Chandler · Arizona Where Values Make The Difference	**PURCHASING ITEM FOR COUNCIL AGENDA**	**1. Agenda Item Number**: 19 **2. Council Meeting Date**: August 27, 2009
TO:	**MAYOR & COUNCIL**	**3. Date Prepared**: July 17, 2009
THROUGH:	**CITY MANAGER**	**4. Requesting Department**: Community Services

5. SUBJECT: Approve Agreement No. BF9-220-2745 with Mechanical Products BAS Inc. for an Energy Management System in an amount not to exceed $1,262,473.

6. RECOMMENDATION: Approval of Agreement No. BF9-220-2745 with Mechanical Products BAS Inc. for an Energy Management System in an amount not to exceed $1,262,473.

7. HISTORICAL BACKGROUND/DISCUSSION: The existing proprietary Energy Management System (EMS) used at twelve (12) City facilities for the past twenty years for the control of heating, venting, air conditioning and lighting has come to the end of its useful life due to technological advancements and the inability to purchase replacement components. City staff has seen an increase of time required in resolving programming issues of equipment coupled with the lack of manufacturers support. The proposed EMS system utilizes an open protocol form of communication. This will allow the City to avoid a single source for future expansion requirements and maintenance. The City would be able to have access to non-proprietary parts in an acceptable period of time, make citywide changes in an expedient manner, predict system-wide energy usage and cost, improve indoor environmental quality and track energy related costs.

8. EVALUATION PROCESS: In May 2009, City staff issued a Request for Proposal (RFP) for an Energy Management System. A pre-proposal conference was held May 27, 2009 in which 11 vendors attended. The RFP was advertised and all registered vendors were notified. A total of 6 responses were received. A panel of 6 evaluators, including two outside consultants, performed the evaluations.

Mechanical Products BAS - $1,052,061
Honeywell - $1,458,313
ECI - (unable to meet specifications)
Johnson Controls Inc - (unable to meet specifications)
Control Engineering - (non-responsive)
GICS - (non-responsive)

Staff is requesting an additional 20% contingency to cover test and balance requirements and unforeseen equipment replacements, bringing the total amount requested to $1,262,473. Staff is recommending award to Mechanical Products BAS Inc, who was deemed to have submitted the most responsive and responsible proposal.

9. FINANCIAL IMPLICATIONS:

Costs: $1,262,473
Savings: N/A
Long Term Costs: N/A

Fund Source:

Acct. No.:	Fund Name:	Program Name:	CIP Funded:	Funds:
101.3200.0000.6212	B&F Improvements-Interior	Energy Mgmt Replace	n/a	$1,262,473

10. PROPOSED MOTION: Move to approve Agreement No. BF9-220-2745 with Mechanical Products BAS Inc. for an Energy Management System in an amount not to exceed $1,262,473.	
Attachment: Agreement	
APPROVALS	
11. Requesting Department Kris Kircher, Parks & Facilities Maintenance Manager	**12. Department Head** Mark M. Eynatten, Community Services Director
13. Procurement Officer Sharon Brause, CPPB, CPCP	**14. City Manager** W. Mark Pentz, City Manager

CC Form 10 – 10/02

CITY OF CHANDLER SERVICES AGREEMENT
ENERGY MANAGEMENT SYSTEM
AGREEMENT NO.: BF9-220-2745

THIS AGREEMENT is made and entered into this day of , 2009, by and between the City of Chandler, a Municipal Corporation of the State of Arizona, hereinafter referred to as "CITY", and **MECHANICAL PRODUCTS BAS, INC.,** a Corporation of the State of Arizona, hereinafter referred to as "CONTRACTOR".

WHEREAS, CONTRACTOR represents that CONTRACTOR has the expertise and is qualified to perform the services described in the Agreement.

NOW THEREFORE, in consideration of the mutual promises and obligations set forth herein, the parties hereto agree as follows:

1. CONTRACT ADMINISTRATOR:

1.1. Contract Administrator. CONTRACTOR shall act under the authority and approval of the Building Maintenance Supervisor /designee (Contract Administrator), to provide the services required by this Agreement.

1.2. Key Staff. This Contract has been awarded to CONTRACTOR based partially on the key personnel proposed to perform the services required herein. CONTRACTOR shall not change nor substitute any of these key staff for work on this Contract without prior written approval by CITY.

1.3. Subcontractors. During the performance of the Agreement, CONTRACTOR may engage such additional SUBCONTRACTORS as may be required for the timely completion of this Agreement. In the event of subcontracting, the sole responsibility for fulfillment of all terms and conditions of this Agreement rests with CONTRACTOR.

1.4. Subcontracts. CONTRACTOR shall not enter into any Subcontract under this Contract for the performance of this Contract without the advance written approval of CITY. The subcontract shall incorporate by reference the terms and conditions of this Contract.

2. SCOPE OF WORK: CONTRACTOR shall provide an Energy Management System all as more specifically set forth in the Technical Specifications, labeled Exhibit B, attached hereto and made a part hereof by reference and as set forth in the Specifications and details included therein. Cabling Specifications (Exhibit D), Performance Bond (Exhibit E1), and Payment Bond (Exhibit E2 are attached and incorporated herein by reference. All addenda have been incorporated into the scope of work requirements herein.

2.1. Non-Discrimination. The CONTRACTOR shall comply with State Executive Order No. 99-4 and all other applicable City, State and Federal laws, rules and regulations, including the Americans with Disabilities Act.

2.2. Licenses. CONTRACTOR shall maintain in current status all Federal, State and local licenses and permits required for the operation of the business conducted by the CONTRACTOR as applicable to this contract.

2.3. Advertising, Publishing and Promotion of Contract. The CONTRACTOR shall not use, advertise or promote information for commercial benefit concerning this Contract without the prior written approval of the CITY.

2.4. Compliance With Applicable Laws. CONTRACTOR shall comply with all applicable Federal, state and local laws, and with all applicable license and permit requirements.

2.4.1 Pursuant to the provisions of A.R.S. § 41-4401, the Contractor hereby warrants to the City that the Contractor and each of its subcontractors ("Subcontractors") will comply with all Federal Immigration laws and regulations that relate to the immigration status of their employees and the requirement to use E-Verify set forth in A.R.S. §23-214(A) (hereinafter "Contractor Immigration Warranty").

2.4.2 A breach of the Contractor Immigration Warranty (Exhibit A) shall constitute a material breach of this Contract that is subject to penalties up to and including termination of the contract.

2.4.3 The City retains the legal right to inspect the papers of any Contractor or Subcontractor employee who works on this Contract to ensure that the Contractor or Subcontractor is complying with the Contractor Immigration Warranty. The Contractor agrees to assist the City in the conduct of any such inspections.

2.4.4 The City may, at its sole discretion, conduct random verifications of the employment records of the Contractor and any Subcontractors to ensure compliance with Contractors Immigration Warranty. The Contractor agrees to assist the City in performing any such random verifications.

2.4.5 The provisions of this Article must be included in any contract the Contractor enters into with any and all of its subcontractors who provide services under this Contract or any subcontract. "Services" are defined as furnishing labor, time or effort in the State of Arizona by a contractor or subcontractor. Services include construction or maintenance of any structure, building or transportation facility or improvement to real property.

2.4.6 In accordance with A.R.S. §35-397, the Contractor hereby certifies that the Offeror does not have scrutinized business operations in Iran.

2.4.7 In accordance with A.R.S. §35-397, the Contractor hereby certifies that the Offeror does not have scrutinized business operations in Sudan.

2.5. Warranties.

2.6. One-Year Warranty. CONTRACTOR must provide a one-year warranty on all work performed pursuant to this Contract.

2.7. Warranty (Equipment). All equipment supplied under this Contract shall be fully guaranteed by CONTRACTOR for a minimum period of one (1) year from the date of acceptance by CITY. Any defects of design, workmanship, or materials, that would result in non-compliance with the Contract specifications shall be fully corrected by CONTRACTOR (including parts and labor) without cost to CITY. The written warranty shall be included with the delivered products to the using Department.

3. ACCEPTANCE AND DOCUMENTATION: Each task shall be reviewed and approved by the Contract Administrator to determine acceptable completion.

3.1. Records. The CONTRACTOR shall retain and shall contractually require each SUBCONTRACTOR to retain all data and other "records" relating to the acquisition and performance of the Contract for a period of five years after the completion of the Contract.

3.2. Audit. At any time during the term of this Contract and five (5) years thereafter, the CONTRACTOR'S or any SUBCONTRACTOR'S books and records shall be subject to audit by the City to the extent that the books and records relate to the performance of the Contract or Subcontract. Upon request, the CONTRACTOR shall produce a legible copy of any or all such records.

3.3. **New/Current Products.** All equipment, materials, parts and other components incorporated in the work or services performed pursuant to this Contract shall be new, or the latest model and of the most suitable grade for the purpose intended. All work shall be performed in a skilled and workmanlike manner.

3.4. **Property of CITY.** Any materials, including reports, computer programs and other deliverables, created under this Contract are the sole property of CITY. CONTRACTOR is not entitled to a patent or copyright on those materials and may not transfer the patent or copyright to anyone else. CONTRACTOR shall not use or release these materials without the prior written consent of CITY.

3.5. **PRICE:** CITY shall pay to CONTRACTOR an amount not to exceed **One Million Two Hundred Sixty-Two Thousand Four Hundred Seventy Three Dollars ($1,262,473)** for the completion of all the Phase I work and services described herein, which sum shall include all costs or expenses incurred by CONTRACTOR, payable as set forth in Exhibit C, attached hereto and made a part hereof by reference. Should the City Manager/designee, at his option, determine that Phase II and Phase III are in the best interest of the CITY, an amendment to the Agreement shall be executed by the CITY in an amount agreed upon between CITY and CONTRACTOR.

4. **TAXES**

4.1. CONTRACTOR shall be solely responsible for any and all tax obligations, which may result out of the CONTRACTOR'S performance of this Agreement. The CITY shall have no obligation to pay any amounts for taxes, of any type, incurred by the CONTRACTOR.

4.2. **Payment.** A separate invoice shall be issued for each shipment of material or service performed, and no payment will be issued prior to receipt of material and/or completion of specified services and receipt of a correct invoice.

4.3. **Estimated Quantities.** The quantities shown on Exhibit C (the Price List) are estimates only, based upon available information. Payment shall be based on actual quantities and there is no guarantee that any certain quantity shall be required by CITY. City reserves the right to increase or decrease the quantities actually required.

4.4. **IRS W9 Form.** In order to receive payment CONTRACTOR shall have a current I.R.S. W9 Form on file with CITY, unless not required by law.

4.5. **Acceptance by City.** CITY reserves the right to accept or reject the request for a price increase. If CITY approves the price increase, the price shall remain firm for the renewal term for which it was requested. If a price increase is agreed upon a written Contract Amendment must be approved and executed by the Parties.

4.6. **Price Reduction.** CONTRACTOR shall offer CITY a price reduction for its services concurrent with a published price reduction made to other customers.

5. **TERM:**

5.1. The work for Phase I must be completed within **eighteen (18) months** from the Notice to Proceed. Should the CITY execute an amendment to the Agreement for Phase II and Phase III, the work must be completed by the CONTRACTOR within twenty-four (24) months from the Notice to Proceed.

6. **USE OF THIS CONTRACT:** The Contract is for the sole convenience of the City of Chandler. CITY reserves the rights to obtain like services from another source to secure significant cost savings or when timely completion cannot be met by CONTRACTOR.

6.1. **Cooperative Use of Contract.** In addition to the City of Chandler and with approval of the CONTRACTOR, this Contract may be extended for use by other municipalities, school districts and

government agencies of the State. A current listing of eligible entities may be found at www.maricopa.gov/materials and then click on 'Contracts', 'S.A.V.E.' listing and 'ICPA'. Any such usage by other entities must be in accordance with the ordinance, charter and/or procurement rules and regulations of the respective political entity.

6.2. **Emergency Purchases:** CITY reserves the rights to purchase from other sources those items, which are required on an emergency basis and cannot be supplied immediately by the CONTRACTOR.

7. **CITY'S CONTRACTUAL REMEDIES:**

7.1. **Right to Assurance.** If the City in good faith has reason to believe that the CONTRACTOR does not intend to, or is unable to perform or continue performing under this Contract, the Contract Administrator may demand in writing that the CONTRACTOR give a written assurance of intent to perform. Failure by the CONTRACTOR to provide written assurance within the number of Days specified in the demand may, at the City's option, be the basis for terminating the Contract in addition to any other rights and remedies provided by law or this Contract.

7.2. **Stop Work Order.** The City may, at any time, by written order to the CONTRACTOR, require the CONTRACTOR to stop all or any part, of the work called for by this Contract for period(s) of days indicated by the City after the order is delivered to the CONTRACTOR. The order shall be specifically identified as a stop work order issued under this clause. Upon receipt of the order, the CONTRACTOR shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage.

7.3. If a stop work order issued under this clause is canceled or the period of the order or any extension expires, the CONTRACTOR shall resume work. The Contract Administrator shall make an equitable adjustment in the delivery schedule or Contract price, or both, and the Contract shall be amended in writing accordingly.

7.4. **Non-exclusive Remedies.** The rights and the remedies of the City under this Contract are not exclusive.

7.5. **Nonconforming Tender.** Services and materials supplied under this Contract shall fully comply with Contract requirements and specifications. Services or materials that do not fully comply constitute a breach of contract.

7.6. **Right of Offset.** The City shall be entitled to offset against any sums due CONTRACTOR, any expenses or costs incurred by the City, or damages assessed by the City concerning the CONTRACTOR'S non-conforming performance or failure to perform the Contract, including expenses to complete the work and other costs and damages incurred by CITY.

8. **TERMINATION:**

8.1 **Termination for Convenience:** CITY reserves the right to terminate this Agreement or any part thereof for its sole convenience with thirty (30) days written notice. In the event of such termination, CONTRACTOR shall immediately stop all work hereunder, and shall immediately cause any of its suppliers and SUBCONTRACTORs to cease such work. As compensation in full for services performed to the date of such termination, the CONTRACTOR shall receive a fee for the percentage of services actually performed. This fee shall be in the amount to be mutually agreed upon by the CONTRACTOR and CITY, based on the agreed Scope of Work. If there is no mutual agreement, the Management Services Director shall determine the percentage of work performed under each task detailed in the Scope of Work and the CONTRACTOR'S compensation shall be based upon such determination and CONTRACTOR'S fee schedule included herein.

