disposal costs.

Photo Not Available

Rendering

High Color



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

Warning

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Graphs_Spectral Power Distribution

GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T8
Base	Medium Bi-Pin (G13)
Rated Life	30000.0 hrs
Rated Life (instant start) @ Time	21000 h @ 3 h 30000 h @ 12 h
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature (MIN)	10.0 K
LEED-EB MR Credit	35 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2950.0
Mean Lumens	2800.0
Nominal Initial Lumens per Watt	92
Color Temperature	4100.0 K
Color Rendering Index (CRI)	85.0
S/P Ratio (Scotopic/Photopic Ratio)	1.8

ELECTRICAL CHARACTERISTICS

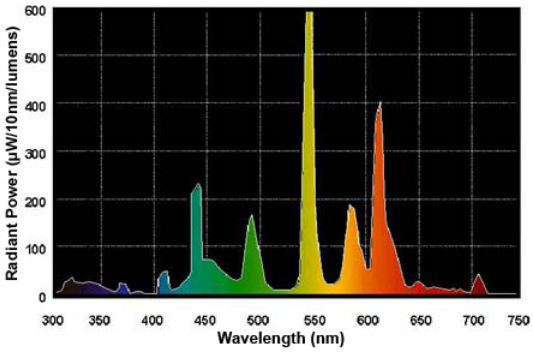
Wattage	32.0
Voltage	137.0
Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 nV
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

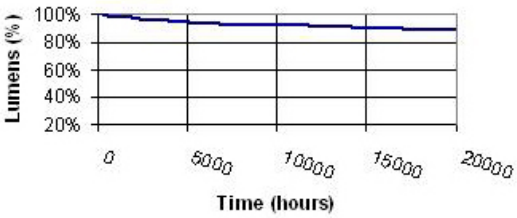
Maximum Overall Length (MOL)	47.7800 in(1213.6 mm)
Minimum Overall Length	47.6700 in(1210.8 mm)
Nominal Length	48.000 in(1219.2 mm)
Bulb Diameter (DIA) (MIN)	0.940 in(23.9 mm)
Bulb Diameter (DIA) (MAX)	1.100 in(27.9 mm)
Bulb Diameter (DIA)	1.000 in(25.4 mm)
Max Base Face to Base Face (A)	47.220 in(1199.4 mm)
Face to End of Opposing Pin (B) (MIN)	47.400 in(1204.0 mm)
Face to End of Opposing Pin (B) (MAX)	47.500 in(1206.5 mm)
End of Base Pin to End of Opposite Pin End (C)	47.670 in(1210.8 mm)

PRODUCT INFORMATION

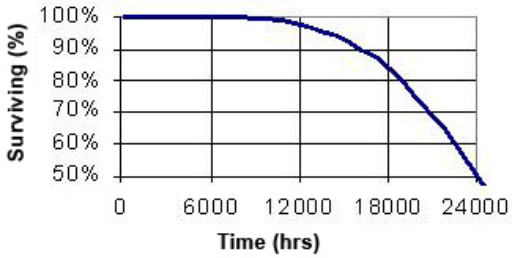
Product Code	25613
Description	F32T8/SPX41/ECO
ANSI Code	1005-2
Standard Package	Case
Standard Package GTIN	10043168256138
Standard Package Quantity	36
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	36
UPC	043168256131



Graphs_Lumen Maintenance



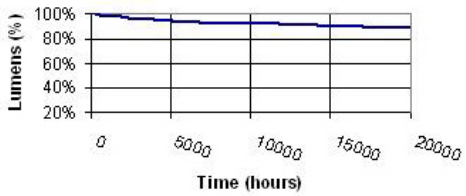
Graphs_Lamp Mortality



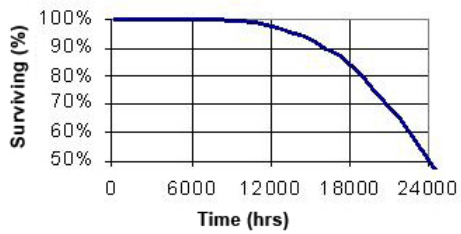
GE Lighting

10488 - F32T8/SPX41/U/6

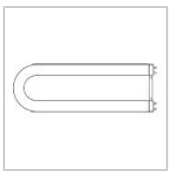
GE Mod-U-line® Starcoat® T8

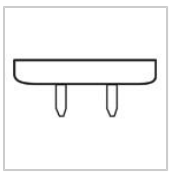


Graphs_Lamp Mortality



Color





CAUTIONS & WARNINGS

Caution

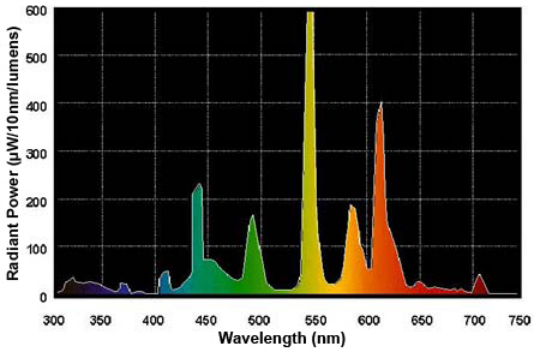
- Lamp may shatter and cause injury if broken
  - Wear safety glasses and gloves when handling lamp.
  - Do not use excessive force when installing lamp.

Warning

- Risk of Electric Shock
  - Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Graphs_Spectral Power Distribution



Graphs_Lumen Maintenance

GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - U-Shaped
Bulb	T8
Base	Medium Bi-Pin (G13)
Rated Life	20000.0 hrs
Bulb Material	Soda lime
Starting Temperature (MIN)	10.0 °C
LEED-EB MR Credit	1711 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2800.0
Mean Lumens	2630.0
Nominal Initial Lumens per Watt	87
Color Temperature	4100.0 K
Color Rendering Index (CRI)	86.0

ELECTRICAL CHARACTERISTICS

Wattage	32.0
Voltage	137.0
Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 nV
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	22.6000 in(574.0 mm)
Minimum Overall Length	22.2500 in(565.2 mm)
Nominal Length	22.500 in(571.5 mm)
Bulb Diameter (DIA)	1.000 in(25.4 mm)
Bulb Diameter in Bend (MIN)	0.890 in(22.6 mm)
Bulb Diameter in Bend (MAX)	1.150 in(29.2 mm)
Bulb Diameter in Legs (MIN)	0.940 in(23.9 mm)
Bulb Diameter in Legs (MAX)	1.100 in(27.9 mm)
Base Face to Top of Lamp	22.250 in(565.2 mm)
Lamp Legs Center to Center Length	6.000 in(152.4 mm)

PRODUCT INFORMATION

Product Code	10488
Description	F32T8/SPX41/U/6
ANSI Code	78901-ANSI-4027-1
Standard Package	Case
Standard Package GTIN	10043168104880
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168104883

D93 Series—Solid-State Relays

Contents

Description	*Page*
D93 Series	
Product Selection	**V7-T3-122**
Accessories	**V7-T3-122**
Technical Data and Specifications	**V7-T3-123**
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D96 Series	**V7-T3-128**
D99 Series	**V7-T3-133**

D93 Series

Product Description

Eaton's D93 series of solid-state relays is a line of heavy-duty industrial relays in the common "hockey puck" package. The removable, finger-safe cover and optional accessories make the D93 safe and easy to install in a variety of applications.

Models are available in a variety of input voltages and switch types up to 75A.

Application Description

A solid-state relay (SSR) can perform many applications that an electromechanical relay can perform. The SSR differs in that it has no moving mechanical parts within it and has some distinct advantages over an electromechanical relay.

When used correctly in the intended application, the SSR provides a high degree of reliability, a long service life, significantly reduced electromagnetic interference, fast response and high vibration resistance.

Applications for the SSR typically include equipment that requires high cycling rates, low acoustical or electrical noise, or high vibration resistance. Some examples are medical equipment, heating/cooling equipment, lighting control and pumps/compressors, among others.

Features and Benefits

- All solid-state circuitry with no moving parts to wear
- Compact, panel mounting for flexible installation
- Isolated input and output terminals to protect the system from electrical noise
- Internal snubber circuitry to protect the SSR from transients

Standards and Certifications

- UL/cUL listed—UL 508
- CSA certified
- CE marked
- RoHS compliant

c UL us Listed CE RoHS COMPLIANT

Product Selection

D93210ACZ1

D93 Series

Input Voltage	Output Voltage	Contact Configuration	Switching Type	Rated Current Load (Amps)	Catalog Number
90–280 Vac	24–280 Vac	SPST-NO	Zero cross	10	**D93210ACZ1**
3–32 Vdc	24–280 Vac	SPST-NO	Zero cross	10	**D93210ACZ2**
3–32 Vdc	24–280 Vac	SPST-NO	Triac	10	**D93210ATZ2**
90–280 Vac	24–280 Vac	SPST-NO	Zero cross	25	**D93225ACZ1**
3–32 Vdc	24–280 Vac	SPST-NO	Zero cross	25	**D93225ACZ2**
3–3		SPST-NO	Triac	25	**D93225ATZ2**
90–		SPST-NO	Zero cross	40	**D93240ACZ1**
3–3		SPST-NO	Zero cross	40	**D93240ACZ2**
3–3		SPST-NO	Triac	40	**D93240ATZ2**
90–280 Vac	24–280 Vac	SPST-NO	Zero cross	50	**D93250ACZ1**
3–32 Vdc	24–280 Vac	SPST-NO	Zero cross	50	**D93250ACZ2**
90–280 Vac	24–280 Vac	SPST-NO	Zero cross	75	**D93275ACZ1**
3–32 Vdc	24–280 Vac	SPST-NO	Zero cross	75	**D93275ACZ2**
3–32 Vdc	3–200 Vdc	SPST-NO	MOSFET	12	**D93312AMD2**
3–32 Vdc	3–200 Vdc	SPST-NO	MOSFET	25	**D93325AMD2**
3–32 Vdc	3–200 Vdc	SPST-NO	MOSFET	40	**D93340AMD2**

Installed in gym fixtures for low voltage switching

Accessories

D93HS1

D93 Series—Heat Sink

Eaton's D93HS1 heat sink is specifically designed to be used with D93 solid-state relays. It is pre-drilled and tapped, and matches the heat dissipation requirements for relays up to 50A.

Heat Sink Accessory

Description	Catalog Number
Heat sink	**D93HS1**

Note: Always ensure that all details of the application are considered when determining heat dissipation requirements, including ambient temperature. The D93 relays must be firmly mounted to the heat sink using a suitable thermally conductive grease or thermal transfer pad.

D93TP1

D93 Series—Thermal Transfer Pad

The D93TP1 is a self-adhesive transfer pad designed for use with Eaton's D93 solid-state relays. When used properly, it will adequately conduct the heat to a heat sink without the use of grease.

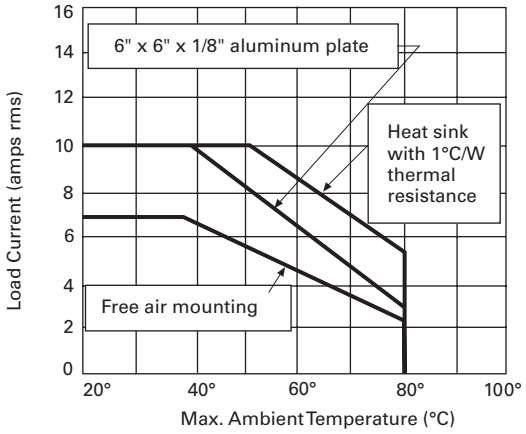
Technical Data and Specifications

D93 Series

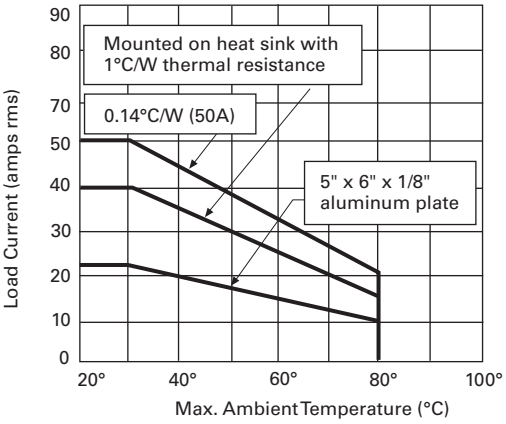
Description	Units	D93210ACZ1	D93210ACZ2	D93210ATZ2	D93225ACZ1	D93225ACZ2	D93225ATZ2
Output Characteristics							
Contact configuration		SPST-NO	SPST-NO	SPST-NO	SPST-NO	SPST-NO	SPST-NO
Switching device		SCR	SCR	Triac	SCR	SCR	Triac
Current rating	A	10	10	10	25	25	25
Switching type		Zero cross	Zero cross	Zero cross	Zero cross	Zero cross	Zero cross
Maximum rate of rise off state voltage (DV/DT)	V/us	200	250	700	500	500	250
Incandescent lamp ampere rating (rms)	A	8	16	16	16	16	16
Motor load rating (rms)	A	4.5	8	8	8	8	8
Min. load current to maintain on	mA	50	120	250	120	120	120
Non-repetitive surge current (1 cycle)	A	83	250	1000	250	250	250
Max. rms overload current (1 second)	A	24	80	50	40	40	80
Max. off state leakage current (rms)	mA	8	10	10	8	10	10
Peak blocking voltage	Vpk	600	300	—	600	600	—
Typical on state voltage drop (rms)	Vac	1.6	1.6	1.35	1.6	1.6	1.6
Max. on state voltage drop (rms)	Vac	1.6	1.6	1.6	1.6	1.6	1.6
Max. I^2t for fusing (A^2)		72	300	1700	312	250	300
Input Characteristics							
Must release voltage	V	10 AC	1 DC	10 AC	10 AC	1 DC	1 DC
Typical input impedance	ohms	13k	Current regulator	16–25k	13k	Current regulator	1.5k
Nominal input current at 5 Vdc or 240 Vac	mA	20	2	12	20	16	2
Reverse polarity protection		NA	Yes	NA	NA	Yes	Yes
Performance Characteristics							
Operating time (response time)							
ON	ms	8.3	8.3	8.3	8.3	8.3	8.3
OFF	ms	8.3	8.3	8.3	8.3	8.3	8.3
Rated insulation voltage—input to input	Vac	4000	4000	4000	4000	4000	4000
Dielectric strength—terminal to chassis	Vac	4000	4000	4000	4000	4000	4000
Environment							
Product certifications		UR, CSA, CE	UR, CSA, CE	UR, CSA, CE	UR, CSA, CE	UR, CSA, CE	UR, CSA, CE
Ambient air temperature							
Storage	°C	–40 to 100	–40 to 100	–40 to 100	–40 to 100	–40 to 100	–40 to 100
Operating	°C	–40 to 80	–40 to 80	–40 to 80	–40 to 80	–40 to 80	–40 to 80
Degree of protection		IP20	IP20	IP20	IP20	IP20	IP20
Miscellaneous Characteristics							
Thermal resistance (junction to case)	°C/W	3.5	3.5	1.45	1.02	1.02	1.45
Weight	g (oz)	100 (3.5)	100 (3.5)	100 (3.5)	100 (3.5)	100 (3.5)	100 (3.5)
LED—input		Green	Green	Green	Green	Green	Green
Input terminals		M3.5	M3.5	M3.5	M3.5	M3.5	M3.5
Output terminals		M4	M4	M4	M4	M4	M4
Terminal torque (max.)	Nm	1.0	1.0	1.0	1.0	1.0	1.0

Temperature Derating Curves

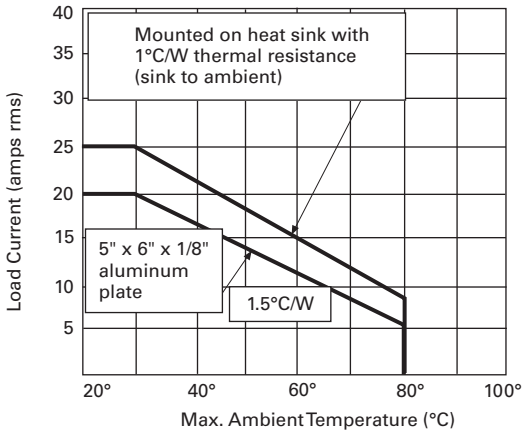
10 Amp Styles



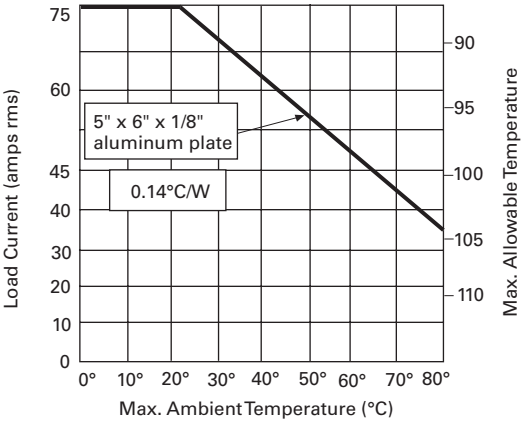
40 and 50 Amp Styles



25 Amp Styles



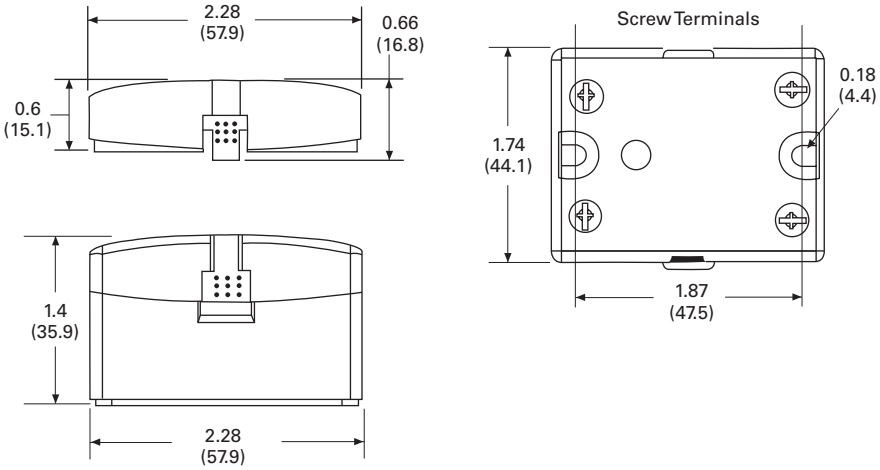
75 Amp Styles



Dimensions

Approximate Dimensions in Inches (mm)

D93 Series



PSG Series

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Sensor Power Supply	770

PSG Series

Product Description

Eaton's PSG Series of power supplies is designed to be a high-performance, high-quality line of products covering a majority of 24 Vdc control applications. With global certifications, compact size and an impressive operating temperature range, the PSG Series fits a wide variety of applications at a competitive price.

Eight models are offered, from 2.5A up to 20A with both single- and three-phase input voltage models available.

Application Description

The PSG Series is a line of general-purpose power supplies for use in a wide variety of industrial control applications. Applications include communication networks, sensors, PLCs and many other electrical systems.

Each model is equipped with a rugged metal housing, heavy-duty screw terminals and a variety of protection features, making the PSG one of the most versatile industrial power supply lines on the market.

Features, Benefits and Functions

- Universal input voltages: 85–264 Vac for single-phase units, 320–575 Vac for three-phase units
- Rugged aluminum housing stands up to harsh environments
- Current surge (power boost) of 1.5 times nominal current for 1 second allows branch protection and powering of high pickup loads
- Wide operating temperature range: –20°C to +75°C (derating above 50°C)
- Adjustable DC voltage output
- LED indicating light for DC OK simplifies troubleshooting
- Compact size, with common depth and height across all models, allows for common panel depths and family consistency
- MTBF up to 800,000 hours ensures uptime and reliability
- Heavy-duty screw terminals with finger-safe protective cover allow use of ring-lug terminals
- All-metal DIN rail mounting hardware
- Class 1, Division 2 hazardous location rated

Standards and Certifications

- UL/cUL listed—UL 508 (industrial control equipment)
- cURus—UL 60950-1
- IEC
- EN
- German safety
- CSA certified (contact Eaton for certification dates and status)
- CE marked
- RoHS compliant

Listed

Product Selection

PSG60E

Power Supply—Single-Phase

	Catalog Number
85–264 Vac input, 24 Vdc/2.5A output	**PSG60E**
85–264 Vac input, 24 Vdc/5A output	**PSG120E**
85–264 Vac input, 24 Vdc/10A output	**PSG240E**
85–264 Vac input, 24 Vdc/20A output	**PSG480E**

Power Supply—Three-Phase

	Catalog Number
320–575 Vac input, 24 Vdc/2.5A output	**PSG60F**
320–575 Vac input, 24 Vdc/5A output	**PSG120F**
320–575 Vac input, 24 Vdc/10A output	**PSG240F**
320–575 Vac input, 24 Vdc/20A output	**PSG480F**

Technical Data and Specifications

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PSG Series

Installed in electrical room below gym for power to relays in fixtures for low voltage switching

Capacity	PSG60E 60W	PSG120E 120W				SG120F 20W	PSG240F 240W	PSG480F 480W
Input								
Nominal voltage	100–240 Vac	100–240 Vac				x 400–500 Vac	3 x 400–500 Vac	3 x 400–500 Vac
Voltage range	②	②					③	③
Frequency	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)
Nominal current ①	1.1A	1.4A	2.9A	5.7A	0.3A	0.5A	0.8A	1.6A
Inrush current limitation ①	30A	<80A	N/A	N/A	<30A	<30A	<40A	<50A
Mains buffering at nominal load (typ.) ①	>20 ms	>35 ms	>20 ms	>20 ms	>30 ms	>35 ms	>35 ms	>20 ms
Turn-on time	<2.5 sec	<1 sec	<1 sec	<1 sec	<2 sec	<1 sec	<1 sec	<1 sec
Internal fuse	T3.15 AH/250V	T3.15 AH/250V	T6.3AH/250V	F10H/250V	3.15AH/500V	3.15AH/500V	3.15AH/500V	3.15AH/500V
External fusing	6A, 10A or 16A	6A, 10A or 16A	10A or 16A	10A or 16A	3 x circuit breakers 6A, 10A or 16A	3 x circuit breakers 6A, 10A or 16A	3 x circuit breakers 6A, 10A or 16A	3 x circuit breakers 6A, 10A or 16A
Leakage current	<1 mA	<1 mA	<3.5 mA	<1 mA	<3.5 mA	<3.5 mA	<3.5 mA	<3.5 mA
Output								
Nominal output voltage	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%
Adjustment range	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc
Nominal current	2.5A	5A	10A	20A	2.5A	5A	10A	20A
Startup with capacitive loads	Max. 8,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF
Max. power dissipation idling nominal load approx.	10W	22.5W	42.5W	72W	9W	18W	36W	72W
Efficiency (at 400 Vac and nominal values)	>85% typ	>84% typ	>84% typ	>86% typ	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac
Current surge (at 24 Vdc)	3.75A	7.5A	15A	30A	3.75A	7.5A	15A	30A
Current surge time/cycle	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)
Residual ripple/peak switching (20 MHz)	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp
Parallel operation	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode
Galvanic Isolation								
Input/output	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)
Input/ground	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/ 1.5 kVAC (routine test)	1.5 kVAC (type test)/ 1.5 kVAC (routine test)	1.5 kVAC (type test)/ 1.5 kVAC (routine test)	1.5 kVAC (type test)/ 1.5 kVAC (routine test)
Output/ground	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/ 500 Vac (routine test)	1.5 kVAC (type test)/ 500 Vac (routine test)	1.5 kVAC (type test)/ 500 Vac (routine test)	1.5 kVAC (type test)/ 500 Vac (routine test)

Notes

① Ratings for single-phase models are at 115 Vac; three-phase models are at 400 Vac.