8.2 **Termination for Cause:** City may terminate this Agreement for Cause upon the occurrence of any one or more of the following events:

A. If CONTRACTOR fails to perform pursuant to the terms of this Agreement;
B. If CONTRACTOR is adjudged a bankrupt or insolvent;
C. If CONTRACTOR makes a general assignment for the benefit of creditors;
D. If a trustee or receiver is appointed for CONTRACTOR or for any of CONTRACTOR'S property;
E. If CONTRACTOR files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws;
F. If CONTRACTOR disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction;
G. Where Agreement has been so terminated by CITY, the termination shall not affect any rights of CITY against CONTRACTOR then existing or which may thereafter accrue.

8.3. **Cancellation for Conflict of Interest.** Pursuant to A.R.S. § 38-511, CITY may cancel this Contract after Contract execution without penalty or further obligation if any person significantly involved in initiating, negotiating, securing, drafting or creating the Contract on behalf of the City is or becomes at any time while this Contract or an extension of this Contract is in effect, an employee of or a consultant to any other party to this Contract. The cancellation shall be effective when the CONTRACTOR receives written notice of the cancellation unless the notice specifies a later time.

8.4. **Gratuities.** CITY may, by written notice, terminate this Contract, in whole or in part, if CITY determines that employment or a Gratuity was offered or made by CONTRACTOR or a representative of CONTRACTOR to any officer or employee of CITY for the purpose of influencing the outcome of the procurement or securing this Contract, an amendment to this Contract, or favorable treatment concerning this Contract, including the making of any determination or decision about contract performance. The CITY, in addition to any other rights or remedies, shall be entitled to recover exemplary damages in the amount of three times the value of the Gratuity offered by CONTRACTOR.

8.5. **Suspension or Debarment.** CITY may, by written notice to the CONTRACTOR, immediately terminate this Contract if CITY determines that CONTRACTOR has been debarred, suspended or otherwise lawfully prohibited from participating in any public procurement activity, including but not limited to, being disapproved as a SUBCONTRACTOR of any public procurement unit or other governmental body. Submittal of an offer or execution of a contract shall attest that the CONTRACTOR is not currently suspended or debarred. If CONTRACTOR becomes suspended or debarred, CONTRACTOR shall immediately notify CITY.

8.6. **Continuation of Performance Through Termination.** The CONTRACTOR shall continue to perform, in accordance with the requirements of the Contract, up to the date of termination, as directed in the termination notice.

8.7. **No Waiver.** Either party's failure to insist on strict performance of any term or condition of the Contract shall not be deemed a waiver of that term or condition even if the party accepting or acquiescing in the nonconforming performance knows of the nature of the performance and fails to object to it.

8.8. **Availability of Funds for the next Fiscal Year.** Funds may not presently be available under this agreement beyond the current fiscal year. No legal liability on the part of the CITY for services may arise under this agreement beyond the current fiscal year until funds are made available for performance of this agreement. The CITY may reduce services or terminate this agreement without further recourse, obligation, or penalty in the event that insufficient funds are appropriated. The City Manager shall have the sole and unfettered discretion in determining the availability of funds.

9. **FORCE MAJEURE:** Neither party shall be responsible for delays or failures in performance resulting from acts beyond their control. Such acts shall include, but not be limited to, acts of God, riots, acts of war, epidemics, governmental regulations imposed after the fact, fire, communication line failures, power failures, or earthquakes.

10. **Alternate Dispute Resolution. REQUIREMENT FOR ALTERNATIVE DISPUTE RESOLUTION:** Notwithstanding anything to the contrary provided elsewhere in the Agreement documents, the alternate dispute resolution (ADR) process provided herein shall be the exclusive initial means for resolution of claims or disputes and other matters in question between CITY and CONTRACTOR arising out of, or relating to the Agreement documents, interpretation of the Agreement, or the performance or the breach by any party thereto, including but not limited to, original claims or disputes asserted as cross claims, counterclaims, third party claims or claims for indemnity or subrogation, in any threatened or ongoing litigation or arbitration with third parties, if such disputes involve parties to Agreements containing this ADR provision.

A. INTERNAL RESOLUTION PROCESS

1. **Notice:** CONTRACTOR shall submit written notice of any claim or dispute to the Purchasing Manager within thirty (30) days of the occurrence, event or disputed response from CITY for immediate resolution pursuant to these provisions. Each claim or dispute shall be submitted and resolved as they occur and not postponed until the end of the Agreement nor lumped together with other pending claims.

2. **Forfeiture:** Failure to submit a notice of any claim, dispute, or other issue within such thirty (30) days shall constitute CONTRACTOR'S forfeiture of its right to dispute the issue, raise the claim or make the request and shall also constitute CONTRACTOR'S agreement and acceptance of CITY'S position.

3. **CITY Response:** The Agreement Administrator will provide to CONTRACTOR a written response to any claim, request for clarification or dispute on or before thirty (30) days from receipt of CONTRACTOR'S written claim.

4. **Appeal:** If CONTRACTOR disagrees with the response of the Purchasing Manager, within fifteen days of the date of the response by the Agreement Administrator, CONTRACTOR shall file with the Assistant Management Services Director, written notice of appeal. The Purchasing Manager shall provide copies of all relevant information concerning the Agreement and claim or dispute to the Assistant Management Services Director who will determine the appeal. The Assistant Management Services Director may request additional information from either party, may hold an informal informational hearing or may make the determination based on the information provided. The Assistant Management Services Director shall make a final determination of the appeal and provide written notice to CONTRACTOR within sixty (60) days from the date of CONTRACTOR'S written notice of appeal.

B. ARBITRATION

1. **Arbitration:** If CONTRACTOR is not satisfied with the determination of the Assistant Management Services Director, the following binding arbitration procedure shall serve as the exclusive method to resolve all unresolved disputes in which the claims are for $500,000 or less except for errors of law which may be appealed if an award exceeds $100,000 and is based on an error of law . If CONTRACTOR chooses not to accept the decision of the Assistant Management Services Director, CONTRACTOR shall notify the Agreement Administrator in writing within ten (10) business days of receipt of the Assistant Management Services Director's decision of a request for arbitration. The CONTRACTOR shall post a cash bond with the Arbitrator in the amount of $5,000, or a greater amount as determined by the Arbitrator, that will

defray the cost of the arbitration as set forth in paragraph E, Fees and Costs, and proceeds from said bond shall be allocated in accordance with said paragraph by the Arbitrator.

2. **Arbitration Panel:** The Arbitration Panel shall consist of the arbitrators selected by the parties involved in the dispute, (i.e., CITY will select one arbitrator, CONTRACTOR will select one arbitrator, and any other CONTRACTOR who has a Agreement with CITY which contains this ADR provision and is a party to the same dispute will also select an arbitrator), and the foregoing arbitrators shall select a neutral Arbitrator who will hear the matter and make a final determination, as set forth herein.

3. **Expedited Hearing:** The parties have structured this procedure with the goal of providing for the prompt and efficient resolution of all disputes falling within the purview of this ADR process. To that end, any party can petition the Arbitrator to set an expedited hearing if circumstances justify it. The Arbitrator shall contact the parties and schedule the arbitration at the earliest possible date. In any event, the hearing of any dispute not expedited will commence as soon as practical, but in no event later than sixty (60) days after notification of request for arbitration having been submitted. This deadline can be extended only with the consent of all the parties to the dispute, or by decision of the Arbitrator upon a showing of emergency circumstances.

4. **Procedure:** The Arbitrator shall conduct the hearing that will resolve disputes in a prompt, cost efficient manner giving due regard to the rights of all parties. Each party shall supply to the Arbitrator a written pre-hearing statement, which shall contain a brief statement of the nature of the claim or defense, a list of witnesses and exhibits, a brief description of the subject matter of the testimony of each witness who will be called to testify, and an estimate as to the length of time that will be required for the arbitration hearing. The Arbitrator shall determine the nature and scope of discovery, if any, and the manner of presentation of relevant evidence consistent with the deadlines provided herein, and the parties' objective that disputes be resolved in a prompt and efficient manner. The Arbitrator, upon proper application, shall issue such orders as may be necessary and permissible under law to protect confidential, proprietary, or sensitive materials or information from public disclosure or other misuse. Any party may make application to the Maricopa County Superior Court to have a protective order entered as may be appropriate to conform to such orders of the Arbitrator.

5. **Hearing Days:** To effectuate the parties' goals, the hearing once commenced, will proceed from business day to business day until concluded, absent a showing of emergency circumstances.

6. **Award:** The Arbitrator shall within ten (10) days from the conclusion of any hearing issue its award. The award shall include an allocation of fees and costs pursuant to the Binding Arbitration Procedure paragraph herein. Any award providing for deferred payment shall include interest at the rate of ten (10%) percent per annum. The award is to be rendered in accordance with the Agreement and the laws of the State of Arizona.

7. **Scope of Award:** The Arbitrator shall be without authority to award punitive damages, and any such punitive damage award shall be void. The Arbitrator shall also be without authority to issue an award against any individual party in excess of $500,000, exclusive of interest, arbitration fees, costs, and attorney's fees. If an award is made against any individual party in excess of $50,000, exclusive of interest, arbitration fees, costs and attorneys' fees, it must be supported by written findings of fact, conclusions of law and statement as to how damages were calculated.

8. **Jurisdiction:** The Arbitrator shall not be bound for jurisdictional purposes by the amount asserted in any party's claim, but shall conduct a preliminary hearing into the question of jurisdiction upon application of any party at the earliest convenient time, but not later than the commencement of the arbitration hearing.

9. **Entry of Judgment:** Any party can make application to the Maricopa County Superior Court for confirmation of any award and for entry of judgment on it.

10. **Severance and Joinder:** To reduce the possibility of inconsistent adjudications, the Arbitrator, may at the request of any party, join and/or sever parties, and/or claims arising under other Agreements containing this ADR provision, and the Arbitrator may, on his own authority, join or sever parties and/or claims subject to this ADR process as they deem necessary for a just resolution of the dispute, consistent with the parties' goal of the prompt and efficient resolution of disputes. Nothing herein shall create the right by any party to assert claims against another party not recognized under the substantive law applicable to the dispute. The Arbitrator is not authorized to join to the proceeding parties not in privity with CITY.

C. **APPEAL TO MARICOPA COURTS:** Any party may appeal errors of law by the Arbitrator if, but only if, the errors arise in an award in excess of $100,000; the exercise by the Arbitrator of any powers contrary to or inconsistent with the Agreement; or any of the grounds provided in A.R.S. 12-1512. Appeals shall be to the Maricopa County Superior Court within fifteen (15) days of entry of the award. The standard of review in such cases shall be that applicable to the consideration of a motion for judgment notwithstanding the verdict, and the Maricopa County Superior Court shall have the authority to confirm, vacate, modify or remand an award appealed under this section.

D. **UNIFORM ARBITRATION ACT:** Except as otherwise provided herein, binding arbitration pursued under this provision shall be governed by the Uniform Arbitration Act as enacted in Arizona in A.R.S. I2-1501, et. seq.

E. **FEES AND COSTS:** Each party shall bear its own fees and costs in connection with any internal dispute resolution procedure. All fees and costs associated with any arbitration before the Arbitrator, including without limitation, the Arbitrator's fees, the prevailing party's attorneys' fees, expert witness fees and costs, will be paid by the non-prevailing party, except as provided for herein. The determination of prevailing and non-prevailing parties, and the appropriate allocation of fees and costs, will be included in the award by the Arbitrator.

F. **EQUITABLE LITIGATION:** Notwithstanding any other provision of ADR to the contrary, any party may petition the Maricopa County Superior Court for interim equitable relief as necessary to preserve the status quo and prevent immediate and irreparable harm to a party or to ongoing work pending resolution of a dispute pursuant to ADR provided for herein. No court may order any permanent injunctive relief except as may be necessary to enforce an order or award entered by the Arbitrator. The fees and costs incurred in connection with any such equitable proceeding shall be determined and assessed in pursuant to the Alternative Dispute Resolution provisional of this Agreement.

11. **INDEMNIFICATION:** To the fullest extent permitted by law, CONTRACTOR shall defend, indemnify and hold harmless the City of Chandler, its Mayor and Council, appointed boards and commissions, officials, officers, employees individually and collectively; from and against all losses, claims, suits, actions, payments and judgments, demands, expenses, damages, including consequential damages and loss of productivity, attorney's fees, defense costs, or actions of any kind and nature relating to, arising out of, or alleged to have resulted from CONTRACTOR'S work or services. CONTRACTOR'S duty to defend, hold harmless and indemnify the City of Chandler, its Mayor and Council, appointed boards and commissions, officials, officers, employees shall arise in connection with any claim or amounts arising or recovered under Worker Compensation Laws, damage, loss or expenses relating to, arising out of or alleged to have resulted from any acts, errors, mistakes, omissions, work or services in the performance of this Contract including any employee of CONTRACTOR, anyone directly or indirectly employed by them or anyone for whose acts CONTRACTOR may be liable, regardless of whether it is caused in part by a party indemnified hereunder, including the City of Chandler. IT IS THE INTENTION OF THE PARTIES to this contract that the City of Chandler, its Mayor and Council, appointed boards and commissions,

officials, officers, employees, individually and collectively, are to be indemnified against their own negligence unless and except their negligence is found to be the sole cause of the injury to persons or damages to property. The amount and type of insurance coverage requirements set forth herein will in no way be construed as limiting the scope of the indemnity in this paragraph.

12. INSURANCE:

12.1. Insurance Representations and Requirements:

A. CONTRACTOR, at its own expense, shall purchase and maintain insurance of the types and amounts required in this section, with companies possessing a current A.M. Best, Inc. rating of B++6, or better and legally authorized to do business in the State of Arizona with policies and forms satisfactory to CITY.

B. Policies written on a "Claims made" basis are not acceptable without written permission from the City's Risk Manager.

C. All insurance required herein shall be maintained in full force and effect until all work or services required to be performed under the terms of this Agreement is satisfactorily completed and formally accepted. Failure to do so may, at the sole discretion of CITY, constitute a material breach of this Agreement and may result in termination of this contract.