② 85–264 Vac (DC input range 120–375 Vdc)

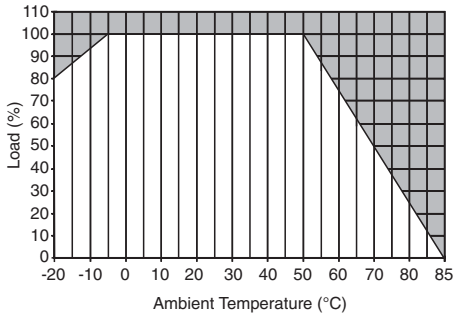
③ 320–575 Vac (DC input range 450–800 Vdc)

PSG Series, continued

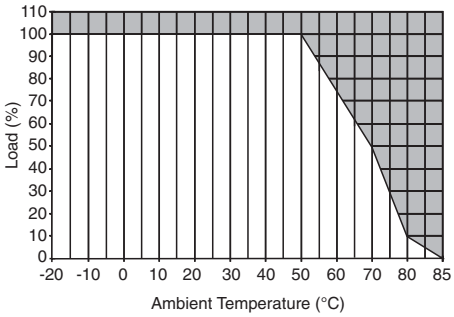
Capacity	PSG60E 60W	PSG120E 120W	PSG240E 240W	PSG480E 480W	PSG60F 60W	PSG120F 120W	PSG240F 240W	PSG480F 480W
General/Physical Data								
Housing material	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)
Signals	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK
MTBF	>800,000 hrs	>800,000 hrs	>300,000 hrs	>300,000 hrs	>500,000 hrs	>500,000 hrs	>300,000 hrs	>300,000 hrs
Dimensions (L)	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm
Dimensions (W)	32 mm	50 mm	85 mm	160 mm	70 mm	70 mm	85 mm	160 mm
Dimensions (H)	120 mm	115 mm	118.5 mm	115 mm	118.5 mm	118.5 mm	120.5 mm	115 mm
Weight (kg)	0.37	0.54	1.04	1.8	0.56	0.72	0.77	1.71
Operating temperature	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)
Storage temperature	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C
Operating humidity	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing	<95% RH, noncondensing
Vibration (operating)	①	①	①	①	①	①	①	①
Pollution degree	2	2	2	2	2	2	2	2
Climatic class	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721
Safety and Protection								
Transient surge voltage	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor
Surge voltage protection against internal surge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Safety class	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection
Shock	②	②	②	②	②	②	②	②

Power Derating Curves

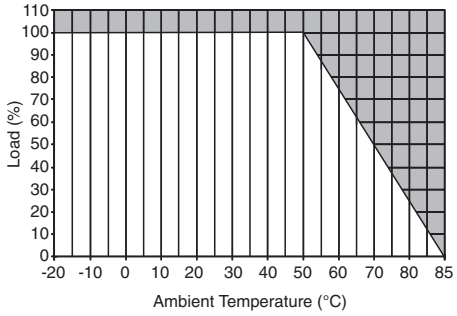
Vertical Mounting Position PSG60E



Vertical Mounting Position PSG240E, PSG240F



Vertical Mounting Position PSG60F, PSG120E, PSG120F, PSG480E, PSG480F



Notes

① 10 to 150 Hz, 0.35 mm acc. 50 m/s/s, single amplitude (5G max.) for 90 min. in each X, Y, Z direction, in acc. with IEC 68-2-6.

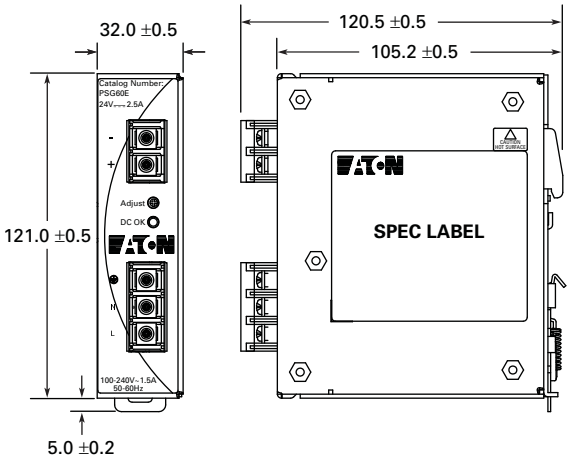
② 30G (300 m/s/s) in all directions according to IEC 68-2-27.

Dimensions

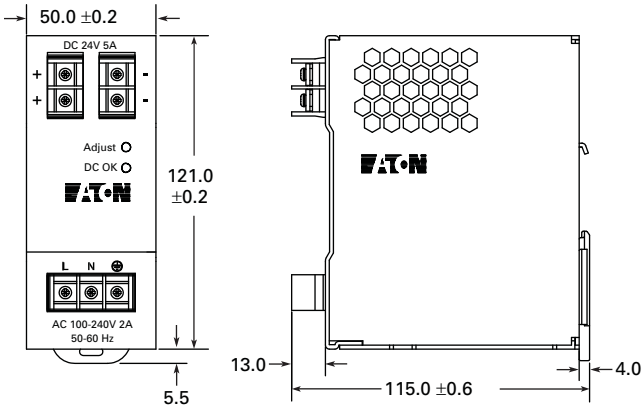
Approximate Dimensions in mm

Note: Dimensions are for reference only.

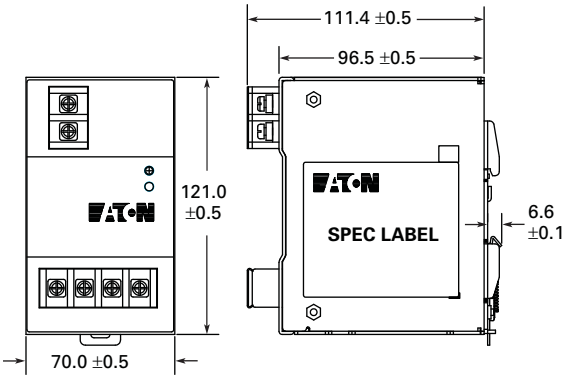
PSG60E



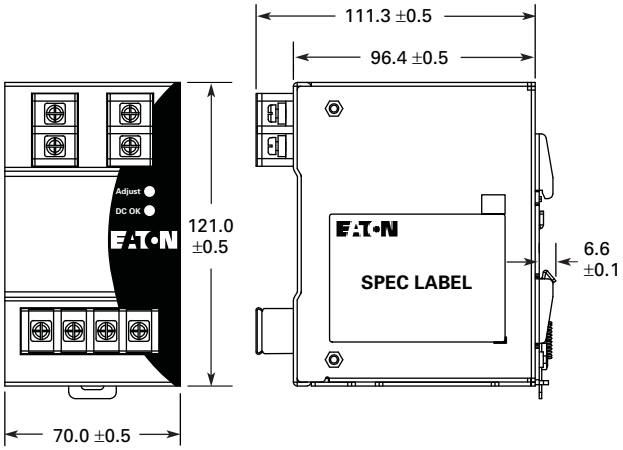
PSG120E



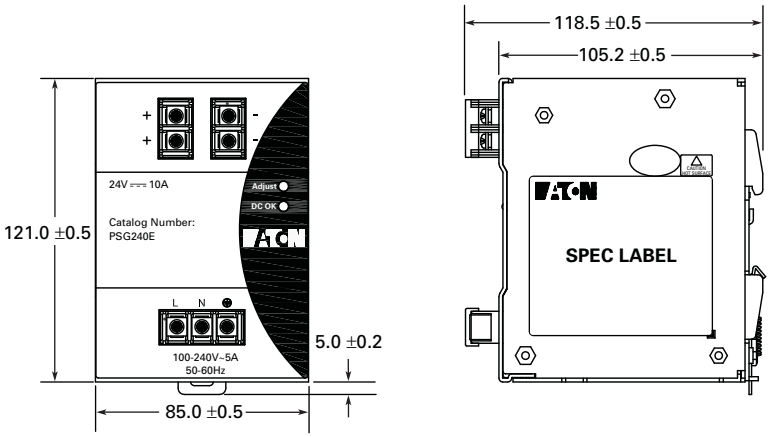
PSG60F



PSG120F



PSG240E



D1 Series Relay

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D1PR/D1PF Series

Product Description

The D1 Series of relay provides a compact single-pole relay capable of handling 20A. Multiple feature and voltage options allow for the perfect fit for any application.

Features

D1PR

- Compact relay capable of breaking relatively large load currents
- Panel and DIN rail mounting

D1PF

- The contact operation can be easily checked by Push-to-Test button
- Flag indicator shows relay status in manual or powered condition
- LED status lamp shows coil ON or OFF status—ideal for use in low light applications
- Push-to-Test button allows for manual operation of relay without the need for coil power
- Lock-down door holds pushbutton and contacts in the operate position when activated
- Finger-grip cover allows operator to remove relays from sockets easily
- ID tag/write label to identify relays in multiple-relay circuits
- Bipolar LED allows for reverse polarity applications

Standards and Certifications

RoHS COMPLIANT c UL us CE CSA

UL Listed When used with accompanying Eaton screw terminal socket.

Catalog Number Selection

D1PR/D1PF Series

D1PF 1 A A

Family Type

D1PF	
D1PR	

Contact Configuration

1	= SPDT

Standard Features

Blank	= Mechanical flag indicator (only with D1PR)
A	= LED test button, flag indicator, lock-down door, finger-grip cover, ID tag (only with D1PF)
1	= LED and mechanical flag indicator

Coil Voltage

A	= 120 Vac
A1	= 110 Vdc
B	= 240 Vac
P	= 6 Vac
P1	= 6 Vdc
R	= 12 Vac
R1	= 12 Vdc
T	= 24 Vac
T1	= 24 Vdc
W	= 48 Vac
W1	= 48 Vdc

Product Selection

D1PR/D1PF Relay/Socket Quick Reference

Relay Type	Socket	Clip	Module Type	ID Tag	Jumper
D1PR1	D1PAA	PMC-1781	B	—	—
D1PF1	D1PAA	PMC-1781	B	—	—

D1PF Series Relay

D1PR/D1PF Series

Coil Voltage	Contact Configuration	Coil Resistance (Ohms)	Catalog Number
Full Featured			
6 Vac	SPDT	12.2	**D1PF1AP**
6 Vdc	SPDT	47	**D1PF1AP1**
12 Vac	SPDT	46	**D1PF1AR**
12 Vdc	SPDT	188	**D1PF1AR1**
24 Vac 50/60 Hz	SPDT	180	**D1PF1AT**
24 Vdc	SPDT	750	**D1PF1AT1**
48 Vac	SPDT	720	**D1PF1AW**
48 Vdc	SPDT	2600	**D1PF1AW1**
110 Vdc	SPDT	13,800	**D1PF1AA1**
120 Vac 50/60 Hz	SPDT		
240 Vac 50/60 Hz	SPDT		
Plain Cover with LED Indicato			
6 Vac	SPDT		
6 Vdc	SPDT		
12 Vac	SPDT		
12 Vdc	SPDT		
24 Vac 50/60 Hz	SPDT		
24 Vdc	SPDT	750	**D1PR11T1**
48 Vac	SPDT	720	**D1PR11W**
48 Vdc	SPDT	2600	**D1PR11W1**
240 Vac 50/60 Hz	SPDT	15,720	**D1PR11B**
110 Vdc	SPDT	13,800	**D1PR11A1**
120 Vac	SPDT	4430	**D1PR11A**
24 Vac 50/60 Hz	SPDT	180	**D1PR1T**
Plain Cover			
6 Vac	SPDT	12.2	**D1PR1P**
6 Vdc	SPDT	47	**D1PR1P1**
12 Vac	SPDT	46	**D1PR1R**
12 Vdc	SPDT	188	**D1PR1R1**
24 Vdc	SPDT	750	**D1PR1T1**
48 Vac	SPDT	720	**D1PR1W**
48 Vdc	SPDT	2600	**D1PR1W1**
110 Vdc	SPDT	13,800	**D1PR1A1**
120 Vac 50/60 Hz	SPDT	4430	**D1PR1A**
240 Vac	SPDT	15,270	**D1PR1B**

Installed in electrical room below gym for control of relays in fixtures for low voltage switching.
Low Voltage switches existing in audio control rack in gym.

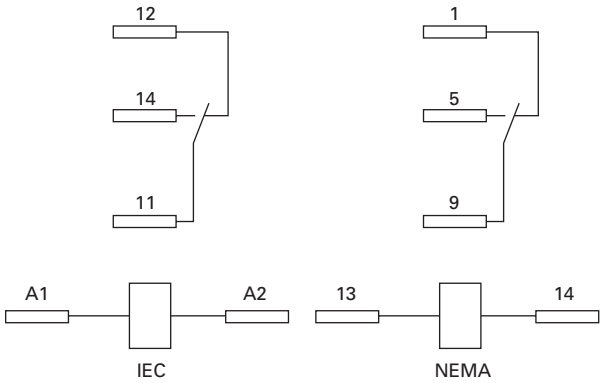
Technical Data and Specifications

D1PF/D1PR Relay Specifications

Description	D1PR	D1PF
Contact Characteristics		
Contact rating	20A	20A
Terminal style	Plug-in	Plug-in
Contact materials	Silver alloy	Silver alloy
Maximum switching voltage	300V	300V
Switching current at voltage—resistive	20A at 120 Vac 50/60 Hz	20A at 120 Vac 50/60 Hz
	20A at 277 Vac 50/60 Hz	20A at 277 Vac 50/60 Hz
	20A at 28 Vdc	20A at 28 Vdc
Switching current at voltage	1/2 hp at 120 Vac	1/2 hp at 120 Vac
	1 hp at 277 Vac	1 hp at 277 Vac
Pilot duty	B300	B300
Minimum switching requirement	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)
Coil Characteristics		
Operating range		
% of nominal (AC)	85 to 110%	85 to 110%
% of nominal (DC)	80 to 110%	80 to 110%
Average consumption	0.9 VA	0.9 VA
	0.7W	0.7W
Dropout voltage threshold	15% (AC)	15% (AC)
	10% (DC)	10% (DC)
Performance		
Electrical life (UL 508) operations at rated current	100,000 operations	100,000 operations
Mechanical life operations unpowered	10,000,000 operations	10,000,000 operations
Response time	20 ms	20 ms
Dielectric strength		
Between coil and contact Vac (rms)	2500V (rms)	2500V (rms)
Between poles Vac (rms)	1500V (rms)	1500V (rms)
Environment		
Ambient air temperature around the device		
Storage	–40° to 131°F (–40° to 55°C)	–40° to 131°F (–40° to 55°C)
Operation	–40° to 185°F (–40° to 85°C)	–40° to 185°F (–40° to 85°C)
Vibration resistance—operational	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz
Shock resistance	10 g-n	10 g-n
Degree of protection	IP40	IP40
Features		
Cover options	Plain cover	Full featured
Features	Mechanical flag indicator (optional LED)	Locking pushbutton/ Bipolar LED/ Removable ID tag/ Mechanical flag indicator
Product certifications	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA

Wiring Diagram

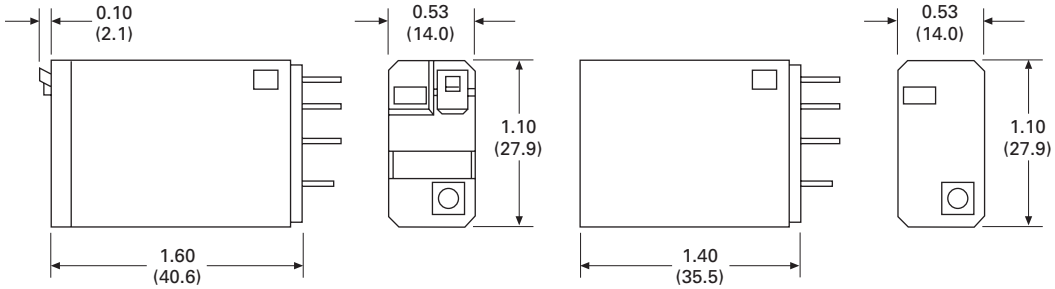
D1PF/D1PR



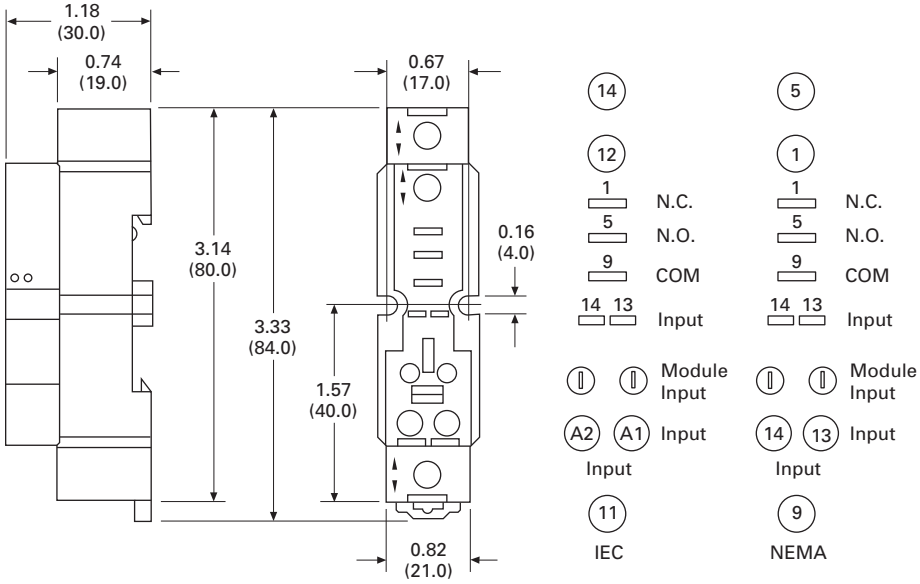
Dimensions

Approximate Dimensions in Inches (mm)

D1PF/D1PR



D1PAA



Appendix B
Key Team Member Resumes

Andrew Williamson, LEED® AP

EDUCATION

- Gonzaga University - B.S. in Mechanical Engineering
- Hogan Entrepreneurial Leadership Scholar

SPECIALTIES

- Performance-Based Contracting
- Project Development
- Energy and Resource Conservation
- Facility Assessment
- Project Financing
- Utility Rebate Negotiation

ACCREDITATIONS

- LEED Accredited Professional

AFFILIATIONS

- Association of Washington Cities
- Washington State Association of Counties

TENURE

Andrew has worked in the industry since 2009.

SALES ENGINEER

As a Sales Engineer at McKinstry, Andrew has helped clients to address variety of their facility needs with the focus on local and state government market place,. He collaborates with customers to optimize building systems performance and reduce energy consumption utilizing performance-based contracting, or a combination of other McKinstry energy and facility services offerings. Andrew's objective is to provide the most effective and efficient solution at the lowest cost. Andrew also is an active member of Washington State Association of Counties.

EXPERIENCE

Municipal
City of Aberdeen
City of Auburn
City of Des Moines
City of Kent
City of Lynnwood
City of Port Angeles
City of Seattle
City of Tacoma
Port of Bellingham
Skagit County
Snohomish County
Thurston County
Woodland Park Zoo
Washington State Department of Transportation (WSDOT)
Department of Ecology

Higher Education
Everett Community College
Peninsula College
Whatcom Community College

K-12
Conway School District

Commercial
Satsop Development Park

Brian Hanson, P.E.

EDUCATION

- B.S. in Mechanical Engineering—University of Idaho (1991)

ACCREDITATIONS

- Professional Mechanical Engineer—Washington (1998)

SPECIALTIES

- Performance-Based Contracting
- Project Development
- Energy and Resource Conservation
- EMCS System Evaluation
- Mechanical Design
- Securing Utility Rebates
- Directed Engineering Studies
- Facility Auditing

TENURE

Brian has worked in the industry since 1991.

SENIOR PROJECT DIRECTOR

Brian Hanson joined McKinstry in 2005. He brings with him over nine years of performance contracting experience and an additional ten years of mechanical design expertise. His performance contracting experience includes data centers, hospitals, laboratory buildings, pools, higher education, K-12 school districts, low rise and high rise office buildings. After graduating from the University of Idaho in 1991, Brian gained mechanical design experience working as a consulting engineer. Mechanical design and code knowledge has been invaluable when performing energy audits and reviewing mechanical and electrical systems. In 1998 he became a Professional Engineer in the state of Washington.

Brian has performed work in Washington, Oregon, Idaho, Hawaii, Virginia, Pennsylvania and New York.

EXPERIENCE

Higher Education Projects

University of Washington
- Smart Grid
- Chilled Water Pressure Independent Control Valves Phase I & II
- 2010 Jobs Act Grant Projects
- Harborview Research & Training
- Tower Lighting Upgrades
- Medical Center – Data Center & Chilled Water Upgrades
- Tacoma Campus – Electrical & Chiller Upgrades
- Chemistry Building

Edmonds Community College

Municipal Projects

King County – Court House and Jail Boiler Installation, Elections Building HVAC Replacement, and Malang Regional Justice Center upgrades
Mountlake Terrace Community Pool
Oregon State - Employment Security Building
Seattle Center – Steam Line Replacement
Seattle City Light – Lighting Upgrades
Seattle Justice Center – Data Center Upgrades
Seattle Parks – Mechanical Upgrades
Seattle Municipal Tower – Data Center Tower replacement & lighting upgrades
Woodland Park Zoo – Feline House HVAC and Electrical Upgrades

Healthcare Projects

Harborview Medical Center – Garage Lighting & Energy Upgrades
Kittitas Valley Community Hospital (Ellensburg)
Odessa Memorial Community Hospital (Odessa)
Providence St. Peter Hospital (Olympia)
Seattle Southeast Health Center – Mechanical Upgrades

K-12 Projects

Highline School District

Dave McClain

QUALIFICATIONS

- Project and Construction Management
- CAD Design and Engineering
- Bulk Material Handling Systems
  - Belt conveyors
  - Screw conveyors
  - Bucket Elevators
  - Pneumatic conveyors
  - Drag chain conveyors
- Power Transmission
  - Bearing engineering and design
  - Gear reducers
  - Electric motors
  - Hydraulic motors
  - V-belt engineering and design
  - Roller chain and sprocket engineering and design

TENURE

Dave has worked in the industry since 1992.

INDUSTRIAL PROJECT MANAGER

Dave McClain holds the position of Industrial Project Manager at McKinstry. Dave has extensive experience with successful planning and execution of entire material handling systems. He is highly skilled in purchase negotiations, CADD, manufacturing and installation processes, supervising installation crews and training.

His expertise continually supports many schools, colleges, hospitals and commercial and industrial customers to successfully implement projects through utilization of his extensive knowledge of industrial systems and construction processes. Unique skills include custom bulk material handling systems and power transmission design. Dave is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations. He strives to design equipment that is cost effective and built with the customer's long term efficient use and maintenance in mind.