D. If any of the insurance policies are not renewed prior to expiration, payments to the CONTRACTOR may be withheld until these requirements have been met, or at the option of the City, the City may pay the Renewal Premium and withhold such payments from any monies due the CONTRACTOR.

E. All insurance policies, except Workers' Compensation required by this Agreement, and self-insured retention or deductible portions, shall name, to the fullest extent permitted by law for claims arising out of the performance of this contract, the City of Chandler, its agents, representatives, officers, directors, officials and employees as Additional Insureds.

F. CONTRACTOR'S insurance shall be primary insurance over any insurance available to the CITY and as to any claims resulting from this contract, it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the described insurance.

G. The insurance policies, except Workers' Compensation, shall contain a waiver of transfer rights of recovery (subrogation) against CITY, its agents, representatives, officers, directors, officials and employees for any claims arising out of CONTRACTOR'S acts, errors, mistakes, omissions, work or service.

H. The insurance policies may provide coverage, which contain deductibles or self-insured retentions. Such deductible and/or self-insured retentions shall be assumed by and be for the account of, and at the sole risk of CONTRACTOR. CONTRACTOR shall be solely responsible for the deductible and/or self-insured retention. The amounts of any self-insured retentions shall be noted on the Certificate of Insurance. CITY, at its option, may require CONTRACTOR to secure payment of such deductibles or self-insured retentions by a Surety Bond or an irrevocable and unconditional letter of credit. Self-insured retentions (SIR) in excess of $25,000 will only be accepted with the permission of the Management Services Director/Designee.

I. All policies and certificates shall contain an endorsement providing that the coverage afforded under such policies shall not be reduced, canceled or allowed to expire until at least thirty (30) days prior written notice has been given to CITY.

J. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the CONTRACTOR with reasonable promptness in accordance with the CONTRACTOR'S information and belief.

K. In the event that claims in excess of the insured amounts provided herein, are filed by reason of any operations under this contract, the amount of excess of such claims, or any portion thereof, may be withheld from payment due or to become due the CONTRACTOR until such time as the CONTRACTOR shall furnish such additional security covering such claims as may be determined by the CITY.

12.2. Proof of Insurance – Certificates of Insurance

A. Prior to commencing work or services under this Agreement, CONTRACTOR shall furnish to CITY Certificates of Insurance, issued by CONTRACTOR'S insurer(s), as evidence that policies providing the required coverages, conditions and limits required by this Agreement are in full force and effect and obtain from the City's Risk Management Division approval of such Certificates.

B. If a policy does expire during the life of this Agreement, a renewal certificate must be sent to the City of Chandler five (5) days prior to the expiration date.

C. All Certificates of Insurance shall identify the policies in effect on behalf of CONTRACTOR, their policy period(s), and limits of liability. Each Certificate shall include the job site and project number and title. Coverage shown on the Certificate of Insurance must coincide with the requirements in the text of the contract documents. Information required to be on the certificate of Insurance may be typed on the reverse of the Certificate and countersigned by an authorized representative of the insurance company.

D. REQUIRED CITY reserves the right to request and to receive, within 10 working days, certified copies of any or all of the herein required insurance policies and/or endorsements. CITY shall not be obligated, however, to review same or to advise CONTRACTOR of any deficiencies in such policies and endorsements, and such receipt shall not relieve CONTRACTOR from, or be deemed a waiver of CITY'S right to insist on, strict fulfillment of CONTRACTOR'S obligations under this Agreement.

12.3. Coverage

A. Such insurance shall protect CONTRACTOR from claims set forth below which may arise out of or result from the operations of CONTRACTOR under this Contract and for which CONTRACTOR may be legally liable, whether such operations be by the CONTRACTOR or by a SUBCONTRACTOR by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. Coverage under the policy will be at least as broad as Insurance Services Office, Inc., policy form CG00011093 or equivalent thereof, including but not limited to severability of interest and waiver of subrogation clauses.

B. Claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;

C. Claims for damages because of bodily injury, occupational sickness or disease, or death of the CONTRACTOR'S employees;

D. Claims for damages because of bodily injury, sickness or disease, or death of any person other than the CONTRACTOR'S employees;

E. Claims for damages insured by usual personal injury liability coverage;

F. Claims for damages, other than to Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;

G. Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle; Coverage will be at least as broad as Insurance Service Office, Inc., coverage Code "I" "any auto" policy form CA00011293 or equivalent thereof.

H. Claims for bodily injury or property damage arising out of completed operations;

I. Claims involving contractual liability insurance applicable to the CONTRACTOR'S obligations under the Indemnification Agreement;

J. Claims for injury or damages in connection with one's professional services;

K. Claims involving construction projects while they are in progress. Such insurance shall include coverage for loading and off loading hazards. If any hazardous material, as defined by any local, state or federal authorities are to be transported, MCS 90 endorsement shall be included.

12.4. Commercial General Liability - Minimum Coverage Limits. The Commercial General Liability insurance required herein shall be written for not less than $500,000 limits of liability. Any combination between general liability and excess general liability alone amounting to a minimum of $2.000,000 per occurrence (or 10% per occurrence) and an aggregate of 5,000,000 (or 20% whichever is greater) in coverage will be acceptable. The Commercial General Liability additional insured endorsement shall be as broad as the Insurance Services, Inc's (ISO) Additional Insured, Form B, CG 20101001, and shall include coverage for CONTRACTOR'S operations and products, and completed operations.

12.5. Automobile Liability. CONTRACTOR shall maintain Commercial/Business Automobile Liability insurance with a combined single limit for bodily injury and property damage of not less than $1,000,000 each occurrence with respect to any owned, hired, and non-owned vehicles assigned to or used in performance of the CONTRACTOR'S work. Coverage shall be at least as broad as coverage code 1, "any auto", (Insurance Service Office, Inc. Policy Form CA 00011293, or any replacements thereof).

12.6. Worker's Compensation and Employer's Liability. CONTRACTOR shall maintain Workers' Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction over CONTRACTOR'S employees engaged in the performance of the work or services; and, Employer's Liability insurance of not less than $1,000,000 for each accident, $1,000,000 disease coverage for each employee, and $1,000,000 disease policy limit.

In case any work is subcontracted, CONTRACTOR will require the SUBCONTRACTOR to provide Workers' Compensation and Employer's Liability to at least the same extent as required of CONTRACTOR.

13. NOTICES: All notices or demands required to be given pursuant to the terms of this Agreement shall be given to the other party in writing, delivered by hand or registered or certified mail, at the addresses set forth below, or to such other address as the parties may substitute by written notice given in the manner prescribed in this paragraph.

In the case of the CITY		In the case of the CONTRACTOR	
Contract Administrator:	Buildings & Facilities	Firm Name:	Mechanical Products BAS
Contact:	Larry LaMay	Contact:	Kevin Estepp
Mailing Address:	PO Box 4008 – MS 906	Address:	3743 W Roanoke
Physical Address:	249 E Chicago St	City, State, Zip	Phoenix AZ 85009
City, State, Zip	Chandler, AZ 85225	Phone:	602-757-5935

Phone:	480-782-2501	FAX:	602-278-0380
FAX:	480-782-2560	EMAIL:	Kevin@MPBas.com

Notices shall be deemed received on date delivered, if delivered by hand, and on the delivery date indicated on receipt if delivered by certified or registered mail.

14. CONFLICT OF INTEREST:

14.1. No Kickback. CONTRACTOR warrants that no person has been employed or retained to solicit or secure this Agreement upon an agreement or understanding for a commission, percentage, brokerage or contingent fee; and that no member of the City Council or any employee of the CITY has any interest, financially or otherwise, in the firm unless this interest has been declared pursuant to the provisions of A.R.S. Section 38-501. Any such interests were disclosed in CONTRACTOR'S proposal to the CITY.

14.2. Kickback Termination. CITY may cancel any contract or agreement, without penalty or obligation, if any person significantly involved in initiating, negotiating, securing, drafting or creating the agreement on behalf of the CITY is, at any time while the Agreement or any extension of the Agreement is in effect, an employee of any other party to the Agreement in any capacity or a CONTRACTOR to any other party to the Agreement with respect to the subject matter of the Agreement. The cancellation shall be effective when written notice from CITY is received by all other parties, unless the notice specifies a later time (A.R.S. §38-511).

14.3. No Conflict: CONTRACTOR stipulates that its officers and employees do not now have a conflict of interest and it further agrees for itself, its officers and its employees that it will not contract for or accept employment for the performance of any work or services with any individual business, corporation or government unit that would create a conflict of interest in the performance of its obligations pursuant to this project.

15. GENERAL TERMS:

15.1. OWNERSHIP. All deliverables and/or other products of the Contract (including but not limited to all software documentation, reports, records, summaries and other matter and materials prepared or developed by CONTRACTOR in performance of the Contract) shall be the sole, absolute and exclusive property of CITY, free from any claim or retention of right on the part of CONTRACTOR, its agents, sub-contractors, officers or employees.

15.2. Entire Agreement. This Agreement, including Exhibits attached hereto, constitutes the entire understanding of the parties and supersedes all previous representations, written or oral, with respect to the services specified herein. This Agreement may not be modified or amended except by a written document, signed by authorized representatives or each party.

15.3. Performance and Payment Bonds. Within fifteen (15) days from the time a Contract is awarded, CONTRACTOR shall furnish fully executed Performance and Payment Bond (Labor and Materials) in such form and context as determined by CITY from a surety approved by CITY. Said bonds shall be in a sum no less than one hundred (100%) of the Contract price.

CITY has the option to forfeit said bonds if the Contract is terminated by the default of CONTRACTOR or if CITY determines that CONTRACTOR is unable or unwilling to complete the work as specified in the Contract Documents.

If the Contract schedule is not adhered to, and CITY determines that the work is unlikely to be completed within a reasonable time after the original target date, then CITY may terminate the Contract and collect the Performance Bond.

The Performance Bond will be reviewed annually and any increases in the contract amount will require bond to be increased and reissued.

15.4. Arizona Law. This Agreement shall be governed and interpreted according to the laws of the State of Arizona.

15.5. Assignment: Services covered by this Agreement shall not be assigned in whole or in part without the prior written consent of the CITY.

15.6. Amendments. The Contract may be modified only through a written Contract Amendment executed by authorized persons for both parties. Changes to the Contract, including the addition of work or materials, the revision of payment terms, or the substitution of work or materials, directed by a person who is not specifically authorized by the City in writing or made unilaterally by the CONTRACTOR are violations of the Contract. Any such changes, including unauthorized written Contract Amendments shall be void and without effect, and the CONTRACTOR shall not be entitled to any claim under this Contract based on such changes.

15.7. Independent CONTRACTOR. The CONTRACTOR under this Contract is an independent CONTRACTOR. Neither party to this Contract shall be deemed to be the employee or agent of the other party to the Contract.

15.8. No Parole Evidence. This Contract is intended by the parties as a final and complete expression of their agreement. No course of prior dealings between the parties and no usage of the trade shall supplement or explain any terms used in this document and no other understanding either oral or in writing shall be binding.

15.9. Authority: Each party hereby warrants and represents that it has full power and authority to enter into and perform this Agreement, and that the person signing on behalf of each has been properly authorized and empowered to enter this Agreement. Each party further acknowledges that it has read this Agreement, understands it, and agrees to be bound by it.

IN WITNESS WHEREOF, the parties have hereunto subscribed their names to this day of 20 .

FOR THE CITY OF CHANDLER

_____
MAYOR

ATTEST:

_____
City Clerk

Approved as to form:

_____
City Attorney

FOR THE CONTRACTOR

By: _____
Signature

ATTEST: If Corporation

SEAL

_____
Secretary

EXHIBIT A
Contractor Immigration Warranty
To Be Completed by Contractor Prior to Execution of Contract

A.R.S. § 41-4401 requires as a condition of your contract verification of compliance by the contractor and subcontractors with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of its employees.

By completing and signing this form and attached Employee Verification Worksheet the CONTRACTOR shall attest that it and all subcontractors performing work under the cited contract meet all conditions contained herein.

Contract Number:	**BF9-220-2745**		
Name (as listed in the contract):	**Mechanical Products BAS Inc**		
Street Name and Number:	**3743 W Roanoke**		
City: **Phoenix**	**State:** **AZ**	**Zip Code:** **85009**	

I hereby attest that:

1. The CONTRACTOR complies with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of those employees performing work under this contract;

2. All SUBCONTRACTORs performing work under this contract comply with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of their employees; and

3. The CONTRACTOR has identified all CONTRACTOR and subcontractors employees who perform work under the contract on the attached Employee Verification Worksheet and has verified compliance with Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214.

Signature of CONTRACTOR (Employer) or Authorized Designee:

_____

Printed Name: KEVIN ESTEPP

Title: SALES ENGINEER

Date (month/day/year): 8-11-09

EXHIBIT B
EMS Technical Specifications

PHASE 1 - PART 1 GENERAL
MECHANICAL DIVISION - SECTION 15975

PART 1 - GENERAL

1.1 DEFINITIONS

Alarm: Notification of an abnormal condition.

Analog: A continuously varying signal value (temperature, current, velocity, etc.)

Application Generic Controller (AGC): A networked device or node that contains a complete, configurable application that is generic in nature and suited for various control tasks. The device manufacturer produces this application. The manufacturer exposes a high number of network variables and configuration properties on the device to allow the specific use of the device to be configured with network tools.

Application Specific Controller (ASC): A networked device or node that contains a complete, configurable application that is specific to a particular task. This application is normally produced by the device manufacturer and contains a number of configuration parameters that may be adjusted by network tools.

Binary: A two-state system where an "on" condition is represented by a high signal level and an "off" condition is represented by a low signal level.

Bridge: A device that routes messages or isolates message traffic to a particular segment sub-net or domain of the same physical communication media.

Channel: A physical media serving a number of nodes. All nodes on any given channel 'hear' messages produced by other nodes on the channel. The network configuration and node application program determines whether or not a device responds to the messages.

Control Unit: A LonWorks control product that handles multiple inputs and outputs and more than one control loop. May utilize a supplemental general-purpose microprocessor in addition to the Neuron chip to perform additional functions or software applications.

Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and PE switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operation.