Dave is a champion for safety. He commands a safe work environment and models McKinstry's commitment to a safe work site. He maintains annual safety certification in first aid, CPR, asbestos and hazardous material awareness, fall protection and equipment operation.

PROJECT RELATED EXPERIENCE

Pacific Coast Canola, Warden WA: Performed duties of a design engineer as part of our mechanical team on the $98 million construction of the only canola seed crushing and refining plant west of the Rockies in both USA and Canada. Designed, detailed, fabricated and installed 129 chutes and 13 conveyor systems. Served as back-up Site Superintendant. Managed install of all drag and screw conveyors and bucket elevators. Used CADD skills to troubleshoot on site construction issues. Managed union issues and trade disputes. Maintained close communication with Owner and implemented Owner input into design of their equipment.

Tahoma School District, Maple Valley WA: Gymnasium lighting replacements for Sr. High and elementary schools. Complete VAV valve replacements for the Jr. and Sr. High schools during the school year without interruption to schedule. BAC upgrades to the Jr. High.

Enumclaw School District, Enumclaw WA: Complete lighting retrofit for 4 schools. HVAC replacements during compressed time slots.

University Place School District, University Place WA: Complete HVAC replacement and re-roof of elementary school including asbestos abatement. Replaced VAV system and upgraded lighting at middle school. All scope completed during summer break.

Washington Department of Transportation, Tumwater WA: Replaced chiller and used construction savings to build DOT a causeway for their employees.

Washington State Department of Ecology, Olympia WA: Performed the largest LED lighting retrofit in the world at the time for the Lacey Campus. Replaced BAC and security systems for all of Ecology in 8 separate facilities. Installed occupancy BAC and lighting energy savings measures.

North Thurston Public Schools, Lacey WA: Design and delivery of two completely prefabricated boiler buildings with NG boilers. Replaced electric boilers and upgraded VAV system. Retrofitted lighting in the gymnasium and replaced 2 chillers.

City of Aberdeen Jail and Museum, Aberdeen WA: Replaced HVAC units in the jail and upgraded the BAC system in short window prior to winter while not interrupting jail schedule. Added heat and ventilation to the museum.

The Evergreen State College, Olympia WA: Installed heat recovery system to the Lab II building including building controls upgrade. Retrofitted lighting for the pool and 3 gymnasiums.

Thurston County Courthouse and Jail, Olympia WA: Complete lighting retrofit to energy efficient fixtures without interruption of jail and courthouse schedules. Insulation upgrade to repair design flaw in original construction.

Washington State General Administration Building, Olympia WA: Emergency replacement of antiquated and unsafe steam system in time for winter. Asbestos abatement.

Washington State Capitol Campus Steam Plant, Olympia WA: Replaced boiler controls while maintaining steam supply to the Capitol Campus. Rebuilt Carrier chiller. Retrofitted lighting to energy saving units. Upgraded insulation for steam piping.

Washington State Employment Security Building, Olympia WA: Installed new chiller.

Washington State Department of Natural Resources, Olympia WA: Complete retro-commissioning of NRB, re-design of BAC system and integration of NRB to McKinstry's KRC for building monitoring. Re-design of heat recovery system and disconnect from data center that was to be de-commissioned. Repairs to HVAC system to repair issues relating to building inefficiencies.

Hoquiam School District, Hoquiam WA: Remodeled the Hoquiam Middle School including all new HVAC units, Exterior window and siding replacement and new roof. All completed in 3 months.

University of Idaho, Moscow ID: Designed, fabricated and installed a Biomass Fuel Storage Conveyor System for the Chip Storage Facility. System is PLC controlled for automated distribution of wood chips into the 26,000 sq/ft building.

ReKlaim, Boardman OR: Designed, fabricated and installed an automated conveyor system for shredding tires for the pyrolysis process.

Valley Medical Center, Renton WA: $7.3 million Central Utilities Plant, $6.5 million HVAC retrofit to main hospital, $1.2 million DDC installation for new Emergency Services Tower Project, $2.3 million Process chiller and Cooling tower project, $1.1 million Data Center build, $1.1 million misc. projects.

King County Maleng Regional Justice Center, Kent WA: $1.2 million HVAC Energy Upgrade. Included heat recovery repairs. Continuous jail operations and coordination with the staff Major for safe and secure performance of work.

Dave Robinaugh, LEED®-AP

EDUCATION

- Brigham Young University, Bachelor of Science in Construction Management, Minor in Business Management, 2009

ACCREDITATIONS

- LEED Accredited Professional
- OSHA 30
- MCAWW CMPM 1

TENURE

Dave Robinaugh has worked in the industry since 2008.

CONSTRUCTION MANAGER

Dave Robinaugh holds the position of Construction Manager at McKinstry. He is responsible for ensuring the success of projects through oversight and management of resources including labor, equipment, material and subcontractors. Dave's experience in these areas make him capable of guaranteeing quality workmanship, communicating clearly with clients, and meeting the financial commitments of the project.

He has used his expertise to support customers from many groups including schools, colleges, hospitals, and various municipalities.

He has had the opportunity to be involved with many different projects throughout the Puget Sound area, including Anacortes, Port Angeles, Hoquiam, Olympia and Seattle.

KEY EXPERIENCE

✓ Part of the project team for the first ESCO project to be awarded ARRA funding —the City of Burien Community Center Renovation.

PROJECT EXPERIENCE

HEALTHCARE

EST Cold Room, Renton WA
Valley Medical Center - $900,000 – 2009
Construction of new server room in parking level of VMC's new emergency services tower. Project scope included installation of a Liebert cooling system. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor management, equipment procurement, daily construction documentation and construction meetings.

Emergency Services Tower, Renton WA
Valley Medical Center - $1,270,000 – 2009
Commissioning of mechanical and controls systems at VMC's new emergency services tower. Dave acted as project manager on the construction team and assisted the construction manager with, daily construction documentation and construction meetings.

Process Chiller Upgrade, Renton WA
Valley Medical Center - $2,320,000 – 2009
Installation of new chiller and heat exchanger at VMC chiller plant. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor management, equipment procurement, daily construction documentation and construction meetings.

Olympic Cold Room, Renton WA
Valley Medical Center - $1,570,000 – 2011
Construction of new server room in VMC's Olympic Building. Project scope included installation of a Liebert cooling system and TI on the second floor above the server room. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor selection and management, equipment procurement, daily construction documentation and construction meetings.

East Penthouse and Heating Hot Water Upgrades, Renton WA
Valley Medical Center - $2,520,000 – 2011
Installation of a new AHU and upgrade of the heating hot water system. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor selection and management, equipment procurement, daily construction documentation and construction meetings.

East Penthouse Multi-zone Unit Replacement, Renton WA
Valley Medical Center - $1,410,000 – 2012
Installation of a new AHU in a rooftop penthouse. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor selection and management, equipment procurement, daily construction documentation and construction meetings.

Covington Clinic Upgrade, Covington WA
Valley Medical Center - $1,000,000 – 2012
Installation of a new AHU on the roof and a TI in a number of occupied spaces. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor selection and management, equipment procurement, daily construction documentation and construction meetings.

COMMERCIAL
111 South Jackson, Seattle WA
Brickman - $1,420,000 – 2008
Mechanical upgrade as part of a commercial TI. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor procurement, site visits and construction meetings.

CORRECTIONAL FACILITIES
Maleng Regional Justice Center Phase 1, Kent WA
King County - $1,250,000 – 2009
Mechanical upgrade of rooftop units serving a King County prison. Dave acted as project engineer on the construction team and assisted the construction manager with subcontractor management and construction meetings.

Thurston County Phase 1, Olympia WA
Thurston County - $720,000 – 2011
Implemented various measures to produce energy savings at county buildings and jail including a full lighting upgrade, building envelope modifications, motor upgrades and VFD installation. This project was a recipient of ARRA funding. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

MUNICIPAL
Burien Community Center, Burien WA
City of Burien – 1,170,000 – 2010
Renovated old Burien Library for use as the City of Burien Community Center. The scope included a full TI and new mechanical systems. This was the first project in the state to receive ARRA funding. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Port Angeles City Hall, Port Angeles WA
City of Port Angeles - $360,000 – 2010
Installed two new cooling systems at the City Hall to provide conditioned air to underserved spaces and partial conversion from pneumatic control to DDC. This project was a recipient of ARRA funds. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings..

WSDOT Materials Lab, Tumwater WA
WSDOT - $510,000 – 2011
Installed a new chiller and the associated equipment. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Skagit County Phase 1, Mount Vernon WA
Skagit County - $740,000 – 2012
Implemented various measures to produce energy savings at a number buildings throughout the county including lighting and plumbing upgrades, weatherization of doors and windows, and motor replacements. Dave acted as Construction Manager and oversaw design, project finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

K-12 EDUCATION

Hoquiam Middle School Phases 1 & 2, Hoquiam WA
Hoquiam School District - $3,540,000 – 2010 & 2011
Completed a full upgrade of the school including building envelope and window renovation, lighting and mechanical upgrades and conversion of pneumatic controls to DDC. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Anacortes School District Phase 1, Anacortes WA
Anacortes School District - $780,000 – 2012
Implemented various measures to produce energy savings at a number buildings throughout the school district including lighting upgrades, boiler replacement and DDC programming upgrades. Dave acted as Construction Manager and oversaw design, project finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Sedro-Woolley School District Phase 1, Sedro-Woolley WA
Sedro-Woolley School District - $900,000 – 2012
Implemented various measures to produce energy savings at a number buildings throughout the school district including lighting and plumbing upgrades, boiler replacement and DDC programming upgrades. Dave acted as Construction Manager and oversaw design, project finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Marysville School District Phase 3, Marysville WA
Marysville School District - $620,000 – 2012
Completed a lighting upgrade at a number buildings throughout the school district. Dave acted as Construction Manager and oversaw design, project finances, subcontractor

selection and execution, equipment procurement, daily construction activities and led all construction meetings.

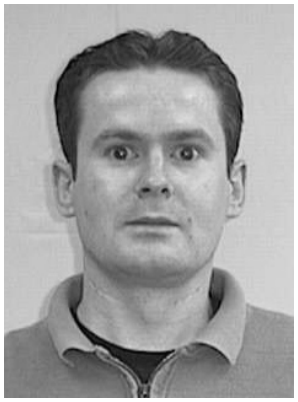
HIGHER EDUCATION

Peninsula College Phase 1, Port Angeles WA

Peninsula College - $590,000 – 2011

Implemented various measures to produce energy savings at the science and technology building including installation of a heat recovery system on their 100% outside air system and addition of VFD on exhaust fan motors. This project was a recipient of WA State Jobs Act funding. Dave acted as project engineer on the construction team and managed design, finances, subcontractor selection and execution, equipment procurement, daily construction activities and led all construction meetings.

Gerry Galvin, P.E.



EDUCATION

- University of Dublin – Bachelor of Science in Building Services Engineering
- SMACNA Project Management Training
- Certified Mechanical Project Manager—MCA of Western Washington

ACCREDITATIONS

- Professional Engineering License, Mechanical Engineering, Wa

SPECIALTIES

- Performance Based Contracting
- Project Development
- Construction Management
- Value Engineering
- Risk Mitigation
- Scheduling Budgeting/Estimating
- Scope Coordination
- Cost Control
- Project Closeout

TENURE

Gerry has worked in the industry since 1994.

SENIOR PROGRAM MANAGER

Gerry holds the position of Program Manager at McKinstry. Gerry is responsible for project development, scheduling, team communication, and overall program management. In addition to the responsibility of developing and maintaining project budgets and project schedules, the main role as a Program Manager is to implement staff and resources to complete projects through all stages. Todd's experience in these areas makes him capable of making critical decisions across disciplines.

Gerry has significant experience in developing projects with K-12, universities and municipal clients. Gerry also has over 10-years of construction management experience both as prime contractor and as mechanical subcontractor.

Gerry's expertise has supported many schools, colleges, universities, hospitals, commercial and retail customers by taking responsibility for a variety of aspects in the project, from business development to developing fee proposals and contracts. Being a leader is a critical and an important qualification in this process. Gerry has managed multiple teams and projects of various scopes of work and delivery types.

PROJECT EXPERIENCE

Higher Education

The Evergreen State College – Biomass Plant Development
The Evergreen State College – ESCO Phase 2

Commercial

Park Place LEED Platinum Project – Rain Water Harvesting

Municipal

City of Burien New Community Center
City of Everett Energy Conservation Projects at the Service Center & Police HQ
City of Lynnwood Waste Water Treatment Plant
King County Elections Building Energy Upgrades

K-12

Federal Way Public Schools – ESCO Phase 2 & 3
Highline Public Schools – ESCO Phase 2
Stanwood-Camano SD Energy Conservation
Mukilteo SD Energy Conservation
Tahoma SD Energy Conservation
Mukilteo SD Energy Conservation
Tahoma SD Energy Conservation
Tukwila SD Energy Conservation
Stanwood-Camano SD Energy Conservation

Heather Helgen, CCM, LEED AP

EDUCATION

- University of Washington, BS Construction Management, 2002

ACCREDITATIONS OR AFFILIATIONS

- CCM (Certified Construction Manager); 2010
- Member - Construction Management Association of America (CMAA)
- LEED ® Accredited Professional; 2005
- MCAWW (Mechanical Contractors Association of Western Washington)
- UW Alumni

QUALIFICATIONS

- OSHA-10 Certified
- CPR/First Aid Trained
- Performance-Based Contracting
- Constructability Review
- Contract Negotiation & Risk Management
- Schedule & Planning Analysis
- Estimating & Financial Management

TENURE

Heather has worked in the industry since 1999.

CONSTRUCTION MANAGER

Heather Helgen holds the position of Construction Manager at McKinstry. Heather is responsible for managing energy projects for both public and private clients from pre-design, design, construction, closeout, commissioning and measurement & verification for energy rebates. Heather's experience in these services allows her the capability of making critical decisions across disciplines. Heather joined the McKinstry team in 2007.

Her expertise has supported many schools, colleges, universities, commercial, and industrial customers by managing construction projects to meet the needs of each individual client. Heather also has extensive experience working in existing, operational facilities— upgrading existing systems while maintaining complete facility operations. Heather is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

She has had the opportunity to be involved with many of the most interesting projects throughout the Pacific Northwest.

KEY EXPERIENCE

- ✓ Work on 1st Automated Demand Response Project in the Pacific NW with LBNL, BPA and SCL.
- ✓ Worked around live animals (large Felines) during a boiler change out at Woodland Park Zoo.
- ✓ Worked in multiple high rise buildings in downtown Seattle while fully occupied (night work, daily clean-up to ensure tenants are not disturbed, logistics to complete work on each tenant floor and accurate scheduling for complete tenant notice).

PROJECT RELATED EXPERIENCE

City of Seattle – Fleets and Facilities – Seattle Municipal Tower Lighting:
Managed Design, Procurement and Installation of complete lighting replacement (over 10,000) light fixtures. Kept construction on schedule and under budget, returning savings to owner. Challenges involved working night shift in occupied spaces through 60 floors of a high rise building. Scheduling had to be exact to make sure fixtures were delivered and each tenant was notified well in advance of the precise dates we would be in their spaces. Project resulted in Energy Savings of over 1.6 million kWh per year. January 2008 – January 2009.

City of Seattle – Seattle City Light – Boundary Dam Lighting Retrofit:
Lighting Retrofit at Boundary Dam (NE corner of Washington State). Managed design, construction and closeout of unique lighting retrofit in 8-10 of the buildings at Boundary Dam including the large carved out rock tunnels and flood lighting over the spillways for a unique safety challenge. Resulting energy savings exceed 280,000 kWh per year. April 2009 – April 2010.

City of Seattle – Seattle Center:
Managed (3) separate projects at Seattle Center in 2008 and 2009. Replaced the chilled water control valves with Delta P valves in (4) of the buildings on campus. Work was over occupied areas and was challenging to get to valves. The larger valves weighed more than 200 lbs. Also managed Phase I and Phase II of Steam Line Joint Repairs. This involved the unique challenge of digging up existing Steam line (approx 10' underground)

with a water type excavation system due to the excessive amount of other utilities above the steam line.

City of Seattle – Seattle City Light Substations Ph I, II, III.
Lighting Retrofits in (13) of the Seattle area substations over 3 years (2008, 2009, and 2010). These projects involve the distinctive challenge of working in a substation with very high voltage electrical hazards –more so then most other sites. Safety is of upmost importance. Most of the substations were built in the 1950's so the lighting retrofits brought lighting levels to current standards and also helped save energy in each of the stations.

Woodland Park Zoo Feline House Energy Upgrades Ph I:
This project posed required the team to perform work inside the zoo's Feline House with the zoo keepers and live animals (lions, tigers, a sloth bear, a geriatric leopard, wild dogs, and Komodo Dragons). Due to the nature and noise of demolishing the existing boilers, installing new boilers, and installing piping near the inside cages of the animals, the McKinstry team had to exercise particular care and caution during all project phases. The Komodo Dragons have to be kept at a temperature of 90 degrees, so the McKinstry team had to have measures in place when removing boilers to ensure the animals' heating source was not removed. We also did a complete electrical service replacement in this building while replacing the boilers with energy efficient models to help the zoo bring their utility bills down and upgrade the 1950's boilers that were in place.

Seattle University:
Chiller Plant Replacement, Roofing and Heat Pump Replacement, Bannan Hall Labs, Digital Music Lab Studio Space, Facilities Building Phase I & 2. Construction Manager for multiple projects at Seattle University campus starting in January 2008 through present. Projects on campus pose the challenge of working in occupied spaces with students on campus. The chiller replacement project had a very tight timeline and involved over 25 pipefitters working in a mechanical room to make sure the chiller plant was online before cooling season. The Facilities building involved over $ 3 million of total scope – plumbing, HVAC, data/communications, electrical, fire sprinkler, fire alarm system, DDC controls, commissioning, and test and balance. One of the projects involved converting a 1920's era building, formerly a Coca-Cola bottling factory and a Qwest Data Center, into the HUB for Seattle University Facilities . This individual project required bringing the building up to current Seattle Energy Code.

Washington Holdings - Two Union Square – VAV & Automation Project:
Construction Manager responsible for multiple trades (HVAC, electrical, low voltage control wiring, and DDC). Project involved replacing over 1400 fan powered VAV boxes throughout 56 floors of a Class A+ office high rise. Challenges included lack of existing TI drawings to facilitate engineering and ability to schedule boxes and proper zoning and CFM. Building is 99% occupied with very high-end tenants. Scheduling was done daily with tenant services and work was performed at night with clean-up done before tenants arrived in the AM. Crews installed 5-7 boxes each evening with very tight ceiling space and difficult logistic constraints.
June 2009 – February 2011.

Unico Properties – Financial Building – Cooling Tower Replacement:
Construction Manager for replacement of cooling towers on roof of 30 story building in downtown Seattle. Challenges include the unique nature of the crane pick and the logistics for getting new equipment into the mechanical space on 29th floor of building. The project required expedited procurement time to make sure cooling towers were

online before April 30th.
March 2010 – May 2010.

Lawrence Berkeley National Laboratory / Bonneville Power Company / Seattle City – Light Open ADR (Automated Demand Response):
Construction Manager for 1st ever ADR project in the Pacific Northwest. The lab (LBNL) has done research on projects of this nature in California over the last few years, but this was the first "winter" application done. Once Phase I was successful, Phase II was a "summer" application. Challenges included getting DDC contractors for each of the buildings up to speed (new technology) and owners to "buy in" on the project. BPA and SCL funded the project, so building owners were not burdened financially.
January 2009 – January 2010.

City of Seattle – Volunteer Park:
Construction Manager for design, subcontracting, construction and Cx phase of this project. Project included new irrigation throughout 100+ year old Seattle park (over 48 acres) and upgraded pump house and irrigation control for water savings.
May 2008 – April 2009.

City of Seattle – Fleets and Facilities – SE Health Center Heat Pump Replacement:
Construction Manager for all phases of this project including design, procurement, construction, Cx and closeout, along with M&V 1 year later. Project involved changing out heat pumps on roof of 2 story health center/doctor's offices. Challenges included working within an occupied building and having to maintain airflow to spaces during construction. Poor original design of HVAC system proved to be another challenge with balancing and DDC control.
January 2008 – April 2008.

City of Phoenix – Job Order Contract I – Phoenix, Arizona:
Project Manager for this job order contracting program that provides at-risk, design-assist and construction services for the City's Parks, Downtown/Urban and Fire/Police departments. Services include medium to large sized new and remodeling construction projects throughout the City. Maximum single project size $2 million.

City of Phoenix – Job Order Contract II – Phoenix, Arizona:
Project Manager for this job order contracting program providing at-risk, design-assist and construction services for the City of Phoenix. Services include medium to large sized new and remodeling construction projects. Maximum single project size $2 million.

Mohave Educational Services – Cooperative Job Order Contract – Arizona:
Project Manager for this state-wide job order contracting program providing at-risk, design-assist and construction services for small to medium projects covering a wide variety of trade disciplines. Maximum single project size $1 million.

Maricopa County Community College – District Job Order Contract I – Tempe, Arizona:
Project Manager for this job order contracting program providing at-risk services for MCCCD's campuses. Services encompass small to medium sized construction projects including remodels, alterations, rehabilitations, repair and maintenance of the facilities. Maximum single project size is $2 million.

Greater Tacoma Convention & Trade Center – Tacoma, WA:
Project Engineer on this new 439,671 square foot design-build project worth $60 million.

University of Washington Tacoma – Tacoma, WA:
Project Engineer for mechanical contractor for this historical renovation of two campus buildings totaling 133,000 square foot with project costs of $40 million.

University of Washington – Recreational Facility – Seattle, WA:
Project Manager for mechanical contractor on this 95,000 square foot addition plus remodeling to the existing 141,000 square foot recreational facility.

Grand Elliott Hyatt Hotel – Seattle, WA:
Project Engineer for mechanical contractor on this new 425 room hotel in downtown Seattle including tenant improvements to the restaurants and storefronts.

Jonathan Schwenke

EDUCATION

- University of Arizona
  B.S., 2005
- IES Certification ED 100 & 150

AFFILIATIONS

- IESNA
- IALD

REFERENCES

PAUL KOCH
Tacoma PS
253.571.3325

JERRY WRIGHT
Seattle City Light
206.684.3360

ARTHUR VAN GELDER
CED
206.706.4929

QUALIFICATIONS

- Performance-Based Contracting
- Project Development
- Lighting & Control Design
- Energy Analysis
- Education and Training
- System Evaluation
- Code compliancy

TENURE

Jonathan Schwenke has worked in the industry since 2007.

LIGHTING ENGINEER

Jonathan Schwenke holds the position of Lighting Engineer at McKinstry. Jonathan is responsible for analyzing lighting systems and proposing energy efficient, aesthetically accepted lighting solutions. Jonathan's experience in these services allows him capable of making critical decisions across disciplines.

His expertise has supported many schools, colleges, universities, hospitals, commercial and industrial customers by leveraging experience in efficient design, negotiating cost structures, utility rebates and streamlining the installation approach. Jonathan is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

Jonathan also serves as a founding member of the Emerging Professionals Program through the IES, which fosters the development of lighting designers and engineers.

KEY EXPERIENCE

- ✓ Innovative design experience applying new technology in existing buildings

PROJECT EXPERIENCE

Western Washington University: Campus-wide energy analysis focused on streamlining the Universities lighting maintenance approach. This project also included applying cost affective lighting control strategies. The lighting portion of this project is projected to decrease the Universities utility budget by $71,156.

Qwest Field: Developed a comprehensive lighting upgrade plan intended to reduce energy consumption by 50% by using energy efficient lighting and smart control strategies that would still maintain the original aesthetics of the facility.

North Shore School District: District wide lighting upgrade focusing on simple cost effective upgrades to full scale redesigned solutions. Phase 1 of the lighting project will save the District over $124,000 annually.

Evergreen State College: Addressed maintenance safety issues by redesigning the pool lighting, which decreased energy usage in the space by 50% but increased light levels and general aesthetics. The phase also including Gym lighting upgrades with controls.

Seattle City Light Substations: Existing system analysis and design in a critical environment. Developed a lighting upgrade plan focused on safety, energy efficiency and ease of maintenance on both exterior and interior lighting.

Qwest Field: Developed a comprehensive lighting upgrade plan intended to reduce energy consumption by 50% by using energy efficient lighting and smart control strategies that would still maintain the original aesthetics of the facility.

City of Seattle: Analyzed over 30 City owned facilities from recreational to industrial to develop upgrade strategies that would produce the most attractive ROI.

Skagit County: Critical environment and office space lighting redesign with the primary focus of reducing maintenance cost and standardizing lamp replacement types to reduce lighting inventory.

Justin Fallstrom

EDUCATION

- University of Washington

Bachelor of Science, Construction Management 2002

SPECIALTIES

- Performance-Based Contracting
- Project Development

TENURE

Justin has worked in the industry since 1999. He joined McKinstry in 2008.

SENIOR CONSTRUCTION MANAGER

Justin Fallstrom holds the position of Senior Construction Manager at McKinstry. He provides each project with specialized expertise resulting in success with the focus of delivering client satisfaction.

His expertise has supported county government, schools, hospitals, and commercial customers by leveraging hard-cost annual operational and utility savings in desperately needed facility upgrades. Justin also has extensive experience working in existing, operational facilities upgrading existing systems while maintaining complete facility operations. He is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs through various energy services offerings while maintaining existing operations.

EXPERIENCE

Harborview Medical Center - Inpatient Expansion Building, ED Remodel Operating Room Fan Replacement, Energy Upgrades

Valley Medical Center – Multiple Air Handler Replacements, Data Center, Lighting Upgrades

Safeco Field – Lighting Upgrades, Water Reduction, Retro-Commissioning, Energy Improvements

King County Elections Building — Energy and Envelope Upgrades

King County Courthouse — Energy Upgrades & Heating Plant Installation

King County Correctional Facility — Energy Upgrades & Heating Plant Installation

Mukilteo School District Phase, multiple phases

Edmonds School District Controls Upgrades, multiple phases

Lake Washington School District - Energy Upgrades, Solar Installation

Logan Building

Boeing Employees Credit Union

VMWare Data Center

AT&T Wireless

Katie Rossmann, P.E., LEED AP

EDUCATION

- Marquette University
  Bachelor of Science Mechanical Engineering, 2003

ACCREDITATIONS

- Professional Engineer - Mechanical CA, 2008
- LEED Accredited Professional 2006

AFFILIATIONS

- Member, ASHRAE

QUALIFICATIONS

- Mechanical Design for Remodels and New Construction
- Energy and Resource Conservation
- Sustainable Building Design
- LEED New Construction (NC) and Existing Buildings (EB)
- IES Modeling Software

TENURE

Katie has worked in the industry since 2006.

ENERGY ENGINEER

Katie combines HVAC design experience on new and retrofit construction with energy systems evaluation and analysis. She provides each project with specialized expertise resulting in success-oriented focus on both the project and client satisfaction. Katie is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs through various energy services offerings.

KEY EXPERIENCE

- ✓ Performed ventilation modeling with IES software to inform Natural Ventilation design strategies.
- ✓ Designed a number of radiant floor and beam systems for community centers, museums, schools and office buildings.

PROJECT RELATED EXPERIENCE

Southern Ute Cultural Center and Museum
Suquamish Community House
Suquamish Museum
UW Ethnic Cultural Center
Les Gove Community Center
St Thomas School
Decade House
Oregon Department of Transportation Office Building
Terry Thomas Office Building
Islandwood Phase 2
Western Washington University Academic Instruction Center

Kristina Sing, P.E., LEED® AP

EDUCATION

- University of Washington B.S. Mechanical Engineering, 1993
- Sustainable Building Advisor Program (2003)

ACCREDITATIONS

- P.E., Mechanical Engineer, Washington, Idaho, Wyoming
- LEED® Accredited Professional
- Certified Sustainable Building Advisor

SPECIALTIES

- Mechanical Design for Remodels and New Construction
- Performance-Based Contracting
- Energy and Resource Conservation
- Sustainable Building Design
- LEED® New Construction (NC) and Existing Buildings (EB)

REFERENCES

Available upon request

TENURE

Kristina has been working in the industry since 1994.

ENGINEERING MANAGER

Kristina Sing joined the McKinstry team in August 2005, bringing experience from both energy services and mechanical design. Kristina's experiences encompass a wide range of clients including: hospitals, military, universities, the State of Washington, the State of Oregon, Port of Seattle, municipalities, and private clients. These experiences inform her current responsibilities at McKinstry as a Engineering Manager dedicated to providing and coordinating design efforts for Energy Services HVAC system upgrades, chilled water, heating water and steam plant master planning, natatorium HVAC upgrades and replacements, performance contracting energy audits and design. Kristina is a Certified Sustainable Building Advisor and LEED® AP, ensuring an element of sustainability with every project.

EXPERIENCE

FEDERAL

Thomas S. Foley US Federal Courthouse, Spokane WA

GSA/Lydig+McKinstry Joint Venture **- $10,000,000** – 2009-2012

Replaced all major mechanical systems, electrical infrastructure and lighting in a fully occupied 300,000+ sqft federal courthouse. Project included a full renovation of the second floor for the U.S. Marshal Service including dedicated mechanical systems with VAV air handler, VAV terminal units and heat recovery. Mechanical system upgrades included: DDC upgrade, replacement of nearly 700 fan coil units located in occupied spaces, replacement of 11 major supply fan systems with fan wall air handlers, replacement of 5 return fan systems, replacement of rooftop cooling towers, replaced a steam plant shared by the USPO with a high efficiency condensing heating water boiler plant dedicated to the Foley Courthouse. Kristina was the stamping mechanical engineer overseeing all of the mechanical design; this project was unique in that it was completed as a design-build project and included a maximum construction cost guarantee and an annual energy use guarantee of 43 EUI. This project required significant coordination as the design was delivered in 14 individual design packages to facilitate an aggressive construction schedule and phased construction approach. Since the building was fully occupied, the air handlers had to remain in operation while the new air handlers were installed. The project is currently in the measurement and verification phase of the project and is on target to meet the energy guarantee.

United States Post Office, Spokane WA

GSA/Lydig+McKinstry Joint Venture **- $400,000** – 2009-2012

Scope included replacing three steam boilers that served both the USPO and the Thomas S Foley Courthouse with a high efficiency condensing heating water boiler plant dedicated to the USPO. The system was converted from steam to hot water requiring the replacement of several steam coils in existing air handlers. The existing boiler stack was replaced to accommodate the new condensing boilers. Due to the historic nature of the USPO, special attention was required to install a new boiler flue while maintaining the historic characteristics of the building. Kristina was the stamping mechanical engineer overseeing all of the mechanical design; this project was unique in that it was completed as a design-build project and included a maximum construction cost guarantee.

Additional Design projects for Federal clients include:

- Fort Lewis Army Post: Underground Storage Tank Remediation Plan, Boiler/Chimney Lining, Office HVAC Upgrade, and PX HVAC Upgrade

Yakima Firing and Training Center MATES Facility HVAC and Plumbing

STATE GOVERNMENT

Highway Licenses Building Washington State Capital Campus, Olympia WA

*WASHINGTON STATE GA/MCKINSTRY – $**2.6M** – 2008 – 2009*
Pressurization issues plagued this building for 15-20 years. Multiple contractors tried to alleviate the issue to no avail. McKinstry approached the project holistically understanding the building and mechanical systems. Through this systematic approach, McKinstry was able to provide a solution that included fan replacements, duct modifications and control upgrade/optimization. Kristina was the stamping engineer and oversaw the analysis and design of this system. This project is an example of the systematic and holistic approach that we approach each and every project.

HIGHER EDUCATION

Seattle University Loyola Boiler Plant, Seattle, WA

*Seattle University/McKinstry – **$650k** – 2011 – 2012*

This project combined two hydronic campus loops served by a combination of boilers and district steam serving 9 buildings to a single dedicated campus high efficiency condensing boiler plant. This was a very challenging project that required a holistic approach to analyze multiple hydronic systems and combine them into a single efficient and optimized system. Kristina was the stamping mechanical engineer overseeing all of the mechanical analysis and design.

Additional Design projects for colleges and universities include:

- University of Washington MHSC Chilled Water Study and K-Wing Fume Hood Study
- Central Washington University (CWU) Chilled Water & Steam Master Plan, Central Plant Upgrades, and Science Building, Hebeler Hall, Lind Hall Lab
- Oregon State University Sacket Hall ESCO Project, Heating Upgrades
- Bellevue Community College Office Building Water Source Heat Pump Replacement and Ventilation Upgrades
- Renton Technical College Health Building HVAC Replacement
- South Puget Sound CC Automotive Shop &
- Welding Shop HVAC

K-12 PROJECTS

University Place SD Sunset Elementary Mechanical System Upgrade
University Place SD Curtis High School Science Building HVAC Upgrade and Chiller Replacement
Northshore SD Wellington Elementary School Mechanical System Upgrade
Northshore SD Woodin Elementary School Boiler Replacement
Juanita High School HVAC Upgrades
Hiram G. Andrews Center Vocational Facility Central Plant and HVAC Upgrade

MUNICIPAL PROJECTS

Mountlake Terrace Recreation Pavilion (Swimming Pool)
Echo Glen Children's Center Swimming Pool HVAC Replacement
City of Fife Swimming Pool Natatorium & Locker Room HVAC Upgrades
Port of Seattle Delta Communications Room Remodel

Port of Seattle United Airlines Ready Room Remodel
Seattle Municipal Tower Condenser Water Loop Fluid Cooler
Washington State GA Office Building Two (OB2) Mechanical System Upgrade
King County Steam Audit
Department of Transportation Chiller and Cooling Tower Replacement
City of Salem Employment Building
Bellevue Fire Station HVAC Remodel & Vehicle Exhaust
City of Kent ESCO

HEALTHCARE PROJECTS

Providence St. Peter Hospital Central Plant Upgrade
Kittitas Valley Community Hospital
American Lake VA Hospital Fire Sprinkler Upgrades (Bldgs 4 & 6)
Veterans Admin HVAC Cath Lab Remodel
Marina Veterinary Clinic HVAC Design/Build

COMMERCIAL PROJECTS

PSNS Office Building Renovation
Avista General Office Building Upgrades
Harmon Building HVAC Design/Build
K & L Distributors HVAC Design/Build for Warehouse and Office Space

Mark Foster

EDUCATION

- University of Washington - B.S. in Mechanical Engineering
- Western Washington MCA - Certified Project Manager

SPECIALTIES

- Performance-Based Contracting
- Project Development
- EMCS System Evaluation & Optimization
- Energy and Resource Conservation
- Facility Assessment
- Project Financing
- Utility Rebate Negotiation

TENURE

Mark has over 10 years of industry experience.

ACCOUNT EXECUTIVE

Since entering the industry nearly ten years ago, Mark has helped clients to address their facility needs. He collaborates with customers to optimize building systems performance and reduce energy consumption, is dedicated to the K-12 market place, and is an active member of CEFPI and WAMOA. He collaborates with clients to optimize building systems performance and reduce utility consumption. Utilizing performance-based contracting, or a combination of other energy and facility services McKinstry offers, Mark's objective is to provide the best total solution at the lowest cost.

EXPERIENCE

Amgen
City of Kent
Clover Park Technical College
Coupeville School District
Enumclaw School District
Federal Way Public Schools
King County
Lake Washington School District
Marysville School District
Monroe Public Schools
Mukilteo School District
Olympic Medical Center
Peninsula College
Providence St. Peter Hospital
Saint Joseph Medical Center
Tacoma General Hospital
The Evergreen State College
U.S. Environmental Protection Agency
Washington State History Museum
Wenatchee Valley College

Mark Nieman, P.E.

EDUCATION

- Washington State University, B.S. in Mechanical Engineering, 1993
- Washington State University, Minor in Math, 1993
- University of Washington, HVAC Continuing Education

ACCREDITATIONS

- Professional Engineer – Washington
- ASHRAE Member

SPECIFIC QUALIFICATIONS

- Sr. Energy Engineer
- Energy Modeling
- Energy Rebate Coordination
- Project Engineer
- Indoor Air Quality through HVAC Systems
- Plumbing Engineering Design
- System Selection and Design
- HVAC
- Process HVAC Piping
- CAD Technician

TENURE

Mark has over 17 years of industry experience.

SENIOR ENERGY ENGINEER

Mark Nieman joined the McKinstry team in December 1997. Mark's work at McKinstry involves energy engineering and mechanical engineering and design involving piping and HVAC. His experience includes energy engineering, detailed engineering plans, and equipment selection for offices, data centers, schools, hospitals, and campus systems.

Mark is a Senior eQUEST/DOE 2 modeler for McKinstry and was a team member in past eQUEST development (programming of quality control, engineering check module). He has previous experience modeling with Trace 600 & 700.

KEY ENERGY MODELING EXPERIENCE

- ✓ Seattle Columbia Tower (74 stories & office space) heat pump energy model
- ✓ Wells Fargo Building (320,000 sq. ft. high rise office) eQUEST model for HVAC upgrades and retrofits
- ✓ King County Courthouse (568,500 sq. ft. high rise historic building) eQUEST energy model for heating plant upgrades
- ✓ Fortune 50 Technology Company Building 97 (large 4-story office) LEED model
- ✓ City of Seattle eQUEST model of data center within high rise office building
- ✓ City of Seattle AWCA Building (historic building, current use as office, building used to be a slaughter house) HVAC upgrades
- ✓ UW Loew Hall (99,300 sq. ft.) and Odegaard Library (165,973 sq. ft.) retrofits: Sr. Energy Engineer supervising the model
- ✓ Many other non-office, low to mid-rise building modeling

EXPERIENCE

Municipal

City of Auburn – Sr. Energy Engineer, performed energy study for future HVAC system upgrades

City of Burien Community Center – Sr. Energy Engineer, performed study that let to retrofit and conversion of old Burien Library to new Community Center

City of Lynnwood WWTP Energy Study – Sr. Energy Engineer

City of Seattle – Sr. Energy Engineer, performed energy study that lead to upgrades to the Seattle Municipal Tower IT condenser system

King County Environmental Lab – Sr. Energy Engineer, performed energy study for future HVAC system upgrades

King County Courthouse – Sr. Energy Engineer, principal energy modeler for project that converted the heat source to a local boiler plant

Maleng Regional Justice Center – Sr. Energy Engineer, performed multiple energy studies that lead to upgrades of the HVAC system and heat recovery systems

WA DSHS and WA DOT Headquarters – Energy Engineer, performed energy study that led to upgrade in CHW plants and HVAC systems

Washington State GA:

Capitol Court Controls Upgrades – ESPC project
Capitol Campus Water Upgrades – ESPC project including water conservation including new fixtures and coordinating irrigation audit and upgrades
Legislative Building and Governor's Mansion Energy Study – ESPC study (no construction)
O'Brien Building – Design Peer Review team responsible for reviewing and commenting on energy improvements by third party design team
Power House – ESPC projects including chiller upgrades, steam boiler upgrades and chilled water control valve upgrades in historic building campus

Higher Education

Highline Community College – Energy Engineer, performed energy study that led to boiler plant upgrades
Pierce College Energy Survey
University of Washington – Sr. Energy Engineer, performed multiple energy studies that lead to upgrades to the campus CHW system and various building HVAC upgrades
Washington State University

Healthcare

Harborview Medical Center – Sr. Energy Engineer, performed multiple energy studies for future HVAC and plant upgrades.

Residential

Summit at First Hill – Designer of HVAC systems for high-rise retirement condominium

Commercial

Cascade Natural Gas Corporate Offices – Designer for HVAC system upgrades
DanKa Tenant Improvement
Lease Crutcher Lewis: Holyoke Building, design/build, Project Engineer, 8-10 story old brick building near Pioneer Square, remodel of basement into meeting space, archives and hoteling spaces
McKay Office Tower
Mountlake Terrace Corporate Center – Designer of HVAC system
Museum of Flight Energy Rebates
Pacific Science Center: ESPC study for upgrading HVAC and controls systems, historic site (1962 World's Fair), Lead Sr. Energy Engineer, also involved with Sustainable Committee, working on 50 year vision of the Science Center
Puget Power 24-hour Customer Service Center – Designer of HVAC system
Safeco Region Building – Site Project Engineer
SBRI Energy Rebates
Siemen's Tenant Improvement
Sterling Plaza Phase II Office Building – Designer for HVAC system
Westin Building Energy Rebates

Industrial

GM Manufacturing Plant
Metawave

Data Centers
Colo. Com
Safeco Data Center – Designer for HVAC system

K-12
Edmonds SD
Evergreen SD
Federal Way SD – Energy Engineer and Designer, performed energy study and designed HVAC system upgrades
Kennewick SD
Port Angeles SD
Tacoma SD – Energy Engineer, performed multiple energy studies that lead to HVAC system upgrades
Vancouver SD

Matt Montagner, P.E.

EDUCATION

- Ohio State University, 1995, B.S. Mechanical Engineering
- Professional Mechanical Engineer - Washington

ACCREDITATIONS

- Professional Mechanical Engineer, Washington
- ASHRAE

SPECIALTIES

- Energy Engineering Studies
- Energy Simulation
- Energy Auditing
- Facility Assessment
- Building Optimization
- Boiler Systems
- Chiller Plant Optimization
- Commissioning

TENURE

Matt has over 13 years of industry experience.

Matt Montagner joined McKinstry in March of 2008 with experience in audit and design management for energy conservation projects. Matt's primary roles include identifying facility improvement measures, performing energy savings calculations, utility data analysis, utility rebate support, and preparing directed engineering studies. Additional responsibilities include developing scopes of work, sequence of operations, and coordinating with sub-consultants during design phase and construction. As an Energy Engineer, Matt investigates specific needs in a facility and develops cost effective facility improvement measures to address the identified needs.

EXPERIENCE

University of Washington William Gates Hall
University of Washington Irrigation Deduct Meters
University of Washington Research and Training Building
Harborview Medical Center
Nike Factory Stores ITS
Waste Management Energy Services Project
City of Kent: Energy Services Project
City of Kent: Kent Meridian Pool
City of Seattle: Seattle Justice Center
WA GA: Employment Security Building
Marysville School District
Tahoma School District
Tukwila School District
Seattle School District: McClure MS
Edmonds School District

Mike Dean

EDUCATION

- University of Washington - B.S. in Mechanical Engineering
- North Seattle Community College - A.A.S. in Electrical Power & Controls/A.A.S. in Digital Electronics
- Steam Engineers License—City of Seattle

ACCREDITATIONS

- WAMOA

ACCREDITATIONS

- Project Development
- Performance-Based Contracting
- Energy and Resource Conservation
- Large Campus Systems Analysis
- EMCS System Evaluation & Optimization
- Complex System Analysis and Design
- Project Financing
- Utility Rebate Negotiation
- Energy Analysis
- Facility Auditing

TENURE

Mike Dean has over ten years of industry experience.

BUSINESS DEVELOPMENT DIRECTOR

Mike Dean started with McKinstry in July 2003. As Project Development Manager he is responsible for the successful and efficient execution of McKinstry's projects.

Mike is committed to his clients and provides them with a wide range of innovative and proven solutions to improve their facilities while conserving resources and improving the environment. With Mike as the link between the owner and the project design and construction teams, project expectations are typically exceeded. Mike has successfully completed projects that range in value from $50,000 to $7,000,000 and span the classifications from simple systems to highly complex critical operations systems. He works closely with the owner to ensure that projects are optimized to the greatest extent possible, providing the owner with improved systems while reducing future cost impacts over multiple budget classifications.

EXPERIENCE

Federal Way School District
Puyallup School District
Tacoma School District
Fircrest School
Seattle Central Community College
Spokane Community College District
Lake Washington Vocational Technical College
DIS Heat Recovery
Kitsap County Energy Audit
Natural Resources Building Lighting Controls
L&I Building Lighting and Controls Retrofit
Sheraton Hotel Ballroom Lighting Replacement
Sheraton Hotel HVAC System Upgrades
Eastern State/Lakeland Village
City of Seattle Water Audits
Omaha VA Medical Center

Norman Foster, PhD., P.E.

EDUCATION

- University of Washington, Doctor of Philosophy in Chemical Engineering, 1979
- Oregon State University, Bachelor of Science in Chemical Engineering, 1969

ACCREDITATIONS

- Licensed Professional Engineer (Chemical) in the State of Washington 1980
- American Oil Chemists' Society

ACCREDITATIONS

- Commissioning, Start Up and Operation of Chemical Plants
- Project Management
- Chemical Process Design and Engineering
- Industrial Equipment Sizing and Specification
- Operations Plans and Procedures
- Operational Audits
- Training Programs

TENURE

Norman has over 39 years of experience in the chemical process industry, including process development, PFD and P&ID development, chemical plant design, commissioning, start-up and operation. Most recently, he has completed commissioning of a waste tire reclamation facility that recovers oil, steel, and carbon black from used tires.

CONSTRUCTION MANAGER

Norman's expertise includes design and engineering of industrial and chemical facilities; commissioning, start-up and operation of industrial facilities, process equipment and chemical plants; and Project Management on a variety of installations including power plants, fuel storage facilities, chemical plants, pharmaceutical plants, and health care facilities. He has written plant-operating plans, operating procedures, emergency procedures, safety plans, Hazardous Waste Management Plans, and he worked with governmental agencies to obtain industrial operating permits. He has also designed and implemented training programs for industrial facility operators and supervisors.

Norman is the author of one U.S. patent, five book chapters, has presented, and published ten papers. Norman works out of our Seattle office and will have the time necessary to ensure project success.

EXPERIENCE

Reklaim Technologies
Chevron Oronite Pte Ltd
Ethyl Petroleum Additives
Consumers Energy
Center for Professional Advancement, Course Director
Eskom
Washington Biodiesel
Group Health Cooperative
Genentech Pharmaceuticals
Huish Detergents
Procter & Gamble
Colgate Palmolive
Unilever

Robert Hail, PE, CEM, LEED AP

EDUCATION

- University of Michigan – Bachelor of Science, Chemical Engineering (1998)
- Optimizing Performance of Chilled Water & Air Distribution Systems: AEE
- Cogeneration Training: AEE
- Metrix Utility Accounting System Training: SRC Systems
- Mechanical and Electrical Estimating Seminar: R.S. Means
- Lighting and Energy Certification Course: OSRAM Sylvania

ACCREDITATIONS

- Registered Professional Engineer, Washington (2003)
- Certified Energy Manager, AEE (2000)
- LEED® Accredited Professional (2007)
- ASHRAE Member - American Society of Heating, Refrigerating and
- Air Conditioning Engineers
- AEE Senior Member - Association of Energy Engineers

SPECIALTIES

- Energy Project Development
- Energy Engineering

TENURE

Robert Hail has worked in the industry since 1998.