Custom Application Controller (CAC): Programmable control product that incorporates solid-state components based upon the ANSI/CEA 709.1 protocol to perform control loops or functions. The application in the controller is custom software produced by the Control System Contractor specifically for the project. These applications shall conform to the LonWorks functional profiles and interoperability standards. Complete documentation including object diagrams, Device Resource Files (DRF), and External Interface Files (XIF) must be submitted EOR (Engineer of Record) when such devices/controllers are used.

Deadband: A temperature range over which no heating or cooling energy is supplied, such as 72-78 degrees F, i.e. as opposed to single point changeover or overlap.

Device Resource File: External Interface files and Lon plug-ins that are required to display manufacturer's defined network variables or configuration parameters correctly.

Distributed Control: A system whereby all control processing is decentralized and independent of a central computer.

Diagnostic Program: A machine-executable program with instructions used to detect and isolate system and component malfunctions.

Domain: A domain is logical collection of nodes on one or more channels. Communications can only take place among nodes configured in a common domain; therefore, a domain forms a virtual network. Multiple domains can occupy the same channels, so domains may be used.

Energy Management System (EMS): The complete facility control system comprised of all mechanical system automation, and automatic temperature control, etc., as defined in the contract documents. The EMS is built upon a single network infrastructure based upon LonWorks Network Services. This infrastructure may include field wiring, LON wiring, routers, bridges, raceways, and gateways as required connecting non-interoperable subsystems and devices.

Gateway: A device that contains an I/O software driver to translate data from other protocols to the conforming LonWorks standard.

Graphical User Interface (GUI): A graphical subset of operator interfaces presented on an operator workstation.

LonTalk: A multi-media device inter-communications protocol developed by Echelon Corporation.

LonWorks: General purpose direct digital control technology platform originally developed by Echelon Corporation and now controlled by ANSI and LonMark. The technology employs routers, gateways, bridges, and multimedia transceivers to permit topology and media independent control solutions comprised of multiple interoperable devices.

LonMark International (LMI)/LonMark Americas (LMA): An international member based, non-profit organization with committees of numerous independent product developers, systems integrators, engineers, and end users dedicated to determine and maintain the interoperability guidelines for the LonWorks industry. LMI tests and certifies devices for interoperable compliance.

Network: A system of distributed control devices that are linked together on a communication bus. A network allows sharing of point information between all control devices. Additionally, a network may provide central monitoring and control of the entire system from an MMI/GUI.

Network Area Controller: A networked device or node that provides supervisory level features and applications for various global control and monitoring tasks (i.e. scheduling, trending, alarming, etc.). The device may also provide web-based user interface capabilities. The Control System Contractor produces these applications and features.

Node: An intelligent device attached to the network. Usually falls into one of the following categories - sensor, actuator, ASC, AGC, CAC.

Operator Interface: A device combination of hardware and software, (PC, laptop or display terminal) which provides client access to the control system, primarily used for network management, configuration, and diagnostics.

Operating System (OS): Software which controls the execution of computer programs.

Programmable Control Unit (PCU): See *Custom Application Controller.*

Point: Group of data, which corresponds to a hardware input, output, or calculated value.

Portable Operator's Terminal (POT): Laptop/tablet device that allows local and remote access to the local control network.

Router: A device that routes or forwards messages destined for a node on another subnet or domain of the control network. The device controls message traffic based on node address and priority. Routers may also serve as communication interfaces between different channel media. (i.e., powerline, twisted pair, Ethernet\TCP\IP, and RF).

Segment: A set of channels connected by bridges or repeaters. A node sees every packet from every other node on its segment.

Sensor: Device capable of measuring the condition or value of a variable.

Software: Programs and routines used to extend the capabilities of computers hardware.

Subnet: A subnet is a logical collection of up to 127 nodes within a domain. Up to 255 subnets can be defined within a single domain. All nodes in a subnet must be on the same segment. Subnets cannot cross-intelligent routers.

Terminal Device Control Unit (TDCU): See *Application Specific Controller.*

Web Server: A computer program that is responsible for accepting HTTP requests from *clients* (user agents such as web browsers), and serving them HTTP responses along with optional data contents, which usually are web pages such as HTML documents and linked objects (images, etc.).

XIF Files: The external interface files created in Neuron C defining the LonMark product's network variables, message tags, and hardware related parameters.

1.2 ABBREVIATIONS

AGC	Application Generic Controller
ASC	Application Specific Controller
BAS	Building Automation System
BMS	Building Management System
CAC	Custom Application Controller
CAV	Constant Air Volume
COS	Change of State
CPU	Central Processing Unit
DDC	Direct Digital Controller
DPR	Damper
DPU	Digital Point Unit
DRF	Device Resource File
DWGS	Drawings
EMS	Energy Management System
EP	Electric-pneumatic
FAS	Facility Automation System
FPB	Fan Powered VAV Box
FPM	Feet per minute
FACP	Fire Alarm Control Panel
FCC	Fire Command Center
FMS	Fire Management System
GPM	Gallons per minute
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
HTML	Hypertext Markup Language
HVAC	Heating, Ventilating and Air Conditioning
ITC	Intermediate Telecommunications Closet
I/O	Input/Output
LAN	Local Area Network
LON	Local Operating Network
LNS	LonWorks Network Services
NAC	Network Area Controller
NSS	Network Services Server
NSI	Network Services Interface
NFPA	National Fire Protection Association
OI	Operator Interface
OS	Operating System
OWN	Operator Workstation Network
OWS	Operating Work Station

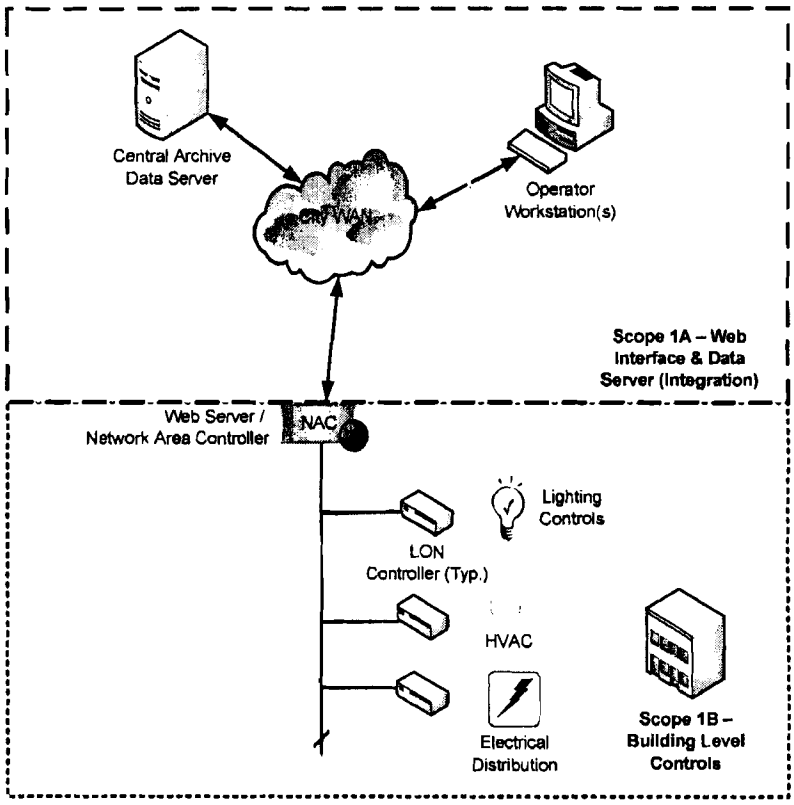
PE	Pneumatic-electric
PID	Proportional Integral Derivative
PRV	Pressure Reducing Valve
PSI(g)	Pounds per square inch (gauge)
RAM	Random Access Memory
SCADA	Supervisory Control and Data Acquisition System
TCS	Temperature Control System
TCC	Temperature Control Contractor
UL	Underwriters' Laboratory
VAV	Variable Air Volume
VCS	Voice Communication System
WAN	Wide Area Network
WBI	Web Browser Interface
WC	Water Column
XIF	External Interface File

1.3 DESCRIPTION

The documentation contained in this section and other contract documents pertaining to HVAC Controls is schematic in nature. CONTRACTOR shall provide hardware and software necessary to implement the functions shown or as implied in the contract documents.

The LonWorks requirements of this project allow for the possibility of multiple and distinct vendors within the current scopes of work. To that end, the total scope of work, as defined herein has been broken down into two (2) distinct scopes of work (Scopes 1.A and 1.B). Figure 1 illustrates the relationship between these two scopes.

Figure 1
City of Chandler EMS Scopes of Work



A. Scope 1.A – WAN Integration
   a. Responsible for providing and installing the Operator Workstation Network (OWN) which shall consist of the equipment described in Sections 2.1, 2.2, and 2.3, associated communication hardware and software, and all associated OWN software, graphics, and programming. The OWN shall provide building operators with transparent access to all buildings on the EMS. The contractor shall comply with all LonWorks requirements described herein. Figure 1 illustrates the integration of the OWN under this scope of work.
   b. All LonWorks devices within a particular facility shall be integrated into one common network infrastructure utilizing a common Network Management tool and creating a single LNS network database. All LonWorks devices shall share common GUI features for supervisory functions such as scheduling, alarming and history logging.
   c. Provide and install a Web Interface and Data Server to be installed at the Information Technology building, 215 E. Buffalo Street in the data server room, and shall be comprised of a new Central Archive Data Server, Operator Workstation(s) as illustrated in the following diagram as Scope 1.A. The Central Archive Data Server hardware shall be provided by the

City. One Operator Workstation PC shall be provided by the contractor under this scope installed at the Parks/Facilities Services Center, 650 E. Ryan Road.

d. Responsible for coordinating with the City to ensure WAN connections at each building are available and that appropriate routing techniques are implemented within the WAN. This scope shall also coordinate with other EMS contractors to ensure full functionality between the OWN and the network within each building.
e. Any vendor-specific software required to support highest level operator functionality not otherwise capable via the primary interfaces provided by this scope (e.g., proprietary programming and/or configuration tools) shall reside on the designated OWS and be fully executable via any of the OWN interfaces.
f. Provide System Monitoring and Supervisory Control through the installation of a Web Browser-based GUI (Graphical User Interface) network device or software application that supports a direct driver to the LonWorks LNS database and is fully compliant and compatible with the LonWorks Network Management and Integration Tool software. The GUI workstation shall provide complete access to any point in the system at any time. The GUI shall be able to directly support LNS based discreet controller "plug-in" configuration modules as supplied by the device manufacturers. The control system shall be fully functional without the GUI.
g. History data logging, time scheduling and alarm detection and management shall be accessible and managed via the GUI. The system may utilize specific controllers on the LON to perform these functions so long as all user interactions are supported directly at the GUI.
h. The OWN shall be able to accommodate multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. All operator functions shall be recorded by an audit trail resident on the GUI platform.
i. Provide system graphics and supervisory functions for all systems outlined in Attachment 1.
j. Supply any instruments required to conduct the commissioning and acceptance tests.
k. Provide trained and knowledgeable technicians for the commissioning and acceptance tests to be performed by an Owner designated Commissioning Authority (CxA). The commissioning process will involve systematically testing all typically similar systems to ensure that they perform interactively according to the design intent, construction documents, and Owner's operational requirements. The GUI is also a commissioned system, and will be subject to Owner acceptance via the commissioning process.
l. Remedy any discrepancies or malfunctions that are determined by these tests, and repeat testing until defects have been corrected to the satisfaction of the CxA and Owner.
m. Provide submittals, software, programming and training on the GUI and on maintenance and operations of the provided equipment.

B. Scope 1.B – Building Specific Controls

a. Provide a EMS incorporating LonWorks, Direct Digital Control, equipment monitoring and control consisting of microprocessor based plant control processors interfacing directly with sensors, actuators, and environmental delivery systems (i.e. HVAC units); electric controls and mechanical devices for all items indicated on drawings described herein including dampers, valves, panels, sensing devices; a primary communications network to allow data exchange between microprocessor-based devices. Figure 1 illustrates the integration of these buildings and coordination with scope 1.A.
b. Provide LonWorks based products that communicate on multiple channels to meet the functional specifications as indicated on the Drawings and the dedicated product functional specifications and profiles specified in other sections.
c. The system will utilize the LonTalk protocol as the common communication protocol between all controlled and controlling devices, and LNS architecture for the definition of the device database. No other device database structure will be permitted. When necessary or desired, LonTalk packets shall be encapsulated into TCP/IP messages to take advantage of existing

infrastructure or to increase network bandwidth. Hierarchal systems consisting of master or global controllers that poll and/or control less intelligent unitary controllers on a secondary bus will not be considered. (This does not preclude the use of "peer" Network Area Controllers designated to provide network wide supervisory monitoring and control functions).

d. The system network shall be an Echelon LON (Local Operating Network). All nodes shall communicate with each other over one or more channels utilizing one of the LonMark approved transceivers (Type 1 – FTT-10A, Type 2 – Twisted Pair, Type 3 – Power Line, Type 4 – Link Power, Type 5 – Radio Frequency). There will be no consideration given to any system that does not use LonWorks as the primary communications network. System controllers shall be capable of sharing standard network variable data with other LonWorks-based devices that utilize the same transceivers.
e. System controllers shall utilize either the Echelon's 3120 or 3150 Neuron microprocessor for network communications. "Hosted" controllers that utilize a 3rd party chip coprocessor for communications are not acceptable. Controllers shall be capable of accepting control programs downloaded over the LON.
f. Controllers shall use a software mechanism for network addressing and identification. It shall not be necessary to set physical network address switches on each controller.
g. System shall utilize LonMark defined standard network and command protocol Types (implicit messaging) for all data including, but not limited to, physical input and output values, input and output overrides, as well as general purpose input and output values used by the controller's control program. The utilization of explicit messaging or protocol converters shall not be acceptable unless approved in writing by the Contract Administrator/designee.
h. Individual products shall conform whenever possible to the LonMark Interoperability Standards. If products are not certified by the LonMark organization, product submittals must include the application source code, external interface file, resource files and complete documentation regarding all LonMark Objects, network variables and configuration properties supported by the device. In addition, the programming tool used to create any custom application programs shall be provided along with the application source code.
i. Products shall be provided with complete documentation. This shall include diagrams of all LonMark objects supported by the product as well as relevant technical specifications. Undocumented products must be tagged and accepted by the Architect or Engineer prior to installation. Do not install undocumented products without such acceptance.
j. All LonWorks devices within a particular facility shall be integrated into one common network infrastructure utilizing a common Network Management tool and creating a single LNS network database. All LonWorks devices shall share common GUI features for supervisory functions such as scheduling, alarming and history logging.
k. The system installed shall be able to seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e. HVAC and lighting shall coexist on the same network channel without the need for gateways. These components shall share common software for network communications, configuration, time scheduling, alarm handling, history logging, custom programming and monitoring.
l. The control system at any particular facility shall be comprised of LonWorks system controllers and LonTalk communicating devices. Each facility may also include one or more Network Area Controllers which provide supervisory level control logic, local master time keeping, scheduling, trending and alarm logging capabilities, connectivity to the City's Wide Area Network (WAN) and the Web-based Graphical User Interface for the Building Management System.
m. All system controllers shall utilize a peer-to-peer communications scheme to communicate with each other and with the PC-type monitoring computer(s). All controllers shall utilize Standard Network Variable Types (SNVTs) and Standard Configuration Property Types (SCPTs) as defined by LonMark International guidelines. Controllers shall implement LonMark device profiles as appropriate, and shall be provided with the manufacturer's LNS plug-in configuration utility. If an LNS plug-in is not available for a device, all device resource files, XIF files, and points list shall be submitted for prior approval.