Robert has thirteen years of energy engineering and performance contracting experience. He has been responsible for developing many large performance contracting projects, totaling more than $40 million in contract value. Robert has also successfully performed all aspects of performance contracting; sales, development, construction management, and measurement and verification.

For this project, Robert will manage the team through the preliminary evaluation, detailed audit, and scope development. His goal is to ensure the overall performance and workflow of the project development, analysis, engineering and performance assurance is maintained at the highest standards.

EXPERIENCE

Washington State Capitol Campus, Multiple Phases
City of Seattle, Multiple Phases
Hoquiam Middle School
Yamhill-Carlton School District
State of Alaska
City of Lynnwood
Reynolds School District
Mukilteo School District
Microsoft
State of Idaho
South Kitsap School District
North Santiam School District
Boeing

Ron Fues, P.E., LEED® AP, HFDP

EDUCATION

- Auburn University, Alabama -M.S. in Building Construction, 1997
- Auburn University, Alabama - B.S. in Mechanical Engineering, 1994
- Pneumatic Controls Evening Course, 2001
- Compressed Air Challenge Training, 2005

ACCREDITATIONS

- Healthcare Facility Design Professional (HFDP)
- Professional Engineer, WA, CA, CO, ID, MN, MT, TX, WY
- LEED Accredited Professional

SPECIALTIES

- Project Development Engineering
- Energy and Resource Conservation
- Mechanical System Design
- Lighting System Evaluation
- Energy Analysis, Calculations, and Modeling
- Facility Auditing
- Performance-Based Contracting
- Measure and Verification
- Risk Mitigation

TENURE

Ron Fues has been in working the energy field since 1997.

TECHNICIAN ENGINEERING SERVICES MANAGER

Ron Fues has been a valuable member of the McKinstry team since 1997. He contributes to the team with energy use calculation and load calculation experience, utility rebate support, lighting, water, and solid waste system evaluation, mechanical equipment selection, mechanical systems design, creation of design drawings, and permit submittals. Ron combines HVAC design experience on new and retrofit construction with energy systems evaluation and analysis.

EXPERIENCE

Higher Education Experience

Western Washington University – Energy engineer for retro-commissioning project and campus air compressor upgrade.

University of Washington – Energy engineer for Fluke Hall laboratory controls upgrade.

Whatcom Community College – Energy engineer for project replacing 25 packaged rooftop units.

Lower Columbia Community College – Energy engineer / peer reviewer

Eastern Washington University – Peer reviewer

Washington State University – Peer reviewer

Oregon State University, HMSC – Peer reviewer

Municipal Experience

Department of Ecology, State of WA – Energy engineer for this LEED–EB Pilot Silver rating project; full responsibility for all points; turnkey LEED consulting. Client is currently working with McKinstry consulting group on additional energy points for LEED-EB O&M recertification.

State of Washington General Administration, Capital Campus – Peer reviewer

City Center Bellevue – Retro-commissioning project for office tower.

Commercial Experience

LBA Realty – Level 1 Energy Auditor

Key Center – Retro-commissioning project for office tower.

Union Square – Energy engineer for full VAV box replacement and DDC controls on high-rise office tower.

Wells Fargo Plaza – Peer reviewer

US Bank Centre – Peer reviewer

Fortune 50 Technology Company West Campus – Total cost of ownership analysis and rebate capture for central chilled water plant.

Fortune 50 Technology Company 7 and 99 Buildings – Total cost of ownership analysis and rebate capture for central chilled water plant.

Healthcare Experience

Seattle Biomedical Research Institute – Rebate capture for this LEED certified project.

UW Medical Center – Energy engineer for UW Medical Center central CHW plant heat recovery chiller upgrades and T wing cooling tower replacement.

UW, School of Medicine @815 Mercer – Peer reviewer

K-12 Experience

Northshore School District – Program manager and energy engineer project including schematic design, rebate capture, grant applications, guaranteed energy savings calculations, and management of the investment grade audit. Full HVAC upgrade at four (4) schools, roofing upgrades, glazing upgrades, lighting upgrades, weatherization, seismic upgrades, water upgrades district wide. (Review and scoring of projects using the Washington Sustainable Schools Protocol.)

Seattle School District – Energy engineer for retro-commissioning project.

Lake Washington School District – Energy engineer for high school project including full HVAC upgrade and natatorium controls upgrade with dehumidification unit heat recovery.

Caldwell School District – Measurement and verification plan for this LEED School Silver project.

Vancouver School District – Energy engineer

Oakville School District – Energy engineer

Salem-Keizer Public Schools – Energy engineer / peer reviewer

South Kitsap School District – Peer reviewer

Central Kitsap School District – Peer reviewer

Bethel School District – Peer reviewer

Wilbur School District – Peer reviewer

Seth Davis, P.E.

EDUCATION

- Clarkson University
- Mechanical Engineer

TECHNICAL SKILLS

- AutoCAD (R14, 2000, 2005, 2009)
- Elite Load Analysis Software
- eQuest DOE-2 Energy Analysis Software

REFERENCES

ROBERT FOSTER
Northshore School District
425 408 7866

JIM HAYES
Washington General Administration
360 902 7281

CLIFF CHAMBERLAIN
Chamberlain Mechanical
425 889 2375

TENURE

Seth has been in the industry for 13 years.

SENIOR ENGINEER

Seth is a Professional Mechanical Engineer and has been a engineer in the industry for over 13 years. He is registered in the State of Washington. As a senior engineer, he is responsible for managing the design process for construction projects. He is experienced in mechanical and piping design. He uses these experiences to lead the design team to create the best building for the customer.

EXPERIENCE

MUNICIPAL

King County Wastewater Treatment Division – Santler Building
Lane County Correctional Facility Heating Plant
Seattle Justice Center Heating Plant
Thurston County Evaluation and Treatment Center
WA State Capitol Campus Office:

- Building Two HVAC Upgrade
- DOT Data Center
- DOT Material Lab Chiller Replacement
- Highway Licensing Building HVAC Upgrade
- Powerhouse Cooling Tower Upgrade
- Powerhouse Boiler Controls Upgrade
- Natural Resources Building HVAC Upgrade

COMMERCIAL

Rainier Tower Chiller Replacement
Paulsen Building Heating Water Plant
Weyerhaeuser Chilled Water System Modifications

K-12

Hoquium Middle School HVAC Replacement
Northshore School District:

- Wellington Elementary School HVAC Upgrade
- Westhill Boiler Upgrade
- Canyon Creek Elementary HVAC Upgrade
- Shelton View Elementary HVAC Upgrade
- Kenmore Elementary HVAC Upgrade

DATA CENTERS

F5 Data Center

HIGHER EDUCATION

Bellevue Community College Building "D"
Seattle University Law School 4th Floor Addition
Seattle University Piggott Hall
Seattle University Student Center
University of Washington Loew HVAC Upgrade
University of Washington Odegaard HVAC Upgrade
UW Tacoma Rooftop Replacement

Whatcom County Community College Rooftop Replacement
Western Washington Student Recreation Center

PRIVATE

Ebsworth Chapel

HEALTHCARE

Providence St. Peter Hospital:

Concourse/Lobby Remodel
Diagnostic Imaging Remodel
ED/Lab

Bob Eggart

EDUCATION

- Walla Walla Community College - Associate of Applied Arts
- Lewis-Clark State College - Associate of Applied Science in Drafting Technology
- Lewis-Clark State College - Bachelor of Applied Science Engineering Technology-Minor Business Administration
- Washington State University & University of Idaho: Economics, Physics, Business Administration, Business Law, Commercial Law, Accounting, Tech/Prof Writing

SPECIALTIES

- Performance Contracting
- Design Development Management
- Value Engineering
- Constructability Review
- Contract Negotiation & Risk Management
- Procurement Strategy
- Schedule & Planning Analysis
- Estimating & Financial Management
- Staffing & Resource Logistics

TENURE

Bob has worked in the industry since 1995.

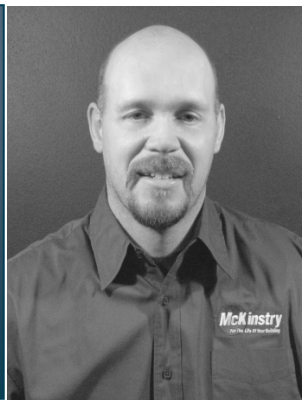
OPERATIONS MANAGER

Bob started with McKinstry in June 2006. Before he joined the team, Bob worked for over 7 years at Washington State University's Capital Planning & Development department where he gained extensive knowledge with all facets of higher education construction but with an emphasis on complex laboratory projects. Prior to WSU, Bob worked as an estimator/project manager for a Civil contractor specializing in bridge construction & public utilities and he worked in the design arena for a Civil Engineering firm, as well as, a Mechanical Engineering firm. Bob brings with him both design experience & construction management knowledge.

EXPERIENCE

-Spokane County Waverly Creek Bridge (Construction)
-Adams County Pigeon Creek Bridge (Construction)
-ODOT Mallory/Troy Bridge (Construction)
-IDOT Mission Creek Bridge (Construction)
-IDOT East Main Street Revision (Construction)
-McCann Property Development (Design/Construction)
-Potlatch Pulp & Paper OSHA upgrade (Design/Construction)
-Latah Credit Union (Construction)
-WSU Student Recreation Center (Construction)
-WSU East Campus Infrastructure (Construction)
WSU Shock Physics Institute (Design/construction)
-WSU Murrow Hall School of Communication (Construction)
WSU Plant Biosciences Phase I (Design/Construction)
*WSU Biotechnology Life Sciences (Design)
-WSU Championship Golf Course (Design)
-WSU Outdoor Tennis Facility (Design/Construction
-Walla Walla County Courthouse- ESPC (Design/Construction)
-Clarkston School District- ESPC (Design/Construction)
-WSU FSHN Fan Walls- ESPC (Design/Construction)
-WSU Murrow/Avery CHW Upgrades-ESPC (Design/Construction)
-WSU Greenhouse 124- ESPC (Construction)
-WSU Hamilton Hall-ESPC (Construction)
WSU Fulmer Hall- ESPC (Design/Construction)
-U of I Base TA Lighting- ESPC (Design/Construction)
-U of I Base TA Controls & HVAC- ESPC- (Design/Construction)
-U of I A & A Chilled Water- ESPC (Design/Construction)
-U of I Biomass Fuel Storage Facility- ESPC (Development/Design/Construction)
-U of I Chiller VFD Upgrades- ESPC (Design/Construction)
-WSU E. Chilled Water Plant & Electric Service- ESPC (Development/Design/Construction)
-U of I TES Tank, Infrastructure & CHW Plant- ESPC (Development/Design/Construction)
-U of I Idaho Street Infrastructure- ESPC (Development/Design/Construction)
-WSU Sloan Hall- ESPC (Design/Construction)
-U of I East Campus Infrastructure- ESPC (Development/Design/Construction)
-Pullman School District- ESPC (Development/Design)

Casey McGourin, P.E.



EDUCATION

- BSMET Mechanical Engineering, Eastern Washington University, Cheney, WA

ACCREDITATIONS

- P.E. Registered Professional Engineer, State of Washington

AFFILIATIONS

- American Society of Heating and Refrigeration Engineers

SPECIAL SKILLS

- Mechanical Design for New Construction and Remodels
- Performance Based Contracting
- Energy and Resource Conservation

REFERENCES

HAL OPHUS
M.J. Takisaki Inc.
509 244 7080

MATT LANDOE
ATS Inland NW
509 981 0886

MIKE CAFFREY
Columbia Hydronics
509 496 4744

TENURE

Casey has worked in the industry since 1994.

PROGRAM MANAGER

Casey joined McKinstry in May of 2006 with 13 years of Mechanical Engineering experience. Since then Casey has worked as a Project Engineer on a broad range of design-build and energy upgrade projects including steam, hydronic, and dry side HVAC systems.

Recently Casey has transitioned into the position of Program Manager. As a Program Manager, Casey serves as the link between the owner and the project design and construction teams. Casey is committed to providing his clients with the most innovative energy conservation strategies to maximize facility energy savings.

Casey's background as a Project Engineer gives him unique insight into understanding mechanical systems and selecting the systems that will best meet the long-term needs of the client.

EXPERIENCE

Fairchild Air Force Base Survival Gymnasium HVAC Remodel, Spokane, WA
Fairchild Air Force Base Air Refueling Dormitory HVAC Remodel, Spokane, WA
LakeHouse Condominiums, Design Build Construction, Chelan, WA
Paulsen High Rise Office Building, HVAC Upgrades, Spokane, WA
Eastern Washington University, HVAC Energy Upgrades, Cheney, WA
Microsoft Data Center, Design Build Construction, Quincy, WA
Pine Lodge Correctional Center for Women, HVAC Energy Upgrades, Medical Lake, WA
Avista Corporate Headquarters HVAC Energy Upgrades, Spokane, WA
Holy Family Medical Center, Design-Bid-Build Construction, Spokane, WA
Cusick School District, HVAC Energy Upgrades, Cusick, WA
City of Spokane, Police Academy, HVAC Energy Upgrades, Spokane, WA
Foley Federal Courthouse, HVAC energy upgrades, Spokane WA

C. Dale Silha, CEM

EDUCATION

- B.S. Mechanical Engineering, University of Idaho 1984
- Master Business Administration, Idaho State University 1992

ACCREDITATIONS

- Certified Energy Manager (CEM)

AFFILIATIONS

- Northwest Energy Efficiency Council Past Board Member

QUALIFICATIONS

- Adjunct Professor, EWU 2006-2011
- Project Development
- HVAC controls
- Innovative Financing
- EMCS System Evaluation
- Demand Side Management Programs
- Securing Utility Rebates
- Directed Engineering Studies
- Facility Auditing
- Value Engineering
- Contract Negotiation & Risk Management
- Schedule & Planning Analysis
- Estimating & Financial Management

TENURE

Dale has worked in the industry since 1990.

BUSINESS DEVELOPMENT MANAGER

Dale is the Business Development Manager across our Inland Northwest office at McKinstry. Dale is responsible for coordination across all McKinstry business offerings and managing client. Dale's experience in the financing, funding, contracting, design, integrated delivery, construction, commissioning, and measurement and verification in projects allows him to make critical decisions and facilitate client-focused solutions.

His expertise has supported many clients to improve the effectiveness, environmental impact, and operational efficiency of their design and construction projects. Dale is motivated to partner with client organizations to assist with transformational change and integration of learning opportunities within the construction process. Team leader and mentor for Gonzaga Engineering and Entrepreneurship team of 4 engineering students. 5 years' experience teaching graduate and 400 level classes for EWU.

PROJECT RELATED EXPERIENCE

HIGHER EDUCATION

Whitworth University, Spokane WA
Developed integrated delivery team to design-build MEP systems for the Whitworth Aquatic Center and implemented onsite resource conservation manager backed by high performance team to reduce utilities on campus by over $100,000 per year.

Community Colleges Spokane, Spokane WA
Developed collaborative relationship and teaming with College administration and staff to acquire State energy grants and develop infrastructure and lighting improvements on 4 sites.

Spokane County, Spokane WA
Coordinated efforts and teams from Spokane Regional Health District, Spokane County, and McKinstry to provide MEP design-build integrated delivery of multiple projects including fast-track heating system conversion.

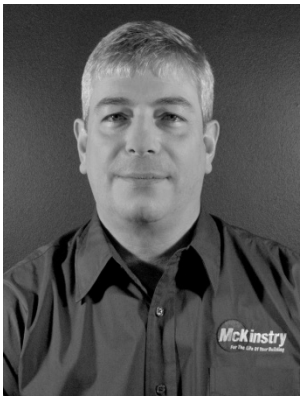
K-12

Richland School District, Richland WA
Coordinated team to design and implement facility improvements, energy accounting systems, education, operational repairs, and ongoing performance diagnostics within 10 District buildings. The project resulted in acquisition of a $500,000 state grant and $130,000 utility incentive.

FEDERAL

DOE Hanford, Richland WA
Organized engineering team and project development of a $32 million steam decentralization project and heating system renovation.

Dave Ray



EDUCATION

- Eastern Washington University - Bachelors in Business Administration

SPECIALTIES

- Performance-Based Contracting
- Design-Build Construction
- Project Development
- Innovative Financing
- Demand Side Management and Utility Rebates
- Energy Management Control Systems
- Motor Driven Systems and Motor Control

TENURE

Dave has been in the industry since 1994.

Dave joined McKinstry in 2004 to help build and manage business development for McKinstry's Inland Northwest group. Dave has been providing energy solutions for Eastern Washington and Idaho customers since 1994, and has implemented hundreds of energy savings measures on both retrofit and new construction projects. In the mid 1990's he helped facilitate one of the first large utility incentive rebates paid to Washington State University by Washington Water Power (Avista Utilities).

Dave's experience and expertise in working directly with school districts to identify and secure low interest financing, grants, and utility rebate incentives has yielded his clients a better return on investment. Dave seeks opportunities to capitalize on annual energy and operational cost savings, energy grants, and available utility rebate incentives in an effort to assist his clients with developing a funding and implementation plan for their facility upgrade projects.

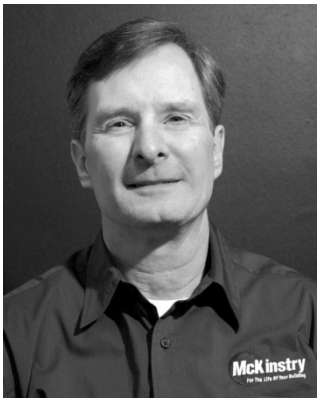
In the recent 2009 OSPI Energy Efficiency Grant program Dave successfully secured grants for 5 of the 6 districts he assisted. The sixth district resubmitted to the 2010 OSPI Round 1 grant program and recently received announcement their grant application had been approved.

PROJECT EXPERIENCE

East Valley School District (Spokane)
Riverside School District
Dayton School District
Naches Valley School District
Grandview School District
West Valley School District (Yakima)
Yakima School District
Pasco School District
Kennewick School District
Yakima School District

Avista Utilities
City of Spokane
Spokane County
Walla Walla County
University of Idaho
Washington State University
Eastern Washington University
Central Washington University
Paulsen Center Building

David Moore
P.E., LEED® AP



EDUCATION

- Oregon Institute of Technology - BSMET, 1979

ACCREDITATIONS

- P.E., Mechanical Engineer, Washington, Oregon, Colorado, Arizona, Texas, Idaho, Montana
- LEED® Accredited Professional
- Member of ASHRAE

REFERENCES

GREG MCCRACKEN
USKH, Inc.
208 746 2661

LARRY KOM
Castellaw Kom Architects
208 746 0183

MARIAN EVENSON
Madsen Mitchell Evenson Conrad, PLLC
509 624 6800

TENURE

David Moore has provided HVAC systems design services since 1979.

ENGINEERING MANAGER

David Moore is the Engineering Manager at McKinstry's Inland Northwest office. As a LEED® Accredited Professional he is familiar with the multitude of issues related to energy and resource conservation in construction. He provides each project with specialized expertise focusing equally on success of the project and satisfaction of the client. David's expertise has supported facility upgrades for many schools, colleges, universities, hospitals, and other commercial and industrial customers, balancing hard-cost, annual operational costs, and utility savings to achieve effective design solutions. David provides clients with innovative solutions focused on reducing utility and operational costs through a variety of energy services offerings. Directing a staff of engineers and designers, David provides thoroughly vetted designs and high quality construction documents to meet and exceed the expectations of his clients. David has been involved with many innovative projects throughout the Pacific Northwest since 1993.

EXPERIENCE

Eastern Washington University PE Classroom Building HVAC Replacement
University of Idaho, Aberdeen Research Center, Lab HVAC Replacement
University of Idaho, Moscow, ID, Delta Tau Delta Fraternity Renovation
University of Idaho, Moscow, ID, Fisheries Chiller Replacement
Whitman College, Walla Walla, WA, Heating System Renovation
National Guard Armory, Lewiston, ID, HVAC System Replacement
Onion Creek School, HVAC Systems Upgrades
Mary Walker School District, PAR Building Renovation
Fruitland High School, Fruitland, ID, Gymnasium Addition and Remodel
Wilson Middle School Renovation, Yakima, WA
Arcadia Elementary School Renovation, Deer Park, WA
Jefferson Elementary School Renovation, Pullman, WA
Coeur d'Alene Federal Courthouse, Grand Jury Room Renovation
City of Spokane Operations Complex, Street Department, Full Renovation
USPO Processing and Distribution Center, Spokane, WA, HVAC Redesign
Idaho Housing Authority, Lewiston, ID, Office Remodel
Asotin Aquatics Center, Clarkston, WA, Addition and Remodel
Idaho Health Department, Moscow Clinic, Addition and Remodel
Clearwater Valley Hospital, Orofino, ID, Addition and Remodel
Newport Hospital, Newport, WA, Remodel and Renovation
Clearwater Valley Hospital, Addition and Remodel
R&L Development Medical Office Building, Lewiston, ID, Remodel
Tri-State Memorial Hospital, Clarkston, WA, Imaging Addition and Remodel
VA Clinic Remodel, Lewiston, ID, HVAC System Replacement
VA Hospital, Spokane, WA, 7th Floor HVAC System Replacement
Cowles Publishing Production Facility Expansion, Spokane, WA
Fairchild Air Force Base, Building 1314 Renovation
Hamilton Adaptive Reuse, Wenatchee, WA, Cold Storage Conversion

Derek Larson, P.E.

EDUCATION

- Gonzaga University – B.S. Mechanical Engineering

SPECIALTIES

- Energy Auditing
- Energy Savings Calculations
- Project Scope Development
- Utility Incentive Capture
- Utility Data Analysis

TENURE

Derek has worked in the industry since 2008.

CREDENTIALS

- Professional Engineering License (WA)
- LEED Green Associate
- Energy Manager in Training (EMIT)

ENERGY ENGINEER

Derek joined the McKinstry team in Spokane in 2010 and focuses on mechanical systems. Derek is responsible for assisting the engineering effort to estimate the energy savings for various projects through energy audits, developing accurate energy models, and managing utility data analysis efforts for McKinstry's Energy Services group.

Prior to joing McKinstry, Derek worked for several years at a MEP design firm which has given him extensive knowledge in designing various types of mechanical systems. This experience has been especially beneficial in accurately modeling these different systems and building types in energy modeling software. That expertise has helped customers to analyze several different system types as well as styles of operation, enabling the customer to choose the best solution for their situation.

Derek is dedicated to meeting customer needs enjoys problem solving where unique characteristics are required. He has worked on numerous public facilities and is relied upon by his team and their customers to develop reliable energy models. Derek has obtained his professional engineering license in Washington and in addition to achieving certifications as a LEED Green Associate and an Energy Manager in Training.

KEY EXPERIENCE

- ✓ Developing full building computer simulated energy models to estimate energy savings.
- ✓ Performing energy audits of commercial, municipal, higher education and K-12 facilities.
- ✓ Working with utility companies to maximize incentive and rebate capture.
- ✓ Developing sustainable facility operating plans.