n. Controllers shall use a software mechanism for network addressing and identification. It shall not be necessary to set physical network address switches on each controller.
o. System shall utilize LonMark defined standard network and command protocol Types (implicit messaging) for all data including, but not limited to, physical input and output values, input and output overrides, as well as general purpose input and output values used by the controller's control program. The utilization of explicit messaging or protocol converters shall not be acceptable unless approved in writing by the Contract Administrator/designee.
p. Individual products shall conform whenever possible to the LonMark Interoperability Standards. If products are not certified by the LonMark organization, product submittals must include the application source code, external interface file, resource files and complete documentation regarding all LonMark Objects, network variables and configuration properties supported by the device. In addition, the programming tool used to create any custom application programs shall be provided along with the application source code.
q. Products shall be provided with complete documentation. This shall include diagrams of all LonMark objects supported by the product as well as relevant technical specifications. Undocumented products must be tagged and accepted by the Architect or Engineer prior to installation. Do not install undocumented products without such acceptance.
r. Controllers shall contain non-volatile memory for storage of control programs, configuration, time schedules, and historical log data. All such data shall be retained in the event of a power failure. System controllers At least one network device shall have an onboard, battery-backed real-time clock to ensure correct time-of-day operation following a power failure. Terminal Device Control Units controllers (VAVs, Heat Pumps, etc) that require time based operation shall be peers on the network and be able to synchronize data from plant controllers a protected timekeeper controller upon network power up.
s. Provide and install Intelligent Devices (Custom Application Controllers, Application Specific Controllers, Network Area Controllers, etc.) as herein specified, as needed to perform functions indicated in the input output summaries and sequences of operation, and/or indicated on the HVAC drawings.
t. Provide wire, raceway systems, 24 VDC and/or 24 VAC power supplies and final connections to nodes provided by this contract and the following Control Units to meet or exceed all pertinent and applicable codes.
u. Provide all controls, sequences of operation, and configurations systems monitoring as required by these specifications and by the drawings. CONTRACTOR shall also provide all required devices, sensors, hardware, software, wiring, controllers, etc. including any required and not specifically identified in this specification, but required for specified system functionality.
v. Provide and install LonTalk routers as required to combine different communication channels onto a central field bus or as required to segment groups of Intelligent Devices and/or Control Units. Equip each router with a network transceiver on each network port (inbound and outbound) as dictated by the network type (Type 1 - FTT, Type 2 - TP, Type 3 - PL, Type 4 - LP, Type 5 RF, and Ethernet).
w. Provide new data communications wiring and connections between LonWorks devices using only doubly-terminated bus topology for FTT-10 networks ("T-Taps" or "Star" topology is not permitted).
x. Gateways shall not be used unless authorized in writing by the project engineer. It is the intent of this specification that gateways be limited to integrating legacy systems where applicable. Acceptance of gateways is at the sole written discretion of the Contract Administrator/designee.
y. The control system shall be designed such that mechanical equipment will be able to operate under stand-alone control. In general, the operation of any controllers on the network shall not rely on any other controller for its functional operation, except as required in a large "plant-type" system. These "multi-controller" systems shall be designed with minimal communication media between controllers, and with hardware I/O and process logic distributed as to permit at least a minimum level of stand-alone operation of the plant

equipment. System controllers that require a master computer or controller will not be considered. Function specific modules may be used to supplement the functionality resident in each controller. As such, in the event of a network communication failure or the loss of any other controller on the LON, the control system shall continue to independently operate under local control of the resident program stored in nonvolatile memory as detailed herein. In such a case, each individual controller shall continue to perform basic functions until a network connection can be restored.

z. Provide, install, program, and troubleshoot interface(s) necessary to integrate with existing ancillary systems including Chillers, Boilers, Lighting, Variable Frequency Drives, Generators/ATS's and Utility- and sub-metering devices as identified in Attachment 1 – Building Specific Scope of Work, using either vendor provided LonTalk integration cards, or additional LonTalk devices with appropriate I/O capability.

aa. Provide the necessary LON Network Management and Integration Tool software and sufficient credits to commission all controllers/nodes installed by EMS contractor.

bb. Provide coordination with the potentially different Contractor awarded work under Phase 1.A (Web Interface and Archive Data Server) to provide all necessary engineering database information required to integrate the two Phases into a complete Energy Management System. This will include technical assistance, Administrator level password access to the control system, and provisions for any special software tools required but not specifically identified in this specification.

cc. Provide field calibration, testing and checkout of all equipment provided in terms of design, function and performance, ready for owner supervised commissioning and acceptance.

dd. Responsible for removal and salvage of the existing local controllers. All salvaged equipment shall be returned to the City. Contractor shall provide and install new local controllers with at least ten (10) percent of each I/O point type available for future use.

ee. Provide I/O points, programming, and EMS functions for all systems outlined in Attachment 1.

ff. Supply any instruments required to conduct the commissioning and acceptance tests.

gg. Provide trained and knowledgeable technicians for the commissioning and acceptance tests to be performed by an Owner designated Commissioning Authority (CxA). The commissioning process will involve systematically testing all typically similar systems to ensure that they perform interactively according to the design intent, construction documents, and Owner's operational requirements. The GUI is also a commissioned system, and will be subject to Owner acceptance via the commissioning process.

hh. Remedy any discrepancies or malfunctions that are determined by these tests, and repeat testing until defects have been corrected to the satisfaction of the CxA and Owner.

ii. Provide submittals, software, programming and training on the GUI and on maintenance and operations of the provided equipment.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.

A. Control Valves
B. Sensor Wells

1.5 QUALITY ASSURANCE

General: The HVAC Control System shall be furnished, engineered, and installed by Licensed Trade Technicians. The EMS contractor shall have at least two Echelon Certified Network Integrators or LonWorks Integrators. The contractor shall employ technicians who have completed Echelon factory authorized training. The contractor shall employ Echelon factory trained technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request. Contractor shall provide evidence of training prior to bid.

A. EMS Contractor Qualifications:

1. The EMS CONTRACTOR shall be regularly engaged in the service and installation of LonWorks

based systems as specified herein, and must have been so for a minimum of three (3) years. In addition, the contractor shall employ and assign to this project system integrators that are regularly engaged in the service and installation of LonWorks based systems as specified herein, and must have been so for a minimum of three (3) years. Written proof of these qualifications must be provided prior to bid.

2. The EMS CONTRACTOR shall be an authorized representative in good standing of the manufacturer of the proposed hardware and software components. In addition, the contractor shall employ and assign to this project system integrators that have experience with the proposed hardware and software components.

3. The EMS CONTRACTOR shall have an office that is staffed with designers trained in integrating interoperable systems and technicians fully capable of providing LonWorks instruction and routine emergency maintenance service on all system components.

4. The EMS CONTRACTOR shall have in house capabilities to provide control strategies for whole building control. This includes HVAC and lighting applications.

5. The EMS CONTRACTOR shall have a service facility, staffed with qualified service personnel, capable of providing instructions and routine emergency maintenance service for networked control systems.

6. The EMS CONTRACTOR shall submit a list of no less than three (3) similar projects, which have LonWorks based Building Systems installed by the system integrator. These projects must be Installed in Arizona by the approved system integrator, and must be LNS (LonWorks Network Services) Based.

7. The EMS CONTRACTOR shall be a certified LonWorks Integrator, and submit resumes with the proposal indicating passing certificates for Echelon Corporation's approved interoperable, or proof of equivalent training. Such proof must include summary of coursework and indicate both written and laboratory requirements of alternate training.

8. The EMS CONTRACTOR shall utilize a LonWorks protocol analyzer tool to monitor network traffic on all installed control channels for a minimum of 24 hours per channel after final installation. The EMS contractor shall reconfigure nodes and/or install additional routers as necessary to maintain traffic to less than 50% of channel bandwidth capacity

B. Hardware and Software Component Manufacturer Qualifications

1. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of LonWorks based systems as specified herein, and must have been so for a minimum of three (3) years.

2. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the Echelon Open Systems Alliance, LonMark International or LonMark Americas.

3. The manufacturer of the hardware and software components shall have an authorized representative capable of providing service and support as referenced in section B above, and must have done so for a minimum of three years.

4. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.

C. Manufacturers listed below are acceptable providers of hardware as listed solely if full compliance with the specifications is demonstrated to the satisfaction of the project engineer. Only products demonstrating full compliance with the specifications will be accepted whether or not the manufacturer's name appears below:

1. Field Level Controllers Manufacturers:
    a. Circon Systems
    b. Distech Controls
    c. TAC
    d. Honeywell International
    e. Staefa Control Systems

2. Web-based GUI/Server Manufacturers:
    a. Tridium
    b. Plexus NETSERVER
    c. Echelon i.Lon

D. Reference Standards

1. Control system components shall be new and in conformance with the following applicable standards for products specified:
    a. ANSI\EIA 709.1 (LonTalk Protocol)
    b. LonMark Certified (Version 3.3 Guidelines)
    c. UL 916 (Energy Management Equipment)

E. Products

1. CONTRACTOR shall utilize standard components for all assemblies. Custom hardware, operating system, and utility software are not acceptable.

2. All products (PCU's, TDCU's and ID's) shall contain LonWorks networking elements to allow ease of integration of devices from multiple vendors.

3. All materials, equipment and software shall be standard components, regularly manufactured for this and other systems and custom designed for this project. All systems and components shall be thoroughly tested.

1.6 SUBMITTALS

General: CONTRACTOR shall submit the following according to conditions and specifications of agreement. In addition, CONTRACTOR shall provide the following:

1. Product data on all components used to meet the requirements of the specifications such as enclosures, network transceivers, XIF documentation, configuration parameter options, mounting details, power supplies, etc.

2. CONTRACTOR shall provide the LonMark Profile version number the devices comply with.

3. Software documentation regarding the proposed PC operating system third party utilities and application programs, and the proposed application program for the Control Units.

4. CONTRACTOR shall provide detailed direction on procurement of software plug-ins for all proposed controllers. Direction shall include web addresses or vendor contacts where the proposed controller plug-ins can be found. If applicable, the price of these plug-ins must also be submitted.

5. Logical and physical diagrams for each channel indicating each node (control devices and ID's), node address (domain, subnet and group), channel type and router specifications.

6. CONTRACTOR shall submit estimated number of LonMaker credits provided for start-up of all control systems.

7. CONTRACTOR shall submit functional temperature control diagrams for each.

8. Mechanical system served by the HVAC Control System. Indicate and Tag each input/output served by each Control Unit or Intelligent Device.

9. Submit 3 sets of submittals for review within 3 weeks of contract award.

A. Shop Drawings

1. The controls CONTRACTOR shall submit AutoCAD or Visio generated schematic drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a one-page diagram depicting the complete system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all temperature controls, start- stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

2. The submittals shall include manufacturer's catalog data describing each item of control equipment or component provided and installed for the project.

3. System Color Graphics using the AutoCAD or Visio generated schematic drawings. Dynamic points, menus Icons, commandable points, etc. should be clearly identified.

4. Color conventions proposed for all graphics.

B. Close-Out Documents

1. CONTRACTOR shall submit final copies of the shop drawings outlined above. These final submittals shall reflect all field modifications and change orders required to complete the installation. Submit the following quantities of record submittal drawings immediately following receipt of notification of substantial completion. AutoCAD drawing or VISIO files of all shop drawings on 3-1/2" floppy disks or CD ROM disks.

2. CONTRACTOR shall provide three (3) complete sets of documents located in a three-ring notebook and organized by subject with divider tabs.

1.7 OPERATION AND MAINTENANCE MANUALS

A. CONTRACTOR shall submit three (3) sets of operation and maintenance manual in accordance with requirements of Division 15.

B. CONTRACTOR shall include the following documentation:

1. Network Management Software User Manual specific to each tool package provided.

2. Maintenance Instructions: Document all maintenance and repair/ replacement procedures. Provide ordering number for each system component, and source of supply. CONTRACTOR shall provide a list of recommended spare parts needed to minimize downtime.

3. Documentation of network variables, network node configurations, priority interrupts, node binding, addressing structure, etc.

1.8 INSTRUCTION OF OWNER OPERATING PERSONNEL

A. FACTORY TRAINING: CONTRACTOR shall furnish, at no additional cost to CITY, factory training for up to four (4) City employees, including airfare, hotel, meals and ground travel. Training shall be held at the manufacturing facility that provides the primary control devices. The training shall encompass as a minimum:
   1. Operator workstation software – 3 days
   2. LonWorks network design – 2 days

B. LOCAL TRAINING: Operator training shall include 2 initial eight-hour sessions or, if CITY desires this time may be allotted differently. The initial operator-training program shall be to establish a basic understanding of Windows based software, functions, commands, mouse, etc. The training shall encompass as a minimum:

   1. Troubleshooting of input devices, i.e., bad sensors.
   2. Sequence of operation review.
   3. Sign on - sign off.
   4. Selection of all displays and reports.
   5. Commanding of points, keyboard and mouse mode.
   6. Modifying English text.
   7. Use of all dialogue boxes and menus.
   8. System initialization.
   9. Schedules, Alarm Management and Trend Logging.
   10. LON Network Management Integration Tool.

1.9 ACCEPTANCE PROCEDURE

A. Upon completion of the hardware installation, CONTRACTOR shall start-up the system with the LON Network Management Integration tool and shall perform all necessary calibration and testing to ensure proper operation of the project control systems.

B. CONTRACTOR shall schedule a hardware demonstration and acceptance test in the presence of the Owner and designated Commissioning Authority. The acceptance testing is defined as demonstrating the sequence of operation as indicated in the drawings. The hardware demonstration is specified in this Section. Contractor shall perform all tests prior to scheduling the acceptance test and hardware demonstration to insure the overall system is ready for inspection and observations.

C. Upon acceptance of the hardware installation, CONTRACTOR shall complete the GUI software installation. Upon completion of the GUI software installation, CONTRACTOR shall schedule a GUI software demonstration and acceptance test in the presence of the Owner and designated Commissioning Authority. The acceptance testing is defined as demonstrating the system graphics and other supervisory level controls as specified in this Section. CONTRACTOR shall perform all tests prior to scheduling the acceptance tests to insure the GUI software is ready for inspection and observations.

D. When the performance of all aspects of the system is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and be deemed substantially complete as defined in Division 1.

1.10 WARRANTY

A. The HVAC Control System shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from the date of substantial completion, the installed equipment is found to be defective in operation, workmanship or materials, the building systems CONTRACTOR shall replace, repair or adjust the defect at no cost to CITY. Service shall be provided within 24 hours upon notice from Contract Administrator/designee.

B. The warranty shall extend to material that is supplied and installed by CONTRACTOR. Material supplied but not installed by CONTRACTOR shall be covered per the above to the extent of the product only. Installation labor shall be the responsibility of the contractor performing the installation.

C. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

A. CONTRACTOR shall not install electronic hardware in the project until non-condensing environmental conditions have been established. Products installed in violation of this request will be replaced at no additional cost to the CITY.

B. CONTRACTOR shall coordinate storage requirements for factory mounted terminal control units on air terminal devices, air handling units or other packaged control equipment. CONTRACTOR shall not store control units on site in non-conditioned areas.

C. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, CONTRACTOR shall arrange for shipping control devices to unit manufacturer.

PART 2 - PRODUCTS

2.1 WEB SERVER / NETWORK AREA CONTROLLER (NAC)

General Requirements: The Web Server/NAC shall provide the interface between browser based GUI operator workstations on the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the Web Server/NAC. It shall be capable of executing application control programs and services to provide:

a. Calendar and Scheduling Functions.
b. Historical Trend Data Logging.
c. Alarm Management.
d. Supervisory Control (Interlock, master setpoint reset, etc.).
e. Time Synchronization (if no other means available).
f. Soap/XML Interface.
g. SNVT/SCPT Data Access.
h. SMTP Server for Email Alarm Notification.

A. User Access: The system shall provide multiple user access using a standard web browser via the Intranet/Internet. It shall support a minimum of 10 simultaneous users.

B. Alarm Management: The system shall provide alarm recognition, logging, routing and annunciation to supplement distributed alarm capabilities of field controllers. Alarm management shall be user configurable to provide the following minimum capabilities:

a. To alarm/fault notification.
b. Return to Normal notification.

c. Runtime or event counts maintenance notification.
d. Assignment of alarm categories for the purpose of routing (i.e. Security, HVAC, etc.).
e. Archiving of alarm log events to the central archive data server.
f. Annunciation of alarm events in any of the following manners as defined by the user:

    1. Screen message text in dedicated alarm window or area.
    2. Graphic with optional flashing icon and color coding
    3. Email messages to specific, multiple recipients.
    4. Pager notification to specific, multiple recipients.

It shall be possible to disable alarm monitoring for specific alarms based on status such as equipment operating mode, time of day scheduling, etc., and to inhibit annunciation of alarms for a definable startup delay when the alarm is enabled.

C. Data Logging: The system shall provide Data Logging capabilities to collect and store data for any object available in the control system. Data logging shall be user configurable to provide the following minimum capabilities.

a. Change-of-state (COS), deviation or time based collection intervals
b. For COS events, provide the ability to configure event condition (to ON, to OFF, etc).
c. For deviation events, provide the ability to configure the maximum differential hysteresis required to trigger logging.
d. For time based events, provide the ability to configure elapsed time, time of day, day of week collection intervals.
e. For all logs, provide the ability to set the maximum number of data records, and to select rollover or stop when full logging. Also provide automatic archiving trigger configurations based on time of day scheduling or number of events, and the option to clear logs once archived.

D. Audit Logging: The system shall provide and maintain an Audit Log that tracks all activities performed on the system by system operators. For each log entry, provide the time and date, user ID and activity details (i.e. logon/logoff, setpoint change, object command, etc.). Provide the ability to archive the Audit log to the central archive data server at user specified intervals.

E. Equipment Scheduling: The system shall provide calendar and time of day scheduling for all field controllers. These schedules shall provide user definable groups of equipment that shall use the same schedule(s), and shall allow configuration of standard weekly schedules, special exception schedules which are only active for a defined date or date range, and holiday schedules.

F. Supervisory Control Logic: The system shall provide a graphical programming feature for the creation of supervisory control logic. This feature shall provide a standard library of logic blocks organized according to their function. The library shall include hardware and software object reference blocks such as Analog Input, Analog Output, Binary Input, Binary Output and Multistate data objects, as well as monitoring and control object blocks to provide the following minimum capabilities.

a. Timer based operations (i.e. scheduling, calendar, minimum on/off timers, etc.
b. Energy based operations (i.e. start/stop optimization, demand limiting/load rolling, setpoint reset, duty cycling, etc.
c. Control loop operations (i.e. PID, sequencers, etc.
d. Logic process operations (i.e. Interlocks, high/low/avg signal select, etc.
e. Math operations (i.e. addition, subtraction, multiplication, division, minimum, maximum, average, etc.

2.2 GRAPHICAL USER INTERFACE (GUI)

General Requirements: The Graphical User Interface consists of the development of the graphic and text based screens necessary to provide a custom user interface for each building control system. The GUI shall employ browser-like functionality, and shall include a tree view (similar to Windows Explorer) for ease of navigation and quick viewing and access to the hierarchical structure of the control system database. In addition, pull down/pop up menus, toolbars and command buttons will permit the operator to perform tasks with a minimum of knowledge of the control system and basic computer skills.

The Contractor should be aware that, depending on the features provided by the Network Area Controller in each site, and the Central Archive Data Server, the GUI may be implemented at either of these devices. This could mean that the Contractor awarded the work defined in Phase 1.A. (GUI) may be required to generate the GUI on a device (Network Area Controller) provided by the Contractor awarded the work defined in Phase 1.B (Controls), if the NAC provides built-in and acceptable Web-based GUI capabilities. Graphical screens developed for the GUI shall be the same screens used for the Web browser clients, without requiring graphics to be stored on the client machines.

The Contractor shall submit samples of proposed graphic screens to the City for feedback and approval before implementation.

The system shall provide the capability to specify a user's home page, and to limit the screens and features available to each user. In addition, the system shall provide the following minimum capabilities:

1. Graphics Editor: The GUI background images shall be developed using any readily available drawing package capable of generating a GIF, BMP or JPG image file. The editor shall provide menus for selecting background images, graphic objects, choosing colors, copying previous graphics, deleting data points in the graphics, and property configuration screens for object definition and linking. A set of standard HVAC graphics shall be provided to allow operators to select from the graphics library for graphic generation.

2. Real-Time Displays: Information on the color graphic and textual display shall be dynamic and automatically updated.

3. Manual Control: A manual control object/capability shall be provided which allows the operator to command points on or off, start or stop, and set points to local mode or release points to automatic mode. This feature will provide a visual indication of the Manual/Automatic state of the point either with text, icon or color coding methods.

4. Graphic Size: The graphic definition mode of operation shall allow the creation of oversized graphics that are up to 3 video screens wide and 3 video screens high. The operator shall be able to pan and scroll around the oversized graphic to view areas of interest.

5. Object Oriented Graphics: Objects shall be provided to simplify operation and allow special functions to be performed. Custom or canned objects shall be able to modified using third party drawing tools. Objects shall be able to be rotated, scaled, filled, and moved based on a change in the process value.

6. Graphics Generation: Default system graphics shall be self-generating. A library of custom graphics shall be supplied for each control unit. In the case where a custom graphic is required (built up air handling units) the operator shall be able to specify a default graphic to a control device to generate a template so that it becomes self-generating.

7. Trending: The software shall allow analog, digital values and calculations to be graphically plotted in real-time. The software shall able to generate trend information for LonWorks devices not provided by the primary supplier.

8. System Documentation: All system documentation, such as wiring diagrams, points lists, and sequences of operations shall be viewable on line through the graphics browser. Any file conforming to Microsoft Active Document shall be viewable in this manner.

9. Alarms: Alarm detection shall be prominently annunciated and displayed at the GUI. Viewing of alarm history for each individual alarm point shall also be available. At a minimum, each alarm message shall include the site name, failed system component and date & time.

10. Scheduling: The system shall provide graphical application objects representing schedules and calendars which can be adjusted using either a graphical slider or manual text entry method, and shall support word processing features such as copy/paste.

11. Maintenance Notes: If required the system operator shall be able to launch an application where comments may be entered regarding maintenance or other data for each individual controller.

12. On-Line Help. The system shall provide a context sensitive, on-line help system to assist the operator in the use and configuration of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen.

13. Tenant Scheduling Override: CONTRACTOR shall configure a web-based, exception schedule only interface for City specified users (tenants) with appropriate access password, to enter exceptions to the normal schedules. The intent of this system is to provide a simple, reliable way of scheduling exception events without the ability to interface with the normal schedules implemented by the Facilities Department through the system GUI.

2.3 GRAPHIC SCREENS

WAN Graphic: The Web browser GUI shall implement the graphic screens in a linked, hierarchical format, with the initial WAN graphic screen depicting the City's Buildings being controlled by the system. The operator shall be able to link to any Building Graphic from this screen with the proper sign-on password. The following graphic screens shall be developed for each building as a minimum:

1. Common Graphic Features: Each graphic screen shall include a header section at the top displaying the name of the building, the name of the system depicted by the graphic, the current time and date, and the outside air conditions. All HVAC System and Zone graphic screens shall include a link to the programmed sequence of operations document for that particular system. This sequence of operation document shall state clearly and concisely, through the use of words and schematics, the programmed control sequences for each mode of operation (i.e. Occupied, Unoccupied, Standby, Warmup, etc.), and shall identify failure mode operations and guidelines.

2. Building Graphics: Each building will include a main Building Graphic screen providing links to each Floor Plan graphic and mechanical rooms.

3. HVAC Floor Plan Graphics: These screens shall show heating and cooling zone identification through the use of background and/or border colors and text, and shall display current zone temperature and state information. The operator shall be able to link to any individual HVAC Zone or HVAC System graphic screen by clicking the mouse on a zone or system identified on this screen.

4. HVAC System Graphics: These screens shall show the graphical representation of a particular mechanical HVAC system such as a VAV Air Handler, Single- or Multi- Zone Air Handler, etc. Selected inputs, outputs and control parameters being controlled or monitored shall be displayed with appropriate labeling and engineering units. Animation shall be provided for rotation and moving mechanical components to enhance usability. All pertinent control parameters required

for operator adjustment shall be displayed on this screen or on an individual parameter screen via a command button.

5. HVAC Zone Graphics: These screens shall show the graphical representation of an individual zones' mechanical HVAC system such as a VAV Terminal Unit, Heat Pump, Fan Coil Unit, or any other unitary HVAC equipment. Selected inputs, outputs and control parameters being controlled or monitored shall be displayed with appropriate labeling and engineering units. Animation shall be provided for rotation and moving mechanical components to enhance usability. All pertinent control parameters required for operator adjustment shall be displayed on this screen or on an individual parameter screen via a command button.

6. HVAC Zone Summary Graphics: These screens shall display related zone information for each multi-zone system such as a VAV, VVT, Multi-Zone AHU, etc. in a tabular format. Displayed information shall include zone identification, input, output and software parameters critical to determining the general status of each zone served by the primary system. The screen shall also display a basic set of data relative to the performance of the primary HVAC system. All pertinent control parameters required for operator adjustment shall be displayed on this screen or on an individual parameter screen via a command button.

7. Central Plant Graphics: These screens shall show the graphical representation of each system in a central plant such as the chillers, boilers, cooling towers, etc. Due to the potential volume of input, output and software parameters in these systems, it may be necessary to provide separate screens for sub-systems within a central plant (i.e. Primary/Secondary pumps, Chilled Water/Condenser Water, Chillers/Boilers, etc.). Selected inputs, outputs and control parameters being controlled or monitored shall be displayed with appropriate labeling and engineering units. Animation shall be provided for rotation and moving mechanical components to enhance usability. All pertinent control parameters required for operator adjustment shall be displayed on this screen or on an individual parameter screen via a command button.

8. Miscellaneous Systems Graphics: These screens shall display information for miscellaneous HVAC or Lighting systems such as general exhaust fans, sump pumps, etc. not directly related to a particular HVAC system. This information may be displayed in either a graphical or tabular format as appropriate. Selected inputs, outputs and control parameters being controlled or monitored shall be displayed with appropriate labeling and engineering units. All pertinent control parameters required for operator adjustment shall be displayed on this screen or on an individual parameter screen via a command button.

2.4 CENTRAL ARCHIVE DATA SERVER (SERVER)

General Requirements: The Central Archive Data Server shall be located in the data server room of the Information Technology building, and shall be provided by the City. The server shall support all Network Area Controllers connected to the City's network whether local or remote via Ethernet WAN/LAN connections also provided by the City. The server may also act as a GUI workstation for any local or remote building control system. The contractor shall provide all necessary support software for the server to perform the required database archive management, and will coordinate with the City's IT department regarding the hardware and operating system requirements. The server shall provide the following minimum capabilities:

a. Global Data Access: The server shall provide complete access to data defined anywhere in the system.
b. Distributed Control: The server shall provide the ability to execute global control strategies.
c. Time Keeper: The server shall include a master clock service and provide time synchronization for all local and remote building control systems. The server shall be capable of synchronizing its own time from a trusted precision Atomic Clock Internet site.

d. Archive Database Management: The server shall provide central archive database support for all local and remote Network Area Controllers for long term storage of Alarm, History and Audit logs. Archiving time and frequency shall be user defined.
e. Archive Data Reporting: The server shall provide centralized reporting features for stored logs (Alarm, History and Audit logs). Reports shall use a structured query language (SQL) based user interface to generate reports based on user defined parameters. Report queries shall be able to be saved for future report generation using the pre-defined query.
f. Site Backup Storage: The server shall maintain a backup copy of all LON network configuration and controller application programming for each building control system.