EXPERIENCE

Eastern Washington University
Kennewick School District
Mansfield School District
Otis Orchards Elementary
Thorp School District
Poudre School District
Nespelem School District
West Valley School District - Yakima
ALK-Abelló
Samaritan Hospital
Spokane County
Lincoln County
Montana State University
Richland School District
Columbia School District
Pasco School District
Almira School District
Grand Coulee Dam School District
Keller School District
Grandview School District
Fox Studios
Newport Hospital
Walla Walla County
Douglas County

Erik Bondo

EDUCATION

- Western Washington University, 2003
- Eastern Washington University Bachelors of Business Administration, 2006

QUALIFICATIONS

- Project Administrator
- Project Coordinator
- Project Engineer
- Senior Project Engineer
- Construction Manager

REFERENCES

JACK CHEETHAM
Director of Operations
McKinstry Co., LLC
206 396 3986

JIM KING
President
Hudson Bay Insulation
206 730 6266

FRANK GABRIEL
Superintendent
Ramsey Northwest
509 370 6743

TENURE

Erik has worked in the industry since 2003.

CONSTRUCTION MANAGER

Erik Bondo joined the McKinstry team in 2006. His responsibilities within the company include estimating, scheduling, purchasing, coordinating with trades, change order preparation, documenting revisions, coordination with other subcontractors and managing projects from development through completion.

EXPERIENCE

DATA CENTER

Microsoft Columbia Data Center Phase 1, Quincy, WA

C01 — $24 million — completed 2007

Project Administrator. Phase 1 of 2-phase data center. 250,00 sq/ft facility comprised of (3) chilled-water production plants, thermal storage tank, cooling towers, (150+) computer room air-handling units, critical environment heating, ventilating and humidification.

Microsoft Columbia Data Center Phase 2, Quincy, WA

C02 — $18 million — completed 2008

Project Coordinator. Phase 2 of 2-phase data center. 250,00 sq/ft facility comprised of (3) chilled-water production plants, thermal storage tank, cooling towers, (150+) computer room air-handling units, critical environment heating, ventilating and humidification.

Sabey Intergate Columbia Building B, East Wenatchee, WA

VMWare Data Center – $7.7 million – 2009

Project Engineer. 125,000 sq/ft data center. Accelerated schedule from ground-breaking to certificate of occupancy in 5-months. Facility earned LEED Platinum certification.

WASTEWATER TREATMENT

Microsoft Columbia Data Center Water Treatment Facility, Quincy, WA

$5 million — completed 2008

Project Engineer. Water treatment facility serving Microsoft Columbia Data Centers (CO-1 and CO-2).

MUNICIPAL AND COUNTY

Whitman County Correctional Facility Phase 1

$494,000 – completed 2012

Primary facility chiller replacement, air-handling unit and boiler system direct-digital controls upgrades.

Spokane Regional Health District

$1.2 million – ongoing construction through spring 2013

District steam to natural gas boiler replacement, lighting upgrades, pneumatic to digital controls conversion, fan-powered reheat box and variable-air-volume box installation.

HIGHER EDUCATION

University of Idaho Energy Services Performance (ESP) Contract

$37 million — ongoing construction through summer 2013

Senior Project Engineer / Construction Manager. Multi-phase, multi-building direct-digital controls upgrades, lighting retrofits, steam, heating-water and chilled-water system upgrades. 2011 Idaho Business Review Top-Ten Government Contract award for Thermal Energy Storage Tank and South Campus Chilled Water Plant project.

Whitworth University Aquatics Center Renewal

$750,000 – completed 2012

Installation of new VFD driven supply and return fan wall arrays, dehumidification unit with hot-gas reheat coil, roof-top HVAC unit conversion, high-voltage electrical service and pool lighting upgrades.

Janet Janes

EDUCATION

- Local 66 SM Apprenticeship

ACCREDITATIONS

- Osha 30
- Priority Management
- First Aid

QUALIFICATIONS

- Purchasing Agent
- Logistics Coordination
- Manpower Coordination
- Project Coordination
- Project Controls
- Safety Engineer
- Claims Management
- Project Engineer

TENURE

Janet has worked in the industry since 1982.

PROJECT ENGINEER

Janet Janes joined the McKinstry team in 1982 and holds the position of Project Engineer where she is responsible for all aspects related to project development, construction and closeout. Janet's experience allows her to make important contributions to McKinstry's energy projects.

Janet supports her customers by maximizing efficiency, ensuring goals are met, schedules are kept, and projects are managed safely. She is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

She has had the opportunity to be involved with many of the most interesting projects throughout Western Washington the INW and Idaho.

PROJECT EXPERIENCE

K-12

West Valley School District, Yakima, WA
West Valley School District — $1,439,912 — Project Engineer
HVAC Equipment & Controls upgrades.

Sunnyside School District
Sunnyside School District — $871,432 — Project Engineer
Lighting and Controls upgrades.

Kennewick School District
Kennewick School District — $2,202,156 — Project Engineer
HVAC Equipment & Controls upgrades. Water Conservation and Trash Compaction Measures.

Columbia School District
Columbia School District — $547,681 — Project Engineer
HVAC Equipment & Controls upgrades.

Cascade School District
Cascade School District — $225,228 — Project Manager
Lighting Upgrades.

Naches Valley School District
Naches Valley School District — $1,122,839 — Project Engineer
New Controls, ERV installation, 2 new boilers Condensing Unit upgrades
And Architectural upgrades.

HIGHER EDUCATION

University of Idaho, Moscow, Idaho
U of I Thermal Storage Tank & Chiller Plant - $9,147,852 – Project Safety Engineer

Design Build – Construct a new 2 million gallon Thermal Storage Tank and Chilled Water Plant.

U of I East Campus Infrastructure - $2,829,989 – Project Safety Engineer

Design Build – Bring in new chilled water, steam and condensate piping to and from the East portion of the U of I Campus.

Eastern Washington University, Cheney, WA

PEA Phase 3.1 - $1,619,556 – Project Engineer

Furnish & Install new AHU's ductwork system and controls including a Lighting Retrofit.

Washington State University, Pullman, WA

Sloan Hall Phase 13.7 — $1,827,258 — Project Engineer

Furnish and install new VAV DDC controlled Air Valves including asbestos abatement and new DDC raceway on floors 1,2 & 3.

HOSPITALITY

Coeur D Alene Casino, Coeur D Alene, ID

Design Build - Indoor Air Quality Phase 1 - $1,466,087 – Project Engineer

Add 2 new AHU's, 1 chiller and 2 Boilers. Build new mechanical room on roof. Install new ductwork and provide Controls Upgrade.

Design Build – Kitchen & Office Remodel - $1,201,671 – Project Engineer

Provide Plumbing, Piping and HVAC for Kitchen and office remodel.

HEALTHCARE

Eastern State Hospital, Medical Lake, WA.

Design Build Energy Project - $2,016,137 – Project Engineer

Provide and install new VFD's, Motors and Chiller. Provide new ceilings and do a Victolic change out and Lighting Retrofit.

Kootenai Medical Center, Coeur D Alene, ID

Phase 1 Free Cooling - $163,517 - Project Engineer

Furnish and install a new Plate & Frame Heat Exchanger, manual isolation valves. Provide Cooling Tower Modifications and associated condensate & chilled water piping.

MUNICIPAL AND COUNTY

Spokane County, Spokane WA

Geiger Correctional Facility - $97,090 – Project Manager

Lighting Upgrades.

Wenatchee City Hall, Wenatchee WA

Wenatchee City Hall Building - $347,061- Project Manager

Provide HVAC, Controls, Insulation and Lighting Retrofit.

ADDITIONAL EXPERIENCE

Washington Mutual Tower

Microsoft Projects

Boeing Projects

Jared Haight
P.E., LEED® AP

EDUCATION

- Washington State University – BS Mechanical Engineering, 2006

ACCREDITATIONS

- P.E., Mechanical Engineering, Washington
- LEED® Accredited Professional

AFFILIATIONS

- Member of ASHRAE

QUALIFICATIONS

- HVAC Systems Evaluation and Design
- HVAC Controls
- Sustainable Building Compliance and Design
- AutoCAD, Revit
- Elite Load Calculations

TENURE

Jared has worked in the industry since 2007.

PROJECT ENGINEER

Jared Haight holds the position of project engineer at McKinstry. Jared is responsible for completing quality HVAC designs using the latest technologies to optimize system performance and energy savings. Jared's experience as a member of McKinstry's Energy and Facility Services design team allows him the capability of making critical decisions across all disciplines while specializing in existing building retrofits. Jared joined the McKinstry team in 2007.

His expertise has supported many K-12 schools, colleges, and universities along with both public and private commercial customers by utilizing his extensive knowledge of HVAC systems to optimize system function and performance while working within the framework of the existing building infrastructure.

PROJECT RELATED EXPERIENCE

Northshore SD – Crystal Springs Elementary HVAC Renovation, Bothell, WA, 2010: Mechanical engineer for replacement of individual gas fired forced air furnaces with hydronic forced air furnaces capable of economizer operation. Designed a heating water boiler plant utilizing condensing boilers and a variable primary pumping strategy. Design meet or exceeded school district standards for energy usage per square foot and indoor air quality.

Foley Federal Courthouse – HVAC Renovation, Spokane, WA, 2010-2011: Mechanical engineer for design of full airside HVAC retrofit, hydronic heating plant installation and cooling tower replacement. Nine story mixed use building including federal courtrooms, United State Marshal Service office and maximum security spaces, Internal Revenue Service along with various other high profile occupants. Project features active energy management, one year energy performance period and LEED certification.

Avista Corporate Headquarters – HVAC Renovation, Spokane, WA, 2009: Mechanical engineer for fifth floor design of a complete HVAC mechanical system retrofit of the existing General Office Building. Project received LEED Gold certification.

Boise State University – Geothermal Conversion, Boise, ID, 2011: Mechanical engineer for HVAC design to integrate geothermal heating hot water system into existing steam to water building infrastructure to capitalize on annual operational and energy savings while driving towards a carbon neutral campus. Design included optimization of existing building systems.

Lake Washington SD – Juanita HS HVAC Renovation, Kirkland, WA, 2007: Mechanical engineer for conversion design to replace rooftop constant volume air handling units with variable air volume air handling units.

Weyerhaeuser, Federal Way, WA, 2007: Wrote control programs to implement real-time optimization for chiller selection and operation. Work included plants with multiple chillers of different sizes/manufacturers, integration of existing chillers with new equipment, and integration of associated cooling towers and the primary/secondary chilled water pumps.

OTHER EXPERIENCE

Boise State University – Micron Engineering Complex VAV Fume Hood System Design, Boise, ID

Eastern Washington University – Campus Metering and Controls Replacement, Cheney, WA

Washington State Department of Ecology – LEED Certification Services, Lacey and Spokane, WA

Samaritan Healthcare – HVAC and Energy Saving Modifications, Moses Lake, WA

University Place SD – HVAC Renovation, University Place, WA

Seattle Municipal Tower – Boiler Replacement, Seattle, WA

Seattle University – Chiller Replacement, Seattle, WA

Capitol Campus Highways and Licenses Building – Chiller Replacement, Olympia, WA

Federal Way SD – Boiler Replacement, Federal Way, WA

Woodland Park Zoo – Feline House Boiler Replacement, Seattle, WA

Two Union Square – Terminal Unit Retrofit / LEED Compliance, Seattle, WA

University of Puget Sound – Boiler Replacement, Tacoma, WA

Port Angeles City Hall – Heat Pump Replacement / DX Cooling Install, Port Angeles, WA

University of Washington Gates Hall – Demand Control Ventilation, Seattle, WA

Hoquiam SD – Rooftop AHU HVAC Renovation, Hoquiam, WA

Capitol Campus Employment Security Building – Chiller Replacement, Olympia, WA

Highline SD – Domestic Water Heater Replacement, Highline, WA

Seattle Municipal Tower – Closed Circuit Fluid Cooler Installation, Seattle, WA

Department of Health – Chilled Water Plant Optimization, Shoreline, WA

Northshore SD Westhill Elementary – Boiler Replacement, Bothell, WA

Eastern Oregon College Pierce Library – Active Chilled Beam HVAC Retrofit, La Grande, OR

Jayson Schmidt

EDUCATION

- Gonzaga University - Bachelor of Science Mechanical Engineering
- Minor - Business Degree, 2009

ACCREDITATIONS

- Engineer in Training - Mechanical WA, 2009

REFERENCES

Available upon request

TENURE

Jason has worked in the industry since 2007.

SALES ENGINEER

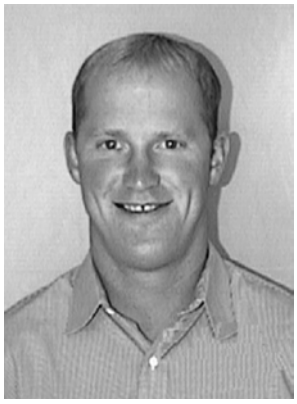
Jayson holds the position of Sales Engineer within McKinstry. Jayson has been with McKinstry since 2007, where he began his career as an intern during the completion of his studies in Mechanical Engineering and Business at Gonzaga University. These two areas of study, combined with hands on interaction during his internship, provide Jayson with a fresh and relevant approach to the industry.

Jayson is aware that business comes as a result of superior past performance, personal and professional relationships, and a reputation for competitiveness. To our clients, Jayson pledges not only to keep the promises set out in our proposals and to act in their best interests, but also to strive to understand their business and deliver custom solutions that will enhance their operations.

EXPERIENCE

Avista
Washington State University
Eastern Washington University
University of Idaho
Northwest Museum of Arts and Culture

Mark Jonson



EDUCATION

- University of Washington – Bachelor of Science Degree, Mechanical Engineering,
- University of Washington - Air Conditioning Fundamentals & Air Conditioning Design

SPECIALTIES

- Construction Estimating
- Project Management
- Business Development
- Wet side & dry side HVAC systems
- Project Financing
- Constructability Reviews
- Value Engineering
- Equipment Expediting
- Scheduling Budgeting/Estimating
- Labor Management
- Supervision
- Scope Coordination
- Cost Control
- Project Closeout
- Pre-Construction Services Commissioning

SUPERVISORY RESPONSIBILITIES

- Mark is responsible for directing McKinstry development and construction teams on various projects, including Eastern Washington University and Washington State University

TENURE

Mark brings with him more than 13 years of experience.

BUSINESS UNIT MANAGER

In Mark's 13 years with McKinstry, he has been responsible for a variety of activities including estimating, conceptual design, pre-construction, and project management for design/build projects. Recently, his primary focus is Busideveloping innovative energy-saving solutions for clients. His depth of construction knowledge and cost estimating provide a key component of the performance contracting process.

Mark also has experience serving as a Project Director for several projects in Washington. His role on these projects has ranged from being responsible for the successful completion of projects to construction estimating where he is responsible for supporting the costing of potential measures. Mark provides internal coordination and direction to the various McKinstry personnel in order to maintain project schedules and meet the requirements of the development, construction, and operational aspects of project delivery.

EXPERIENCE

ORGANIZATION	TYPE	COST
City of Seattle—East Precinct	P/S	$500,000
Eastern Washington University	ESPC	$6,000,000
Washington State University	ESPC	$21,000,000
Pierce College	ESPC	$700,000
Renton School District	ESPC	$1,100,000
Seattle School District	ESPC	$400,000
Western Washington University	ESPC	$500,000
Whatcom Community College	ESPC	$400,000
University of Idaho	ESPC	development
Walla Walla County	ESPC	2,000,000
East Valley School District	ESPC	1,000,000
City of Post Falls—City Hall	ESPC	development
Steptoe School District	ESPC	$150,000
ImageX.com	D/B	$250,000
Guy Carpenter	D/B	$240,000
Onvia.com	D/B	$1,100,000
Empty Space Theatre	D/B	$75,000
Pioneer Medical Office Building	D/B	$1,600,000
St. Elizabeth MOB & Surgery Addition	D/B, P/S	$750,000
St. Anthony Medical Office Building	D/B	$630,000
ZymoGenetics—Lab Expansion	D/B	$1,400,000
Philips Medical Systems—Building D	D/B	$3,700,000
Philips Medical Systems—Various	D/B	$200,000
Phamis Phase I & II	D/B	$160,000
Sellen Construction Office Building	D/B	$640,000
Summit at First Hill	D/B	$4,000,000
One Convention Place—Various TIs	D/B	$1,200,000
Totem Lake Distribution Center	D/B	$375,000

University Center Office/Retail Complex	D/B	$600,000
Washington Mutual Home Loan Center	D/B	$130,000
Wesley Homes & Gardens Remodel	D/B	$400,000
Digital Equipment Corporation	D/B	$200,000

Additional Projects:
Northgate Medical Office Building
Evergreen Hospital – Boiler Piping Mod.
Medalia Healthcare Clinic
Central Washington Hospital MOB
Microsoft Data Center
Mercer/Yale Office Building

Matt Ophardt

EDUCATION

- Washington State University – B.S. Mechanical Engineering
- Certified Landscape Irrigation Auditor
- Certified Measurement & Verification Professional

SPECIALTIES

- Energy Auditing
- Measurement & Verification
- Energy Engineering
- Risk Mitigation
- Utility Data Analysis

TENURE

Matt has worked in the industry since 2004.

SENIOR ENERGY ENGINEER

Matt has been with McKinstry since May of 2004 and focuses on mechanical systems. Matt has three main responsibilities. First, he oversees the team's Measurement and Verification (M&V) Program. Second, he leads the engineering effort to estimate the energy savings for various projects, and finally he manages Utility Data Analysis efforts for McKinstry's Energy Services group.

Matt has extensive knowledge and experience in modeling a wide variety of HVAC systems and building types in energy modeling software. That expertise has helped customers to analyze several different system types as well as styles of operation, enabling the customer to choose the best solution for their situation.

Matt is dedicated to meeting customer needs and enjoys problem solving where unique characteristics are required. He has worked on numerous public facilities and is relied upon by his team and their customers to develop reliable energy models. He has also spent time analyzing several biomass, ground source heat pump, and solar domestic hot water heating projects, several of which are in operation today.

EXPERIENCE

Vancouver School District
Kent School District
Lake Washington School District
Lower Columbia College
Whatcom Community College
Evergreen School District
Renton School District
Central Kitsap School District
Ellensburg School District
Washington State University
Eastern Washington University
University of Washington
Pend Oreille County
Central Campus Group Health
Portland Public Schools
Northshore School District

Michael James, P.E., LEED® AP, CEM

EDUCATION

- Washington State University, B.S. Mechanical Engineering

ACCREDITATIONS

- Professional Engineer
- LEED Accredited Professional
- Certified Energy Manager

AFFILIATIONS

- Member of ASHRAE
- Member of USGBC
- Member of AEE

SPECIFIC QUALIFICATIONS

- Project Development
- Public/Private Partnerships
- Feasibility Studies
- Business Plans
- Energy & Resource Conservation
- Preliminary Design
- Lighting System Evaluation
- Energy Analysis and Calculations
- Facility Auditing
- Performance-Based Contracting
- Measure & Verification
- Risk Mitigation

TENURE

Michael has worked in the industry for over 10 years.

PROJECT DIRECTOR

Michael James joined the McKinstry team in April of 2002 as an Energy Engineer. Since that time he has moved into the Project Director role, taking on greater responsibility for leading project development teams, facility auditing, energy analysis, preliminary design, risk mitigation, and measure and verification.

Michael is motivated to provide owners with solutions focused on reducing their utility and operational costs through various energy related offerings. His expertise has supported several universities, counties, and cities by leveraging hard-cost annual operational and utility savings to help fund needed facility and system upgrades.

Lately, Michael has been involved with various cogeneration opportunities in Idaho, as well biomass heating opportunities at various school districts in Eastern Washington and Montana. His role on these projects has been Project Director where he is responsible for the successful development of projects, as well as delving into fuel supply issues.

EXPERIENCE

HIGHER EDUCATION

Washington State University
Over $10.8 million in performance contracting projects in six years

University of Idaho
Over $26 million in performance contracting projects in six years

Eastern Washington University
Over $10.1 million in performance contracting projects in six years

University of Montana
Over $365,000 in performance contracting projects in four years

Whitworth University
Enterprise Energy Management and Resource Conservation Management services

K – 12

Central Valley School District
Great Falls School District
Newport School District
Nespelem School District
Grand Coulee Dam School District
Mansfield School District
Keller School District
Steptoe School District
East Valley School District
Rosalia School District

POWER GENERATION

Shoshone County
Townsend School District

Dayton School District

MUNICIPALITIES
City of Spokane
City of Pullman
Deer Lodge
Pend Oreille County
Walla Walla County

MUSEUMS/LABS
Fred Hutchinson Lab
Museum of Arts and Culture
SIRTI Technology Center

TRIBES
Confederated Tribes of the Colville Reservation

CORRECTIONS
Pine Lodge Pre-Release Facility

Michael Lubbering

EDUCATION

- Texas A&M University
- B.S. Industrial Distribution, Cum Laude

QUALIFICATIONS

- Performance-Based Contracting
- HVAC controls
- Estimating & Financial Management
- Demand Side Management Programs
- Renewable Energy Systems
- Security utility rebates
- Facility auditing
- Value engineering
- Contract negotiation and risk management
- Schedule and planning analysis

TENURE

Michael Lubbering has worked in the industry since 2005.

PERFORMANCE ASSURANCE SPECIALIST

Michael Lubbering is the Performance Assurance Specialist at McKinstry's Inland Northwest office. Michael is responsible for the measurement and verification of Inland Northwest projects. He uses engineering theory and practical application to portray an accurate utility savings to clients throughout the Inland Northwest in reports and presentations. Michael's experience in measurement and verification allows him to make critical decisions across disciplines to ensure the best quality results for his customers. Michael Lubbering joined the McKinstry team in 2011.

Michael's expertise has supported many schools, colleges, universities, and communities by ensuring the clients' promised utility savings are being realized. He is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations. Michael works with clients on a regular basis to troubleshoot additional utility savings and improve indoor air, lighting, and water quality.

KEY EXPERIENCE

- ✓ As a Performance Assurance Consultant, Michael provided analysis of energy usage and comparison to internally developed models, acted as primary client interface to projects after installation, and presented energy data at board meetings and sales presentations.
- ✓ As a Senior Project Sustaining Engineer, Michael updated & maintained project documents during the installation phase, modified sequences and software during project implementation, and commissioned controls sequences (in-house and third-party) and mechanical systems.
- ✓ Managed over 4 million dollars in annual guarantees for over 15 option C type projects throughout Texas including K-12 schools, municipalities, state schools and hospitals, and universities
- ✓ Implemented, tested, and verified operation of various control systems at client facilities. Controls knowledge includes programming, optimization and integration side setup of TAC Xenta, Invensys, Alerton, Automated Logic, TAC I/Net, JCI Metasys, Trane Tracer, Delta, and Andover Continuum
- ✓ Commissioning, retro commissioning, controls programming, optimization, advanced troubleshooting, and validation.

Mike Phenicie, EIT

EDUCATION

- South Dakota School of Mines & Technology, Bachelor of Science Mechanical Engineering, 2004

SPECIFIC QUALIFICATIONS

- Commissioning
- HVAC Performance Testing
- Energy Audits

TENURE

Mike has worked in the industry since 2005.