2.5 PROGRAMMABLE CONTROL UNIT (PCU)

General Requirements: Control Units shall be equipped with Echelon's 3120 or 3150 Neuron microprocessor for communications. There shall be no intermediate device between the Neuron chip and the input and output channels. As referenced above, "Hosted" controllers that utilize a 3rd party chip for communications processing are not acceptable. The controller shall have a minimum of 32K programmable non-volatile (flash or EEPROM) memory for general data processing, power supply, input/output modules, termination blocks, and network transceivers.

A. System controllers shall share network variable data with other LonWorks based devices across multiple channels.

B. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.

C. The PCU shall be equipped with a dedicated software clock battery if required for stand-alone operation. The battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a 2-week period. CONTRACTOR shall include an integral calendar with automatic leap year compensation. The PCU shall provide time synchronization with TDCU's when required.

D. PCU packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. Make all board terminations facilitate troubleshooting, repair and replacement. The complete PCU, including accessory devices such as relay, transducers, power supplies, etc., shall be wired and housed in an enclosure or as required by the location and local code requirements.

E. CONTRACTOR shall provide PCU boards with one (1) port to provide an optional LonWorks communication link

F. Equip PCU's with diagnostic indicators for the following:

a. Transmit.
b. Receive.
c. IMOK - Application Program is running correctly
d. Input/Output Requirements:

G. The PCU shall contain inputs of the universal type capable of handling current, voltage, resistance, or open and closed contacts in any mix. Analog current and voltage inputs of the following types shall be supported in the PCU:

a. 4-20 Ma.
b. 0-10 volt.
c. 2-10 volt.

H. 1000 ohm RTD or 10K ohm thermistor.

I. CONTRACTOR shall provide programmable intermediate ranges and linearization table for sensor types specified. Standard linearization tables will be available for common sensors.

J. Thermistor type temperature sensors shall require programmable calibration constant unique to a specific resistance group.

K. Digital input types supported by the CU:

   a. normally open contacts. (24V)
   b. normally closed contacts. (24V)

L. The PCU shall accommodate both digital and true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated. All analog outputs shall be proportional current or voltage type with a minimum incremental resolution of 0.5% of the full operating range of the output. Match the proportional range of the output to the full operating range of the actuating device. Use zero and maximum output voltage or current values for shutdown and close-off modes. For troubleshooting and load analysis, the value of each analog output shall be available in the database for trending and display.

M. The analog/digital resolution process shall be 12 bit based. The digital to analog resolution process shall be a minimum of 12 bits.

N. Each controller shall have at least 10% spare point capacity after installation and configuration is complete.

O. PCU Software

   a. General: PCU shall operate totally standalone and independent of a central computer or master device. Software shall include a complete operating system (O.S.), communications handler, point processing, standard control algorithms, and specific control sequences.

   b. Operating System (O.S.) software shall reside in programmable battery backed RAM, operate in real- time, provide prioritized task scheduling, control time programs, and scan inputs and outputs. Operating System shall also contain built in diagnostics.

P. Input/Output Point Processing Software shall include:

   a. Continuous update of input and output values and conditions. All connected points are to be updated at a minimum of one-second intervals.

   b. Assignment of proper engineering units and status condition identifiers to all analog and digital input and outputs.

Q. Command Software

   a. A "fixed mode" option shall be supported to allow inputs ~~to,~~ and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode" inputs and output shall be assigned a high residual command priority to prevent override by application programs.

R. Run Time Totalization:

a. It shall be possible to totalize run time (either on time or off time) for up to 40,000 hours with one-minute resolution. Run time counts shall be resident in non-volatile memory and have PCU resident run time limits assignable through the operator's terminal.

S. Transition Counting: A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter is to be non-volatile and capable of accumulating 40,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

T. Custom DDC Control Loops

a. Custom DDC programs are to be provided to meet the control strategies as called for in the sequence of operation sections of these specifications. Each PCU shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences:

i. Proportional Control, Proportional plus Integral (PI), and Proportional plus Integral plus Derivative (PID).

ii. DDC control programs shall include an assignment of initialization values to all outputs to assure that controlled devices assume a fail-safe position on initial system start-up.

2.6 TERMINAL DEVICE CONTROL UNIT (TDCU)

A. General Requirements: Control Units shall be equipped with a 3120 or 3150 Neuron microprocessor controller, programmable non-volatile memory for general data processing, power supply, input/output modules, termination blocks, and network transceivers.

1. System controllers shall be capable of sharing network variable data with other Lon-based devices that utilize the same transceivers.

2. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.

3. The TDCU shall synchronize its time with a PCU or dedicated TimeKeeper device on the network upon power up of the network.

4. TDCU packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. Make all board terminations facilitate troubleshooting, repair and replacement. The complete TDCU including accessory devices such as relay, transducers, power supplies, etc., shall wired and housed in an enclosure or as required by the location and local code requirements.

5. TDCU's shall be LonMark certified and shall operate a LonMark certified program application to minimize configuration time. Application specific programs shall be able to be reconfigured in the event that controlled equipment is replaced or application options are added or removed.

B. Input/Output Requirements

1. The TDCU inputs shall have inputs of the Universal type capable of handling current, voltage, resistance, or open and closed contacts in any mix. The TDCU shall support analog current and voltage inputs as is appropriate for the application.

2. As is appropriate for the applications, the Digital input types supported by the TDCU are:

a. Normally open contacts.
b. Normally closed contacts.

3. The TDCU shall accommodate both digital and analog outputs when appropriate for the application. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated. All analog outputs shall be proportional current or voltage type with a minimum incremental resolution of 0.5% of the full operating range of the output. Match the proportional range of the output to the full operating range of the actuating device. Use zero and maximum output voltage or current values for shut- down and close-off modes. For troubleshooting and load analysis, the value of each analog output shall be available in the database for trending and display.

1. Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits.

2. The analog/digital resolution process shall be 10 bit based. The digital to analog resolution process shall be a minimum of 8 bit.

3. All digital outputs shall utilize onboard relays with a minimum 2 amp contact rating. If the TDCU utilizes triacs as digital outputs, they must be field wired to a pilot relay and status LED.

4. To reduce exposure to vandalism, TDCU's shall not be mounted in areas that are accessible to the general public but rather in concealed areas such as equipment rooms, ceiling plenums, and air handlers. Wall-mounted communicating thermostat controllers shall not be acceptable.

5. Each controller shall have at least 10% spare point capacity after installation and configuration is complete.

C. TDCU Software

1. General: A TDCU shall operate totally standalone and independent of a central computer for all specified control applications. Software shall include a complete operating system (O.S.), communications handler, point processing, standard control algorithms, and specific control sequences.

2. All TDCU's shall include a manufacturer supplied LNS plug-in for all program application configuration. The use of Echelon generic browser or configuration plug-ins as the only method of configuration is unacceptable.

3. O.S. software shall reside in programmable flash memory, operate in real-time, provide prioritized task scheduling, control time programs and scan inputs and outputs. O.S. shall also contain built in diagnostics.

4. Input/Output Point Processing Software shall include:

   a. Continuous update of input and output values and conditions. All connected points are to be updated at a minimum of one-second intervals.

   b. Assignment of proper engineering units and status condition identifiers to all analog and digital input and outputs.

5. Command Software

   a. A "fixed mode" option shall be supported to allow inputs ~~to,~~ and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode" inputs and output shall be assigned a high residual command priority to prevent override by application programs.

2.7 LON ROUTERS, BRIDGES, REPEATERS AND TRANSCEIVERS

A. Routers, Bridges and Repeaters

1. CONTRACTOR shall provide EIA-709 routing over Ethernet.

2. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.

3. Routers and bridges shall utilize LonTalk protocol transport, network, and session layers to transparently route messages bound for a node address in another subnet or domain.

4. Channels shall be designed so that there are no more than 60 devices per FT-10 channel and no more than 2000' of twisted pair.

5. Routers, bridges and repeaters shall be capable of DIN rail or panel mounting, and be equipped with status LED lights for power, Network traffic and diagnostics.

6. Acceptable Manufacturers.
   - Echelon
   - Loytec

C. Transceivers.

1. Type 1 Network Transceiver, Free Topology, and Twisted Pair: Provide a transformer isolated, twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:

   a. Meets LonMark Interoperability Association Standards.
   b. Differential Manchester encoded signaling for polarity insensitive network wiring.
   c. Transformer isolated for common mode rejection.
   d. 78kbs network bit rate up to distances of 2000m.

2.8 ELECTRONIC INPUT/OUTPUT DEVICES

A. Temperature Sensors and Transmitters

1. General Sensor & Transmitter Requirements:

   a. CONTRACTOR shall provide sensors and transmitters required as outlined in the input/output summary and sequence of operation, and as required to achieve the accuracy as specified herein.

   b. Transmitters shall be equipped with individual zero and span adjustments. The zero and span adjustments shall be non-interactive to permit calibration without iterative operations. CONTRACTOR shall provide a loop test signal to aid in sensor calibration.

   c. Transmitters shall be sized and constructed to be compatible with the medium to be monitored. Transmitters shall be equipped with a linearization circuit to compensate for non-linearities of the sensor and bridge and provide a true linear output signal.

   d. Temperature sensors shall be of the resistance type and shall be either 1000 ohm RTD or 10K ohm thermistor.

e. Thermistors are acceptable provided the mathematical relationship of a thermistor with respect to resistance and temperature with the thermistor fitting constraints is contained with the Control Unit operating software and the listed accuracy's can be obtained. Thermistors shall be certified to be stable +\- 0.24°F. over 5 years and 0.36°F accurate and free from drift for 5 years.

f. The following accuracies are required and include errors associated with the sensor, lead wire and analog to digital conversion.

B. Point Type Accuracy
- Outside Air 0.5°F.
- Chilled Water 0.5°F.
- Room Temperature 1.00°F.
- Hot Water/Steam 0.75°F.
- Duct Temperature 0.5°F.

C. Sensors used in BTU or process calculations shall be accurate to +\- 0.1°F. over the process temperature range. Submit a manufacturer's calibration report indicating that the calibration certification is traceable to the National Bureau of Standards (NBS) Calibration Report Nos. 209527/222173.

D. Thermowells

1. When thermowells are required, the sensor and well shall be supplied as a complete assembly including wellhead and greenfield fitting.
2. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
3. Thermowells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
4. Thermowells shall be constructed of the following materials:

   a. Chilled and Hot Water; brass.
   b. Steam; 316 stainless steel.
   c. Brine (salt solutions): marine grade stainless steel.

5. Outside Air Sensors
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

6. Duct Type Sensors
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (sealtite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
   b. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Duct sensors probe shall be constructed of 304 stainless steel.
   c. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.

7. Averaging Duct Type Sensors

a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, utilize an averaging sensor with multiple sensing points. The averaging sensor shall be a 304 stainless steel tube with holes extending across the duct or plenum to be sampled. A bleed hole outside the duct or plenum causes air to enter the sample tube and exit at the bleed hole, thus bathing the sensor in average air. The averaging sensor shall be installed complete with end cap, compression fittings, gaskets, mounting flange and required accessories.

b. Provide capillary supports at the sides of the duct to support the sensing string.

8. Room temperature sensors

a. Room temperature sensors shall include an LCD temperature display temperature adjustment knob or lever with user adjustable span, and push-button override function. Display, adjustment knob and override button features are not required for temperature monitoring only applications.

b. Acceptable manufacturers: BAPI, ACI or approved.

E. Relative Humidity Sensors/Transmitter

1. The sensor shall be a solid state, resistance type relative humidity sensor of the Bulk Polymer Design. The sensor element shall be washable and shall resist surface contaminations.
2. Humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2 wire isolated loop powered, 4-20ma, 0-10 vdc linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy including lead loss and A to D conversion: Room Type Sensor +\- 3% RH.
4. CONTRACTOR shall provide a single point humidity calibrator, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
5. Acceptable Manufacturers: BAPI, MAMAC, ACI, Veris, Hycal or approved

F. Differential Pressure Transmitters and Accessories

1. General Air and Water Pressure Transmitter Requirements:

a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.

b. Pressure transmitters shall provide the option to transmit a 0 to 5V dc, 0 to 10V dc, or 4 to 20 mA output signal.

c. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (3 valve manifolds).

d. Provide a minimum of a NEMA 1 housing for the transmitter. Locate transmitters in accessible local control panels wherever possible.

e. Low air pressure, differential pressure transmitters used for room filter monitoring. Shall be equipped with a LED display indicating the transmitter output signal.

2. Low Air Pressure Applications (0 to 0.5" WC)

a. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the room and reference static pressure input signals with the following minimum performance specifications.

- Span: Not greater than two times the design space DP.
- Accuracy: Plus or minus 0.5% of F.S.
- Dead Band: Less than 0.3% of output.
- Repeatability: Within 0.2% of output.
- Linearity: Plus or minus 0.2% of span.
- Response: Less than one second for full span input.
- Temperature Stability: Less than 0.01% output shift per degree °F change.

b. The transmitter shall utilize variable capacitance sensor technology and be immune to shock and vibration.
c. CONTRACTOR shall provide a two-year warranty for each transmitter. CONTRACTOR shall replace all transmitters found to be defective at no cost to the CITY during the warranty period. Acceptable Manufacturers:

- VERIS
- MAMAC
- Or approved

B. Flow, Pressure Measuring Apparatus
1. Traverse Probe Air Flow Measuring Stations: Traverse probes shall be a dual manifold, cylindrical, type constructed of 3003 extruded aluminum with an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow and without the physical presence of forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tips on opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as +\- 20° in the approaching air stream. The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
2. Traverse probes shall be accurate to +\- 25% of the measured airflow range down to 0.25" wc static pressure.
3. Each flow measuring station shall be complete with its own dedicated microprocessor with a 4-line, 80 character, Alpha Numeric display and full function keypad. The panel shall be fully programmable and display calculated CFM directly on a LED monitor on the panel face.
4. CONTRACTOR shall provide 24 volt 1 phase power to each flow measuring station.
5. Acceptable Manufacturers: Air Monitor, Brandt, Ebtron, Air Sentinel or approved equal.