COMMISSIONING ENGINEER

Mike Phenicie joined McKinstry in September 2008 as a Commissioning Engineer. Mike is responsible for overseeing the commissioning process either as an in-house design/design build project or as a third party consultant as the Commissioning Manager.

As a Commissioning Manager, Mike has experience in developing and implementing commissioning plans that include on-site surveys/observations/inspections, conducting commissioning meetings, energy audits and analysis, validating and documenting HVAC system functional performance, owner training, developing final commissioning reports, and systems manuals. Mike is also skilled in the installation and troubleshooting of HVAC and controls systems.

Mike has experience commissioning K-12 schools, universities, labs, and commercial buildings. Mike has developed and supervised functional test procedures for commissioning complete HVAC DDC control systems, including, Alerton, Automated Logic, Delta, INET 2000 and INET 7, Johnson Controls Metasys building systems, and factory installed standalone controls.

EXPERIENCE

Commissioning Experience With McKinstry:

- BioPol Laboratories, Post Falls, ID
- University of Idaho Facility Improvements
- WSU Biotech Life Sciences
- WSU Facility Improvements
- Cascade School District, MT
- Townsend School District, MT

Energy Audit & Existing Building Commissioning Experience Prior To McKinstry:

- Manitou Springs School District ESPC, Technical Audits, CO
- Denver West Energy Audit
- Department of General Services, State of California, 4-buildings: Lab, Corcoran State Prison Hospital, 2 Office Buildings.
- Colorado State University Engineering Building, Fort Collins, CO
- Ritz Carlton, Aspen, CO
- Grand Hyatt, Aspen, CO

Commissioning experience with Prior To McKinstry:

- Adams 12 Five Star Schools, Summer 2005 and 2006 Program, Thornton, CO
- Stapleton II K-8 School (Denver Public Schools), Denver, CO
- Aurora Hinkley High School (Aurora Public Schools), Aurora, CO
- Prairie View High & Middle School (Brighton Public Schools), Brighton, CO
- Yuma School District Maintenance Program, Yuma, CO
- Manitou Springs School District ESPC Program, Manitou Springs, CO
- University Corporation for Atmospheric Research, Foothills Lab 0, Boulder, CO
- Qualcomm Buildings W and WT, San Diego, CA
- Orchard Grove, Billings, MT
- Acme Hotel Remodel, Billings, MT
- GSA, Davenport, IA Federal Courthouse
- Crowley County Schools, CO
- South Conejos Schools, CO
- Walsenburg Schools, CO

Robert Sawyer, P.E., CEM, LEED AP

EDUCATION

- University of Idaho
  Bachelors of Science - Chemical Engineering

ACCREDITATIONS

- Professional Engineer
- Certified Energy Manager
- LEED Accredited Professional
- EPA Universal Technician
- Siemens Master Programmer

QUALIFICATIONS

- Project Development
- Energy Engineering
- Control Systems
- Chilled Water Operations
- Hot Water Operations

TENURE

Rob has worked in the industry for over 10 years.

SENIOR PROGRAM MANAGER

Rob joined the McKinstry team in 2008 bringing with him 10 years of energy industry experience. His most recent project activity has been developing energy saving projects for Washington State University and University of Idaho. He has spent the last seven years concentrating on identification, development, and creation of energy related projects for a combination of governmental, institutional and commercial customers located in the Eastern United States. Rob is a beneficial asset to McKinstry Inland Northwest Energy team.

EXPERIENCE

Whitman County
Pullman School District
Washington State University Greenhouse Lighting Retrofit
Washington State University Lab Building HVAC Upgrade
University of Idaho Remote Wood Storage Facility
Hospital Chilled Water & Steam Plant Design and Feasibility Study
Federal Government Campus Wide Control System Replacement
Pittsburgh Steelers Chilled Water and Hot Water Plant Performance Monitoring
Nashville, TN District Energy Plant Construction and Operation
Las Vegas Shopping Mall Mechanical Design Review
Federal Government Agency Energy Audit(s)
Retail and Mixed Use Property Utility Use Analysis and Review
Underground Infrared Insulation Performance Verification

Stewart De La Hunt

EDUCATION

- Oregon State University – B.S. Mechanical Engineering
- Montana State University – Course Work in Chemical Engineering

SPECIALTIES

- Project Management
- Site Superintendent
- Construction Management
- Mechanical Engineering
- Manufacturing Controls
- Pumping Systems
- Maintenance Standards/Procedures
- Hydraulic Systems
- Production Enhancement
- Compressed Air Systems
- Root Cause Analysis
- Air Scrubbing Equipment
- Vibration Monitoring
- Cooling Towers
- Control Valve Sizing/Repair
- Overhead Cranes
- Centrifugal Pumps
- HVAC Systems

TENURE

Stewart has more than 16 years logistical and construction experience.

CONSTRUCTION MANAGER

Stewart holds the position of Construction Manager at McKinstry and is responsible for developing project strategies, goals, and objectives. Stewart specializes in managing projects with a hands-on involved approach, providing the utmost in customer service while delivering the project at or above the expectation of the client's needs every time. He works closely as required with the design team, client's engineers, maintenance managers, maintenance mechanics, university faculty, local authorities, etc… in a comprehensive communicative fashion as the project requires, ensuring the seamless implementation in areas of potential significant impacts.

Stewarts' expertise has supported many schools, colleges, universities, hospitals, commercial and industrial customers by leveraging his extensive background in the HVAC and design-build solutions arena. Stewart is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

Stewart has had the opportunity to be involved with many interesting projects throughout the Inland Northwest.

EXPERIENCE

HIGHER EDUCATION

Eastern Washington University, Cheney, WA

Tawanka Hall - Commons controls & HVAC upgrade
Rozell Building – Cooling Tower & Boiler Feed Pumps
Aquatic - Controls and HVAC upgrade
Kingston Hall - Controls & HVAC upgrade
Isle Hall - Controls & HVAC upgrade
Martin Hall – Classroom HVAC upgrades
Campus Wide Metering – in progress
Staefa Migration – Controls Replacement – in progress

K-12

AC Davis H.S. - Chiller replacement
Wilbur SD - Boiler replacement
Naches HS - Boiler replacement

MUNICIPAL

Pend Oreille County - Lighting & HVAC
Amazon - Earthquake Damage Commercial Building
Solectron Manufacturing Line Installation Industrial
Global 1 – Computer Data Center Data Center
Rosen Building (LAB)

Boeing Building 2 – 122 Earth/Environmental Lab LAB

Anne Goerlich

EDUCATION

- University of Washington
  Bachelor of Science – Electrical Engineering, 1995

SPECIALTIES

- Utility Data Analysis
- Performance Based Contracting
- Directed Engineering Studies
- Document Control

TENURE

Anne has worked in the industry since 2007.

ELECTRICAL PROJECT ENGINEER

Anne Goerlich holds the position of Utility Data Analyst/Specialist at McKinstry. Anne is responsible for gathering, organizing, entering, and analyzing utility information associated with energy services projects. Anne's experience in these services allows her the capability of making critical decisions across disciplines. Anne joined the McKinstry team in 2007.

Her expertise has supported many schools, colleges, universities, and commercial customers by helping to establish the baseline energy usage for these facilities before energy conservation project installations and then tracking their energy usage post project installation. Anne is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

She has had the opportunity to be involved with many of the most interesting projects throughout Oregon.

EXPERIENCE

K-12

Dallas School District: Collected historical utility data and performed utility data analysis for six schools. Continued to track the energy usage at these facilities through the measurement and verification phase of the project.

Camas School District - Prune Hill Elementary: Collected historical utility data and performed a utility data analysis for the school. Wrote the first year measurement and verification report.

Banks School District: Collected historical utility data and performed utility data analysis for three schools.

Days Creek Charter School: Collected historical utility data and performed a utility data analysis for the school. Performed economic fuel switch calculations for a biomass boiler installation project.

Enterprise School District: Performed economic fuel switch calculations for a biomass boiler installation project. Tracked energy usage post biomass boiler installation. Wrote the first, second and third year measurement and verification reports.

Toledo School District: Collected historical utility data and performed utility data analysis for three schools.

Higher Education

OHSU School of Nursing & Medical Research Building: Collected historical utility data and performed utility data analysis for the two medical teaching facilities.

Oregon University System – Climate Action Plan: Collected historical utility data and performed utility data analysis for seven Oregon State campuses. The utility data analysis was done at the campus level and at the building level for selected buildings.

Municipal

Montgomery Park Building: Collected historical utility data and performed utility data analysis for commercial facility.

Eugene Water & Electric Board - Steam Audits: Collected historical utility data and performed utility data analysis for the majority of buildings on a district steam system that is to being phased out.

Tualatin Hills Parks and Recreation District: Collected historical utility data and performed utility data analysis for several community recreational facilities. Continued to track the energy usage at these facilities through the measurement and verification phase of the project.

Industrial

Genentech Fill and Finish Facility: Performed document control tasks that included collecting, assembling and checking for completion and accuracy the design documents, technical submittal documents, test reports, performance tests, start-up, and commissioning reports.

Brandon Adams, CEM, NaCSBA

EDUCATION

- Associates of Applied Science, Energy Management Technician 2003
- University of Oregon School of Business
  Mastery in Communication
  Leadership in Action Certificate, 2003

ACCREDITATIONS

- Certified Energy Manager, AEE 2007
- Nationally Certified Sustainable Building Advisor 2006

AFFILIATIONS

- Oregon Association of Professional Energy Managers, Past President, Current Board Member
  2005 – present
- Association of Energy Engineers

QUALIFICATIONS

- Program Manager for ODOE
- Former Oregon Rebuild America Representative
- Public Procurement
- Design Reviews
- Energy Study Quality Control
- Project Management
- Energy Conservation Projects
- Measurement and Verification
- Energy Conservation Studies
- HVAC Retrofit Projects
- BETC Applications
- Energy Trust of Oregon Incentives
- Other Utility Incentive Coordination
- Govt. Affairs

TENURE

Brandon has over 10 years of industry experience.

PROJECT DIRECTOR

Brandon is responsible for overseeing all phases of the ESPC. His responsibility begins with analysis, continues through design and construction, and finishes with post project performance validation. He manages the project team from preliminary evaluation through final proposal, construction, and measurement and verification. His goal is to ensure that the overall performance and workflow of the project development, analysis, engineering, and performance assurance phases are maintained at the highest standards, and that the engineered solution meets the owner's desired outcome.

Brandon's seven+ years with the Oregon Department of Energy uniquely qualify him to help our clients navigate the sometimes complex funding vehicles available to them, ensuring that we are optimizing leveraging opportunities at all times.

Brandon and our staff of program managers, engineers, construction managers, commissioning agents, and measurement and verification staff work closely with all parties involved to identify innovative initiatives that not only increase the efficiency and comfort of the facilities, but also enhance the mission of the organization.

PROJECT RELATED EXPERIENCE

K-12

Bend LaPine School District, OR, High Performance School
Canby School District, OR, High Performance School
Coos Bay School Disitrct, OR, ESPC
Corvallis School District, OR, High Performance School
Crook County School District, OR, ESPC
Enterprise School District, OR, ESPC
Greater Albany Public Schools, OR, ESPC
Harper School District, OR, Lighting
Hood River County School District, OR, Energy Saving Performance Contract (ESPC)
Marion County, OR, ESPC
LaGrande School District, OR, ESPC
North Lake School District, WI, Lighting
Nyssa School District, OR, Lighting
Ontario School District, OR, Lighting
Parkrose School Distirct, OR, ESPC
Portland Public Schools, OR, ESPC
Salem-Keizer School District, OR, ESPC
Scappoose School District, OR, Lighting
Springfield School District, OR, High Performance School
Sutherlin School District, OR, ESPC
Roseburg Public Schools, OR, ESPC
Willamina School District, OR, ESPC
Yamhill-Carlton School District, OR, ESPC

HIGHER EDUCATION

Blue Mountain Community College, OR, ESPC
Oregon University System, Climate Action Plan

MUNICIPAL

Eugene Water and Electric Board, OR, Design Consulting
Oregon Health Sciences University, ESPC

FEDERAL

Veterans Affairs, (Portland, White City, Roseburg), ESPC

Dennis Oberto, LEED® AP

EDUCATION

- San Jose State University - Bachelor of Science Environmental Studies

ACCREDITATIONS

- LEED® AP BD+C
- SEED
- APEM – OR
- AEEE
- Green Building Certification
- USEPA - Green Lights
- PPL – FinAnswer Commissioner
- USDOE - IBP
- BPA - Level I, II and III Analyst & Inspector
- OUS - Master Conserver

SPECIALTIES

- Energy Studies and Audits
- HVAC & Building Mechanical Systems
- eQUEST, Trace building modeling
- Alternative Energy Systems
- Schools
- Natatoriums
- Commercial Buildings
- Corrections Facilities
- Energy Conservation Projects
- Design Reviews
- Measurement and Verification
- Demand Side Management Programs

TENURE

Dennis Oberto has more than 30 years of industry experience.

ENERGY ENGINEER

Dennis' 30 years of energy auditing (field and modeling) experience gives him an expert level understanding of how building construction and mechanical systems must work together to achieve optimal building conditions through energy efficient methods. Dennis has extensive experience performing energy audits for state, utility, federal (BPA), regional, and local energy programs. He has performed energy efficiency audits and measure verification for pools and natatoriums, commercial, K-12, higher education, city, county, state, federal, and industrial buildings. He has audited over 1,500 buildings and over 25 million sq. ft. of building space.

He has performed M&V, Cx or Energy Audits for Housing & Urban Development, Institutional Buildings Program, Commercial Audit Program, Portland General Electric , Northwest Natural Gas, Pacific Power & Light, Emerald People's Utility District, State Home Oil Weatherization, Residential Conservation Standards, Energy Edge, Energy Smart Design, Federal Energy Management Program, BPA and others.

He has proficiency with the following modeling software: eQuest, Trane Trace, Visual DOE, Energy Smart Pools, ASEAM, SEA, ACES, TrakLoad, PC-DOE, and VCACS. He was the primary energy modeler for "A Comparative Evaluation of Commercial Building Energy Simulation Software," BPA — Corson, G., (1990). He has proficiency with BPA's Lighting Calculator and ASD Calculator software.

Dennis is responsible for field verification, site surveying, data logging, and energy analysis and calculations, Dennis will work with our clients to identify the needs within a facility and determine how to meet those needs in a cost effective manner.

PROJECT RELATED EXPERIENCE

Developed, studied, performed, or reviewed energy and water savings audits and calculated savings for multiple schools in the following school districts:

Centennial School District
Dallas School District
Hood River County School District
Sheridan School District 48j
Three Rivers School District
Yamhill-Carlton School District 1
Warrenton-Hammond School District
Astoria 1*
Athena-Weston 29rj*
Beaverton 48j*
Bend/Lapine 1*
Brookings-Harbor *
Canby 86*
Cascade 5*
Centennial 28j*
Central 13j*
David Douglas 40*
Dayton 8*
Eugene 4j*
Forest Grove*
Gaston 511j*
Gervais 1*
Gladstone 115*
Glendale 77*
Grants Pass 7*
Grant Union*
Greater Albany 8j*
Gresham*
Gresham-Barlow 10j*
Hillsboro 1j*
Imler*
Jefferson 14j*
John Day*
Klamath County*
Lake Oswego 7j*
Medford 549*
McMinnville 40*
Newberg 29j*
North Clackamas 12*
North Marion 15*
Nyssa 26*
Oakland 1*
Oakridge 69*
Oregon City 62*
Perrydale 21*
Portland 1j*
Rogue River 35*
Roseburg 4*
Salem/Keizer 24j*
Seaside 10*
Silver Falls 4j*
St Helens 502*
St Paul 45*
The Dalles 12*
Vernonia 47j*
West Linn-Wilsonville 3j*
Willamina 30j*
Woodburn 103*

* Experience with prior firms

MUNICIPAL

Eugene Water & Electric Board

Analyzed the space heating and domestic water heating systems energy use and proposed code and efficient replacement systems in 55 private and public buildings to separate them from EWEB district steam system.

Lane County Adult Corrections

Developed and studied energy savings measures via eQUEST, providing guaranteed energy savings for measures studied, created the scopes of work, and worked with utilities for rebates. Key projects implemented include, high efficiency condensing boilers, condensing hot water heater, lighting upgrades, and dual duce constant volume system to VFD controls.

Lane County Courthouse

Developed and studied energy savings measures via eQUEST, providing guaranteed energy savings for measures studied, created the scopes of work, and worked with utilities for rebates. Key projects implemented include, high efficiency condensing boilers, condensing hot water heater and VFD cooling tower controls.

Marion County Work Release Center

Developed and studied energy savings measures via eQUEST, providing guaranteed energy savings for measure studied, created the scopes of work.

Marion County Courthouse

Used eQUEST to study energy savings measures providing guaranteed energy savings for measure studied, created the scopes of work, and worked with utilities for rebates. Key projects implemented include, improved digital controls systems, high efficiency condensing boilers, condensing hot water heater, lighting upgrades, VAV system upgrades and VFD installations.

HIGHER EDUCATION

Oregon University System

Performed audits of all the OUS campus (Oregon State University, Portland State University, Western Oregon University, Eastern Oregon University, Southern Oregon University, and Oregon Institute of Technology) to provide information needed for Climate Action Planning.

FEDERAL

Oregon Veterans Affairs

Performed audits of two of the VA campus (White City and Roseburg) to provide information needed for ESPC energy audits. Reviewed energy savings measures, energy savings, and scopes of work. Key projects include: improved digital controls systems; high efficiency boilers; lighting upgrades; HVAC system upgrades; VFD; photovoltaic; biomass boilers.

SYSTEM SPECIFIC – POOLS

WILLAMALANE POOLS*

Developed and studied energy and water savings measures, calculated energy savings for each measure studied.

Hood River Pool*

Developed and studied energy and water savings measures, calculated energy savings for each measure studied. Key projects implemented include improved controls systems, high efficiency boiler and hot water heater and solar pool heating system installations.

Tualatin Hills Parks and Recreation Department

Energy Audit and recommendation of construction projects for reduction in energy use for seven pools/natatoriums.

Portland Parks & Recreation Pools*

Developed and studied energy and water savings measures, calculated energy savings for each measure studied.

La Grande Pool*

Developed and studied energy and water savings measures, *calculated energy savings for each measure studied.*

Astoria Pool*

Developed and studied energy and water savings measures, calculated energy savings for each measure studied.

St Helens Pool*

Developed and studied energy and water savings measures, calculated energy savings for each measure studied.

***** Experience with prior firms

Felix Kersting, P.E., QCxP

EDUCATION

- Portland State University - Bachelor of Science, Mechanical Engineer, 1988
- University of Wisconsin - Qualified Commissioning Provider (QCxP), 2004
- Journeyman Plumber, 1979

ACCREDITATIONS

- Licensed Professional Engineer Oregon, 1992

AFFILIATIONS

- ASHRAE, 2000
- APEM - OR, 2008

QUALIFICATIONS

- Energy Management & Control Systems
- HVAC & Building Mechanical Systems
- Chiller Plant Optimization
- HVAC Optimization
- Energy Analysis
- Excel based calculations
- Trane Trace modeling
- Utility Data Analysis
- Building Commissioning
- Retro Commissioning
- Cleanrooms
- Solar Domestic Hot Water
- Biomass Boilers
- Directed Engineering Studies
- Facility Auditing
- Value Engineering
- Constructability Review
- Machine design & Hydraulics
- Journeyman Plumber
- Small Business Owner

TENURE

Felix has 14 years of plumbing experience and has worked as an engineer since 1988.

ENERGY ENGINEER

Felix joined the McKinstry team in 2006 and is responsible for energy use calculations, cooling and heating load calculation oversight, utility rebate support, water savings/alternative energy/solid waste system evaluations, mechanical equipment selection and design oversight, and HVAC system and controls design oversight. Felix also works closely with the cost estimating team, design team, M&V specialist and commissioning agent to insure that his original intent for measures remains intact through the process. Felix's experience in commercial and industrial HVAC, plumbing, controls, and commissioning make him capable of critical decisions across disciplines.

His expertise has supported many schools, colleges, universities, commercial and industrial customers by developing energy saving projects that improve comfort, reduce maintenance costs, and update outmoded equipment while meeting the financial needs of the owner.

Felix also serves as a volunteer at the University of Portland, lending technical and process expertise to the Biodiesel Club.

KEY EXPERIENCE

- ✓ Installed over 100 of solar domestic water heaters as a plumbing contractor (1979 through 1986).
- ✓ Designed and implemented energy saving projects that resulted in a 20% reduction in energy use and an award from Governor Gary Locke at a local high tech fab (2000).
- ✓ Provided energy audits and project development, including boiler sizing for the first biomass boiler installed in a school in the State of Oregon in over 50 years (2007)

PROJECT RELATED EXPERIENCE

K-12 Projects

Evergreen School District – Audited 13 buildings, developed savings measures, calculated guaranteed energy savings, created the scopes of work & Sequence of Operations for DDC system replacement/upgrades, and worked with utilities for rebates. Key projects implemented include replacement of 23 roof units, DDC control system replacement, DDC control system upgrades, and lighting controls.

Oakridge Elementary School – Audited building, modeled building in Trace to determine appropriate boiler size, and created the scopes of work. Key projects implemented include installation of a biomass boiler.

Days Creek Charter School – Audited two buildings, modeled building in Trace to determine appropriate boiler size, and created the scopes of work. Key projects implemented include installation of a biomass boiler and steam trap replacement.

Hood River County School District – Audited 14 schools and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrade, and worked with utilities for rebates. Key projects implemented include new district wide web based digital controls, installation of 7 new boilers, replace HVAC systems, trash compaction, steam trap replacement, retro-commissioning, and lighting upgrades.

K-12 Projects Continued
LaGrande School District – Audited five schools and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrade, and worked with utilities for rebates. Key projects implemented include upgraded digital controls, installation of two new gas boilers, one new boiler burner, steam trap replacement, retro-commissioning and lighting upgrades.

Enterprise School District – Audited three schools and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrade, and worked with utilities for rebates. Key projects implemented include upgraded digital controls, installation of a biomass boiler, retro-commissioning and lighting upgrades.

Prune Hill Elementary (Camas School District) – Audited one school and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scope of work & Sequence of Operations for DDC system replacement, and worked with utilities for rebates. Key projects implemented include replaced digital controls, right-sized 12 heat pumps, fluid cooler piping modifications, retro-commissioning and lighting upgrades.

Caldwell School District – Audited 12 schools, developed energy, and water savings measures, calculated guaranteed energy savings for each measure, developed scope of work, and worked with utilities for rebates.

Willamina School District – Audited three schools and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrade, and worked with utilities for rebates. Key projects implemented include new digital controls, installation of two new heat pumps, retro-commissioning, window replacement, and lighting upgrades.

Commercial Projects
Montgomery Park – Audited facility, developed savings measures, calculated guaranteed energy savings, created the scopes of work & Sequence of Operations for DDC system upgrades, and worked with utilities for rebates. Key projects implemented include Cooling tower replacement, VFD additions, pump replacements, building wide plumbing fixture replacements, DDC controls upgrades and lighting projects.

U.S. Bank Tower – Audited facility and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrades and worked with utilities for rebates. Key projects implemented include upgraded digital controls (chiller plant re-sequencing, optimal start and night purge), chiller plant piping modification, and retro-commissioning.

Higher Education Projects
Oregon Health and Sciences University (OHSU) – Audited School of Nursing And Medical Research Building, developed savings measures, calculated guaranteed energy savings, created the scopes of work & Sequence of Operations for DDC system upgrades, and worked with utilities for rebates. Key projects implemented include removing an older chiller from operation and tying a chilled water loop from a large plant in a nearby building to the existing loop for improved efficiency when cooling. Added floor-by-floor cooling to the same building to reduce simultaneous heating and cooling. Steam trap and valve repair/replacement, controls upgrades including DCV, VFD additions, and retro-commissioning of 125 pneumatic VAV box controllers, valves, and thermostats.

Umpqua Community College – Provided ETO audits for 13 buildings, developed energy, and water savings measures, estimated energy savings for each measure and estimated utility rebates.

Municipal Projects
Firstenburg Community Center – Audited facility and developed energy and water savings measures, calculated guaranteed energy savings for each measure, created the scopes of work & Sequence of Operations for DDC system upgrades, and worked with utilities for rebates. Key projects implemented include upgraded digital controls, pool pump VFD, re-sequenceing of gas boilers, retro-commissioning VAV system, ductwork modifications and lighting control upgrades.

Gabe Johnson, MBA, CEM

EDUCATION

- UC Santa Barbara
  Bachelor of Science
  Mechanical Engineering
- University of Phoenix
  Masters of Business Administration
  Technology Management

ACCREDITATIONS

- Certified Energy Manager No. 13210

AFFILIATIONS

- Senior Member – Association of Energy Engineers
  2008-Present
- Member of International Facility Managers Association (IFMA)

QUALIFICATIONS

- Energy Saving Performance Contracting
- Renewable Energy
- HVAC Direct Digital Controls
- Internal and External Project Promotion
- Utility Rebate Negotiations
- Cash Flow Analysis and Program Financial Development
- Energy Audits and Needs Assessments
- Mechanical System Design

TENURE

Gabe Johnson has over 12 year's industry experience.

ACCOUNT EXECUTIVE

As an Account Executive, Gabe is responsible for developing energy savings performance contracting (ESPC) solutions for clients throughout Oregon and Southwest Washington. His tasks include securing utility rebates, Business Energy Tax Credits, and sourcing the best financing package for the ESPC project. Gabe works with clients to coordinate the promotion of the project to internal and external stakeholders, as well as insuring the overall satisfaction of the client from project conception to project closeout.

Gabe has been working in the HVAC/Energy Efficiency market for over 12 years. Gabe began his career as an account manager responsible for the distribution of HVAC controls peripheral devices. Gabe transitioned into the Direct Digital Controls market and gained valuable experience and knowledge of HVAC controls and energy management systems.

Gabe brings a unique and diversified set of skills to the McKinstry team. With a technical background in mechanical engineering (BSME), a business degree (MBA) with an emphasis in Technology Management, and an energy certification (CEM), Gabe assists clients in understanding the full spectrum of an Energy Savings Performance Contract.

PROJECT RELATED EXPERIENCE

HIGHER EDUCATION

Columbia Gorge Community College Energy Management Controls
CGCC – $225,000

Blue Mountain Community College ESPC
$2,100,000

MUNICIPAL

Deer Ridge Correctional Institute Energy Management Controls*
DRCI – $2,000,000

Department of Public Safety and Standards Training Energy Management Controls*
$600,000

HEALTHCARE

Kaiser Hospital Energy Management Controls*
$2,500,000

K-12

Banks School District ESPC
$550,000

Estacada School District ESPC
$1,800,000

Stanfield School District ESPC
$500,000

Dallas School District ESPC
$3,900,000

Evergreen Public Schools ESPC
$4,400,000

Toledo School District ESPC
$550,000

OTHER
Montgomery Park ESPC
$3,000,000

* Experience with prior firms.

Jason Carver, CMVP

EDUCATION

- Oregon State University, Bachelor of Science Mechanical Engineering, 2003

ACCREDITATIONS

- Oregon State Board of Examiners for Engineering and Land Surveying, EIT
- International Performance Measurement and Verification Protocol, CMVP

AFFILIATIONS

- ASHRAE, 2004

QUALIFICATIONS

- HVAC & Building Mechanical Systems
- Measurement and Verification
- Estimating
- Construction Management
- Energy Analysis
- Building Energy Surveys
- Greenhouse Gas Inventories
- Energy Conservation Studies
- Energy Conservation Projects

TENURE

Jason has worked in the industry since 2003.

PERFORMANCE ASSURANCE SPECIALIST

Jason holds the position of Performance Assurance Specialist (PAS) at McKinstry. Jason is responsible for verifying energy savings from measures implemented for McKinstry customers, energy/utility use analysis and savings calculations, and utility rebate support. While working as an engineering consultant, construction project manager, energy engineer, and as a PAS since graduation from Oregon State University, Jason gained experience with building control systems, mechanical systems and how they must work together to achieve optimal building conditions through an energy efficient method while remaining constructible.

As a Performance Assurance Specialist, Jason works with our clients to identify project performance metrics, verify project performance, and ensure that system performance metrics are maintained. Jason joined the McKinstry team in 2005.

His expertise has supported many schools, colleges, universities, hospitals, commercial and industrial customers by leveraging his knowledge of building systems to help carry a facility improvement project from development through performance assurance. Jason is motivated to provide clients with innovative solutions focused on reducing their utility and operational costs and improving their operations.

He has had the opportunity to be involved with many successful projects throughout Oregon and Southern Washington.

KEY EXPERIENCE

- ✓ Job experience in the following areas of construction: Project Management, Estimating, Energy Engineering, Project Development, and Project Performance Assurance.

PROJECT RELATED EXPERIENCE

MUNICIPAL

Tualatin Hills Parks and Recreation Department

Energy Audit and recommendation of construction projects for reduction in energy use. Implementation of performance assurance strategy for energy savings.

Eugene Water and Electric Board

Performed audits of buildings on EWEBs steam system and developed recommendation reports for the buildings to transition off of central steam.

K-12

Camas School District

Energy Audit and recommendation of construction projects for reduction in energy use.

Dallas School District

Energy Audit and recommendation of construction projects for reduction in energy use. Implementation of performance assurance strategy for energy savings.

Days Creek School District

Implementation of performance assurance strategy for energy savings related to a Biomass Boiler.

Estacada School District

Implementation of performance assurance strategy for energy savings related to a Biomass Boiler.

Hood River County School District

Implementation and execution of performance assurance strategy for energy savings related to lighting and mechanical energy efficiency upgrades.

Oakridge School District

Implementation of performance assurance strategy for energy savings related to a Biomass Boiler.

Toledo School District

Energy Audit and recommendation of construction projects for reduction in energy use.

Vancouver School District

Energy Audit and development of construction projects for reduction in energy use.

RESIDENTIAL

Ashforth Pacific

Estimation and construction management of tenant improvements for high-rise buildings in Ashforth's Portland portfolio.

TMT Development

Estimation and construction management of tenant improvements for high-rise buildings in TMT's Portland portfolio.

Brewery Blocks (PREM Group)

Estimation and construction management of tenant improvements for high-rise buildings in PREM's Brewery Blocks facilities.

HIGHER EDUCATION

Oregon University System

Performed audits of all the OUS campus to provide information needed for Climate Action Planning.

Blue Mountain Community College

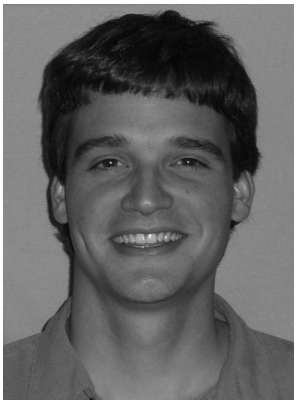
Energy Audit and recommendation of construction projects for reduction in energy use.

FEDERAL

U.S. Federal Government

Energy Audit and recommendation of construction projects for reduction in energy use at facilities served by Bonneville Power Administration.

Joe Fuetsch



EDUCATION

- Colorado State University - Bachelor of Science, Mechanical Engineering, 2005

AFFILIATIONS

- APEM 2008 -2012

QUALIFICATIONS

- Project Development
- Construction Management
- Estimating
- Constructability Review
- Energy Management & Control Systems
- HVAC & Building Mechanical Systems
- Utility Data Analysis
- Incentives
- Energy Service Performance Contract Management
- Measurement and Verification Installations
- Energy Conservation Studies

TENURE

Joe Fuetsch has more than nine years of industry experience and six years of experience with McKinstry.

PROGRAM MANAGER

Joe is responsible for managing the development, scope, and engineering of the client's energy and utility conservation measures. He will manage the team from preliminary evaluation through to the final proposal. This includes overseeing the project scope and development phases of work.

Joe will ensure the overall performance and workflow of the project's development, analysis, engineering, construction, and performance assurance to meet the highest standards. Joe and our staff of engineers work closely to identify innovative initiatives, determine construction costs and savings, and mitigate project risks. He will also secure all utility grants and Business Energy Tax Credits on behalf of our clients.

Joe provides a unique advantage for this project. His experience as a Construction Manager, Program Manager, and Energy Auditor results in a well-diversified education in tangible solutions for our clients. His specific insight will ensure systems are designed, installed and perform to the anticipated energy savings.

BOILER-SPECIFIC EXPERIENCE

- ✓ Joe has preformed energy audits on over 80 facilities in Oregon; 80% of these facilities included boiler plants in which the boiler systems were evaluated for boiler burner upgrades or replacements.

PROJECT RELATED EXPERIENCE

K-12

Banks School District, OR

Energy Savings Performance Contract (ESPC)

Replaced oil fired burner with a new modulating gas fired burner.

Corbett School District, OR, ESPC

Greater Albany School District, OR, ESPC

Hood River County School District, OR

ESPC

Replaced four boilers with new condensing hot water boilers and tuned 13 burners throughout the district.

Parkrose School District, OR, ESPC

Portland Public Schools, OR, Energy Audit

Roseburg School District, OR

ESPC

Replaced there natural gas boiler burners with modulating burners, preformed testing and tuning on 22 other boiler through the district.

Salem Keizer School District, OR, ESPC

Stanfield School District, OR, ESPC

INDUSTRIAL
Reklaim Technologies, WA
Tire Reclamation Industrial Processing

COMMERCIAL
Unico Bank Tower, WA
Commercial Building Energy Audit & Commissioning

Integra Telecom
Energy Audit

HIGHER EDUCATION
Blue Mountain Community College, OR
ESPC
Evaluated three boiler systems and replaced with new condensing gas fired boilers.

George Fox University, OR
ESPC

FEDERAL
Veterans Affairs, White City
ESPC

MUNICIPAL
Hood River County, OR
ESPC

Jon Eicher, P.E.

EDUCATION

- Oregon State University Bachelor of Science Mechanical Engineering, 2003

ACCREDITATIONS

- Licensed Professional Engineer Oregon, 2009

AFFILIATIONS

- ASHRAE, 2009
- APEM - OR, 2007

QUALIFICATIONS

- Energy Management & Control Systems
- HVAC & Building Mechanical Systems
- Utility Data Analysis
- eQUEST modeling
- Performance Assurance Plan Development
- Utility Bill Assessments

REFERENCES

Available upon request

TENURE

Jon has worked in the industry since 2005.

ENERGY ENGINEER

Based out of our Portland Office, Jon is responsible for energy use calculations, cooling and heating load calculation oversight, utility rebate support, water savings opportunity evaluations, alternative energy opportunities, solid waste system evaluations, mechanical equipment selection and design oversight, and HVAC system design oversight.

Since graduating from Oregon State University, Jon has gained experience working as a controls contractor, site supervisor, energy auditor, and as an energy engineer. Jon has a thorough understanding of building control and mechanical systems and how they must work together to achieve optimal building conditions through an energy efficient method.

As a McKinstry Energy Engineer, Jon works with our clients to identify the needs within a facility and determines how to meet those needs cost effectively. Jon has audited over 200 buildings, and over 7 million square feet of building space.

PROJECT RELATED EXPERIENCE

Salem-Keizer School District
Greater Albany Public Schools
Dallas School District
Parkrose School District
Estacada School District
Three Rivers School District
Coos Bay School District
Willamina School District
Roseburg School District
South Umpqua School District
Oregon Health and Sciences University
George Fox University
Sheridan School District
Stanfield School District
Sutherlin School District
Days Creek School District
Three Rivers School District *
Tigard-Tualatin School District *
US Post Office*

*Experience with prior firms

Kirk Carl

CERTIFICATIONS/LICENSES

- EPA Universal Refrigeration CFC Certified
- OSHA Forklift Operator Trainer Certified
- Green Plumbers Certificate
- Certified Quality Assurance Inspector for USN

SPECIALTIES

- Commissioning
- Retro-Commissioning
- Critical Environments
- Facility Management
- Project Management
- Bio-Tech Laboratories
- Control & Mechanical Sys. Verification
- Sequence of Operation Development
- Test, Adjust, and Balance
- Boilers and Chillers
- Ultra Pure Water, De-Ionization, and Auxiliary Water Systems
- Acid Waste Neutralization
- Development of Preventive Maintenance Schedules
- Fisher Rosemount Delta-V controls

TENURE

Kirk has worked in the industry since 1992.

COMMISSIONING ENGINEER

Kirk Carl is a Commissioning Engineer with over 18 years' experience in the high tech, educational, and commercial markets. He specializes in hot water and steam boilers, chillers, pneumatics, hydraulics, generators, PLC controls, and DDC systems. He is responsible for commissioning, test and balance tasks, facility management and monitoring, in addition to working in conjunction with the client and McKinstry's construction department. Kirk's responsibilities include ensuring the system design intents are met while delivering safe and efficient building operations to the owner. He provides each project with specialized expertise resulting in both project and client satisfaction. Kirk has been with McKinstry since December of 2004.

EXPERIENCE

Kirk has provided commissioning, controls, and other miscellaneous services for the following projects:

MUNICIPAL

Tualatin Hills Park & Recreation
Controls, lighting, and boiler commissioning
Center for Disease Control
Service and small projects

K-12

Hood River School District
Controls commissioning and retro-commissioning
Dallas School District
Controls and Boiler Commissioning
Parkrose School District
Commissioning and retro-commissioning

HEALTHCARE

Providence Medical
Retro-commissioning

HIGHER EDUCATION

Portland Community College
Service and small projects

INDUSTRIAL

Laser Processing Technologies
Service and small projects
Genentech
Commissioning
IBM
Service and small projects
Credence
Service and small projects
Cummins Diesel

Mike Shadley

EDUCATION

- Western Michigan University, Construction Management, 1994
- Electrical Apprentice Program, 1996

AFFILIATIONS

- Construction Management Association of America (CMAA) 2009

SPECIFIC QUALIFICATIONS

- Design Build
- Project Management
- Contract Negotiation
- Account Management
- Scheduling
- Estimating
- Constructability Review

TENURE

Mike Shadley has over 22 years of industry experience.

SENIOR CONSTRUCTION MANAGER

Mike is a Senior Construction Manager based out of McKinstry's Portland office. Mike is directly responsible for managing the construction-based scope, budget and schedule, and the coordination of all trades working on the project(s). Mike's primary focus is on the safety of the staff and clients and the success of overall project implementation from beginning to end.

Mike plays a key role within McKinstry's project development team. Mike is charged with reviewing all design documents to ensure contractibility as well as maintainability. Mike also reviews budgets at several stages during design to make sure the entire scope of work is accounted for early in the project. Once construction begins, Mike is the bridge for information between design schedule and construction.

KEY EXPERIENCE

Natatorium Experience
Mike has recently completed (5) Pool Lighting Upgrades for the Tualatin Hills Parks & Recreation; Aloha , Beaverton , Conestoga, Harman and the 50-meter pool at Howard M Terpenning Complex; (3) Automatic Pool Cover upgrades; Aloha, Sunset and Harman using Alta Enterprises, two of which requiring structural upgrades; and Control upgrades to Conestoga Recreation Center and Tualatin Hills Parks & Recreation Admin building.

EXPERIENCE

High-Tech
Asahi Glass, Hillsboro, OR* — $11M
Fujimi FO, Tualatin, OR* — High Tech Manufacturing Facility — $15M

Higher Education
Center for Visual Arts, Southern Oregon University, Ashland, OR* —$12M
Western Culinary Institute, Portland, OR* — $4.5M

Municipal
City of Vancouver, WA – Evidence/Crime Lab Facility* ($2.9M) and West Precinct Police Facility* ($6.4M)
Hilo Judiciary Complex, Hilo, HI* — $59M
Montgomery Park Building, Portland, OR — Cooling Tower Replace, Lighting and Controls Upgrade ESPC — $2.9M
Tualatin Hills Parks & Recreation, Beaverton, OR — ESPC — $1.7M

K-12
Enterprise School District, Enterprise, OR — Biomass Boiler System ESPC —$1.6M
Estacada School District, Estacada, OR — Biomass Boiler System ESPC ($1.0M) and Control Upgrade ESPC ($0.5M)
Evergreen School District, Vancouver, WA — Rooftop Unit Replacement with Full Control Upgrade (2 Schools) ESPC — $4.1M

Vancouver School District, Vancouver, WA — Heating and Lighting Upgrade ESPC — $0.7M

Dallas School District, Dallas, OR — Control Upgrade (5 Schools) ESPC ($1.5M), Complete Energy Plan Upgrade (5 Schools) ESPC ($3.2M), and Lighting Upgrade ESPC ($0.1M)

Retail

Orvis Shop, Bend, OR* — $3M

The Shops at the Old Mill District, Bend, OR* — $11M

*Experience with prior firms

Tom Konicke, P.E., LEED-AP

EDUCATION

- Purdue University, Bachelor of Science, Mechanical Engineering, 1992

ACCREDITATIONS

- Registered Professional Engineer, OR 65661PE
- USGBC LEED AP Accredited Professional
- BCxA Building Commissioning Professional Development Program graduate

SPECIALTIES

- K-12 Energy Efficiency Project Development
- Commercial Office Building Energy Projects
- Performance-Based Contracting
- High-Tech Facility Efficiency Project Development
- Demand Side Management Programs
- Securing Utility Rebates
- Directed Engineering Studies
- Mechanical System Design
- Measurement and Verification
- Carrier HAP, Trane Trace, and eQuest modeling experience

TENURE

Tom has been with McKinstry since 2004 and has worked in the Mechanical Design/Build and Energy Efficiency industry since 1992.

OPERATIONS MANAGER

For more than 18 years Tom has provided clients with facility upgrade solutions in all aspects of their buildings. His working experience includes Energy Efficiency Analysis Services, Building Systems Condition Assessment Services, Performance Contracting, Commissioning Services, and Mechanical HVAC Preliminary Design. Tom's role as McKinstry's Operations Manager for the Energy & Facility Services (E&FS) Team in Portland, Oregon, allows him to extend his extensive experience to his team of 25 individuals focused on developing energy efficiency and facility infrastructure upgrade projects for their clients throughout their region.

Tom is responsible for leading the Project Development and Operations teams, which include project directors, program managers, construction managers, energy engineers, energy analysts, and performance assurance specialists. Tom and the E&FS team work to identify and implement facility improvement projects that provide energy, building utility, and operational cost savings for clients.

While working closely with clients, Tom Konicke can identify and implement facility improvement projects that will provide energy savings to reduce their building(s) utility and operational costs. Tom's relationships with the Energy Trust of Oregon and with the Oregon Department of Energy also maximize the benefits of performing energy implementation services through McKinstry.

EXPERIENCE

Project Name	Type of Project	Cost
Ask.com Data Center	DB-Mech, CM/GC n	$14M
Camas SD	ESPC	$650K
City of Vancouver – Firstenberg	ESPC	$220K
City of Washougal	ESPC	$300K
Coos Bay SD	ESPC	$1.7M
Corban College	ESPC	$600K
Crook County SD	ESPC	$1.2M
Oakridge SD	ESPC	$140K
Enterprise SD	ESPC & Biomass Boiler	$1.9M
George Fox University	ESPC, CM/GC	$322K
Greater Albany Public Schools	ESPC	$4.6M
La Grande SD	ESPC	$990K
Lane County Adult Corrections	ESPC	$3.5M
Marion County	ESPC	$4.0M
Mt Angel SD	ESPC	$550K
Parkrose SD	ESPC	$2.2M
Roseburg SD	ESPC	$1.68M
Salem Keizer SD	ESPC	$3.2M
South Umpqua SD	ESPC	$465K
SP Newsprint*	CM/GC	$300K
Sutherlin SD	ESPC	$381K
Three Rivers SD	ESPC	$1.4M
US Bancorp Tower	Commercial Building Energy Audit & Cx	$40K
Willamina SD	ESPC	$586K

Trey Scavone

EDUCATION

- Bradley University
  College of Engineering Bachelor of Science Construction Management, 1998
- Bradley University
  College of Business, Bachelor of Science, Business Management, Minor in Technical Writing, 1998

QUALIFICATIONS

- Operations Management
- Project Development
- Contract Negotiation
- Account Management
- Business Development
- Estimating
- Constructability Review

AFFILIATIONS

- APEM Since 2010

TENURE

Trey Scavone has more than 19 years of industry experience and has been with McKinstry for eight years.

SENIOR CONSTRUCTION MANAGER

As Senior Construction Manager Trey's primary role is to ensure that the proper resources are alloted to each and every project his team works on.

During development Trey acts as a resource for the team when it comes to reviewing constructibility, developing budgets and with the customer financial creiteria. Trey also personally oversee the development and execution of the contract and bond.

Trey is the cornerstone of the Construction Team once projects enter the implemntation phase. Safety, schedules, budgets, means and methods are all the responisbility of the Sr. Construction Manager and Trey leveraging his years of experience in ESCO contracting to ensure a flawlees delivery while limiting risk for both McKinstry and the client.

EXPERIENCE

K-12

Banks School District
$550,000
Camas School District
Coos Bay School District
Crook County School District
Days Creek School District
Enterprise School District
Ellensburg School District
Greater Albany Public Schools
Mt Angel School District
Oakridge School District
Parkrose School District
Roseburg School District
Salem Keiser School District
Spokane Public Schools*
Three Rivers School District
Toledo Public Schools
$550,000
Vancouver School District
Warrenton-Hammond School District
Project included QZAB and SB1149 funding along with a CEWO grant and over $50K in guaranteed annual energy savings to replace boilers and control systems in both the grade school and the high school.
Wilbur School District
Yakima Valley School District

HEALTHCARE

Cancer Care NW Genetic Engineering*
Dr. Toillion and Toillion*

HIGHER EDUCATION

Eastern Washington University
Washington State University
Whitman College*

HOSPITALITY

Eugene Hilton and Conference Center

MUNICIPAL

Lane County Corrections
Lane County Courthouse
Marion County Corrections
Marion County Courthouse
Pend Oreille County
Pine Lodge Pre Release Facility

STATE

WA DOC – Pine Lodge

COMMERCIAL

Morscheck Professional Building*
Wal-Mart Remodel – Spokane Valley*
Wal-Mart Super Center – N. Spokane*

INDUSTRIAL

Reklaim, Inc.

* Experience with prior firms.