C. Shielded Static Pressure Sensor

1. CONTRACTOR shall provide for each zone where required a shielded static pressure sensor suitable for ceiling surface mounting, complete with multiple sensing ports, pressure impulse suppression chamber with minimum volume of 50 cubic inches, airflow shielding, and 3/8" compression takeoff fittings, all contained in a welded stainless steel casing, with polish finish on the exposed surfaces.
2. These probes shall be capable of sensing the static pressure in the proximity of the sensor to within 1 % of the actual pressure value while being subjected to a maximum airflow of 1000 FPM from a radial source.
3. The shielded static sensing devices shall be used for both reference and space pressure sensing.
4. Pressure sensors used for outside air pressure reference purposes shall be equipped with a conduit seal for pneumatic tubing and bushings for a weather tight installation.
5. Static Pressure Traverse Probe
6. CONTRACTOR shall provide multipoint traverse probes in the duct at each point where static pressure sensing is required.
7. Each duct static traverse probe shall contain multiple static pressure sensors located along the exterior surface of the cylindrical probe. Pressure sensing points shall not protrude beyond the surface of the probe.
8. The duct static traverse probe shall be of 304 stainless steel construction and (except for 3/4" dia. probes with lengths of 24" or less) be complete with threaded end support rod, sealing

washer and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probe shall be capable of producing a steady, nonpulsating signal of standard static pressure without need for correction factors, with an instrument accuracy of 21.

D. Venturi Flow meter

1. Pressure drop on Venturi type flow meters shall not exceed 0.25" wc. Each Venturi low and high-pressure taps shall be equipped with nipples, valves and quick disconnects.

2. CONTRACTOR shall equip each Venturi with a metal identification tag indicating the size, location, GPM and meter reading for the GPM specified.

3. CONTRACTOR shall provide (1) 6" dial differential pressure meter of the proper range to determine piping system flow rate. The meter shall be the property of the CITY.

4. Venturi meters shall utilize flanged or screwed connections for removal purposes and shall be rated for the system operating pressures.

5. The Venturi flow meter shall be factory calibrated to provide a minimum of flow accuracy between actual and factory flow calibration data.

E. Current Transformers:

1. The current transformers shall be designed to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design.

2. The core and windings shall be completely encased in a UL approved thermoplastic rated 94 V A. No metal parts shall be exposed other than the terminals.

3. The current transformers shall meet the following specifications:

   a. Frequency Limits: 50 to 400 Hz.
   b. Insulation: 0.6 KV Class, 10 KV BIL.
   c. Accuracy +\- 1% at 5.0 to 25.0 VA accuracy class with U.P.F. burden.

F. Power Monitoring Equipment

1. Power monitoring equipment shall measure true RMS consumption, electrical demand, individual phase voltage and current, individual and average power factor, reactive power, and line frequency. The accuracy of the power monitoring equipment shall be 0.5% of actual reading and meet the ANSI C12.15 requirements for accuracy

2. Acceptable Manufacturers:
   a. Continental Control System, Veris or approved equal

G. Electronic Valve & Damper Actuators

1. General Requirements:

   a. Electronic actuators shall be electric, direct-coupled type capable of being mounted over the shaft of the damper. They shall be UL listed and the manufacturer shall provide a 2-year unconditional warranty from the date of commissioning. Power consumption shall not exceed 8 watts or 15 VA of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators.

   b. Electronic overload protection shall protect actuator motor from damage. If damper jams actuator shall not burnout. Actuators may be mechanically and electrically paralleled on the

same shaft to multiply the available torque. A reversing switch shall be provided to change action from direct to reverse in relation to control signal as operation requires.

H. Valve Actuators:

1. Control Valves Actuators (3 inch and smaller)

   a. Actuators shall have a gear release button on all non-spring return models to allow manual setting. The actuator shall have either an insulating air gap between it and the linkage or a non-conducting thermoplastic linkage. Care shall be taken to maintain the actuator's operating temperatures and humidity within its specifications. Pipes shall be fully insulated and heat shields shall be installed if necessary. Condensation may not form on actuators and shall be prevented by a combination of insulation, air gap, or other thermal break.

   b. The control circuit shall be fully modulating using 2-10 volt or 4-20 mA signals. Accuracy and repeatability shall be within %1 of control signal. A 2-10 volt or 4-20 mA signal shall be produced by the actuator which is directly proportional to the shaft clamp position which can be used to control actuators which are paralleled off a master motor or to provide a feedback signal to the automation system indicating valve position.

   c. Valve body and actuators shall be shipped fully assembled and tested at the valve factory prior to shipment.

   d. Acceptable Manufacturer: BELIMO ONLY

2. Control Valve Actuators (4 inch and larger).

   a. The valve actuator shall consist of a permanent split capacitor, reversible type electric motor that drives a compound epicycle gear. The electric actuator shall have visual mechanical position indication, readable from a distance of 25 feet, showing output shaft and valve position. Unit shall be mounting directly to the valves without brackets and adapters, or readily adapted to suit all other types quarter-turn valves. Actuator drive time shall be 30 seconds or less.

   b. The actuator shall have an integral terminal strip, which, through conduit entries, will ensure simple wiring to power supplies. Cable entries shall have UL recommended gland stops within the NPT hole to prevent glands from being screwed in too far and damaging cable.

   c. The actuator shall be constructed to withstand high shock and vibrations without operations failure. The actuator cover shall have captive bolts to eliminate loss of bolts when removing the cover from the base. One copy of the wiring diagram shall be provided with the actuator.

   d. The actuator shall have a self-locking gear train, which is permanently lubricated, at the factory. The gearing shall be run on ball and needle bearings. Actuators with 600 in/lbs. or more output torque shall have two adjustable factory calibrated mechanical torque limit switches of the single- pole, double-throw type. The motor shall be fitted with thermal overload protection. Motor rotor shaft shall run in ball bearings at each end of motor.

   e. The actuator housing shall be hard anodized aluminum for full environmental protection.

   f. The environmental temperature range of the actuator shall be -30°C to +60°C (-20°F to +140°F).

   g. For intermittent on/off service, the actuator shall be rated at a 20% duty cycle (i.e., 12 minutes extended duty in every hour, or alternatively; one complete cycle every 2 minutes). For more frequent cycling and modulating service, an actuator shall be rated for continuous

duty. The actuator rated for continuous duty shall be capable of operating 100% of the time at an ambient temperature of 40°C.

h. The actuator shall have an integral self-locking gear train. Motor brakes shall not be required to maintain desired valve position. Levers or latches shall not be required to engage or disengage the manual override. Mechanical travel stops, adjustable to 15° in each direction of 90° rotation shall be standard, as well as two adjustable travel limit switches with electrically isolated contacts. Additional adjustable switches shall be available as option.

i. Single Phase Motor: The motor shall have Class B insulation capable of withstanding locked-rotor for 25 seconds without overheating. Wiring shall also be Class B insulation. An auto-reset thermal cutout protector shall be embedded in the motor windings to limit heat rise to 80°C in a 40°C ambient. All motors shall be capable of being replaced by simply disconnecting the wires and then removing mounting bolts. Disassembly of gears shall not be required to remove the motor.

j. Materials of Construction: The electric actuator shall have a pressure die-cast, hard-anodized aluminum base and cover. The compound gear shall be made of die-cast, hard-anodized aluminum or steel. An alloy steel worm gear shall be provided for manual override and torque limiting. Bearings for gears shall be of the ball and needle type; bronze bearings shall be used on the shafting parts.

k. Acceptable Manufacturer: BELIMO ONLY

2.9 CONTROL VALVES

A. General Control Valve Requirements

1. All automatic control valves shall be linear, fully proportioning, with modulating ball, plug or V-port inner guides unless otherwise specified. The valves shall be quiet in operation and fail safe in either normally open or normally closed position in the event of control air failure or loss of electronic output signal.

2. All valves shall be capable of operating in sequence when required by the sequence of operation. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads as specified. All control valves shall be suitable for the pressure conditions, and shall close against the differential pressures involved. Valve body pressure rating and connection type (screwed or flanged) shall conform to ANSI pressure classifications appropriate for the system working pressures.

3. Acceptable Manufacturers: BELIMO ONLY

B. Hot and Cold Water Control Valves

1. Hot and cold water globe type control valves shall be single-seated type, with equal percentage flow characteristics. The valve discs shall be composition type and shall be sized using ISA methods.

2. Pressure drop through the valves shall not exceed 5 psi unless otherwise indicated.

3. Ball valves shall be equipped with 316 stainless steel trim, Teflon seals and adjustable packing gland nuts. Provide a handle for manual operation during start-up and maintenance.

2.10 SWITCHES

A. Current Sensing Switches

1. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. Current sensing switches shall consist of a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over current up to twice its trip into range.

2.11 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

A. CONTRACTOR shall provide low voltage interlock wiring between supply and exhaust fans where indicated, electrical wiring for relays (including power feed) for temperature and pressure indication.

B. CONTRACTOR shall provide power wiring, conduit and connections for low voltage devices provided under this specification, alarms, flow switches, actuating devices for temperature, humidity, pressure and flow indication, point resets controlled by this Section.

C. CONTRACTOR shall provide all other low voltage wiring required for the complete operation of the specified systems.

D. CONTRACTOR shall install all wiring raceway methods complying with the requirements of the National Electrical Code.

E. Conduit shall be utilized in all mechanical room, electrical rooms and any other location dictated by governing code.

F. Network Communication Requirements
   1. Wired network communication shall be via channels consisting of a 22 AWG twisted pair Echelon approved cable.
   2. Communication wire runs shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible. All cable runs shall be parallel or perpendicular to the buildings structural elements.
   3. All shields shall be ground (earth ground) at one point only, to eliminate ground loops.
   4. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted shielded pairs (22awg) with the shields grounded in accordance with the manufacturer's wiring practices.
   5. All communication wiring shall be installed in a buss topology with no more than 2000' of twisted pair per channel.
   6. All Network wiring shall be tagged and labeled at each end. Termination point labels shall identify the source device and the destination device at every termination point.

G. Input/Output Control Wiring:
   1. RTD wiring shall be two-wire or four-wire twisted, shielded, minimum number 18 gauge.
   2. Other analog inputs shall be a minimum of number 18 gauge, twisted, (shielded optional and device dependant).
   3. Binary control function wiring shall be a minimum of number 18 gauge.
   4. Analog output control functions shall be a minimum of number 18 gauge, twisted, (shielded optional and device dependant).
   5. Binary input wiring shall be a minimum of number 18 gauge.

6. All Input/Output wiring shall be tagged and labeled at each end.

H. Splices

1. Splices in shielded cables shall consist of terminations and the use of shielded cable couplers, which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein.

I. Conduit and Fittings

1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.

J. Relays: Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.

K. Solid State Relays (SSR): Input/output isolation shall be greater than IOE 9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz. The contact life shall be 10 x 10 E6 operations or greater. The ambient temperature range of SSRs shall be -20 to + 140F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.

L. Contactors: Contactors shall be of the single coil, electrically operated, and mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi permanent magnets. Contactors shall be double-break-silver-to-silver type protected by arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

2.12 EMS HARDWARE IDENTIFICATION

B. Automatic Control Valve Tags

1. For valves, etc., use metal tags with a 2-inch minimum diameter, fabricated of brass, stainless steel, phenolic or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or heavy duty shipping tag.

2. Tag valves with identifying number and system. Number valves by floor level, column location and system served.

3. Prepare lists of all tagged valves showing location, floor level, and tag number, use. Prepare separate lists for each system. Include copies in each maintenance manual.

C. Miscellaneous Equipment Identification

1. Screwed-on, engraved black lamicoid sheet with white lettering on all control panels and remote processing panels. Lettering sizes subject to approval.

2. Inscription, subject to review and acceptance, indicating equipment, system numbers, functions and switches. For panel interior wiring, input/output modules, local control panel device identification.

PART 3 - EXECUTION

3.1 EXAMINATION

A. CONTRACTOR shall verify that systems are ready to receive work.

B. Beginning of installation means installer accepts existing conditions.

C. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

D. CONTRACTOR shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator/designee for resolution before rough-in work is started.

E. The EMS CONTRACTOR shall examine the drawings and specifications for other parts of the work, and if head room or space conditions appear inadequate or if any discrepancies occur between the plans and his work and the plans for the work of others, he shall report such discrepancies to the Architect/Engineer and shall obtain written instructions for any changes necessary to accommodate his work with the work of others.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. CONTRACTOR shall install all control components in accordance with manufacturer's instructions and recommendations.

B. If the controls contractor is responsible for providing the damper then provide mixing dampers of parallel blade construction arranged to mix streams. CONTRACTOR shall provide separate minimum outside air damper section adjacent to variable outside air damper.

C. CONTRACTOR shall mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide nameplates for instruments and controls inside cabinet and nameplates on cabinet face.

D. After completion of installation, test and adjust control equipment. CONTRACTOR shall submit data showing set points and final adjustments of controls.

E. CONTRACTOR shall install equipment, piping, wiring/conduit parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

F. CONTRACTOR shall provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

G. CONTRACTOR shall verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

H. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.3 ELECTRICAL SYSTEM INSTALLATION

A. CONTRACTOR shall comply with all Division 16 Installation Requirements.

B. CONTRACTOR shall install low voltage power, LonWorks, and LAN communication trunks in conduit in the following locations regardless of local building code allowances otherwise.

1. Mechanical rooms.
2. Electrical rooms.
3. Storage rooms.
4. Open Areas where the wiring will be exposed to view or tampering.

C. CONTRACTOR shall conceal conduit within finished shafts, ceilings and wall as required. CONTRACTOR shall install exposed conduit parallel or at right angles with the building walls.

D. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
2. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.

E. CONTRACTOR shall not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

F. Where Class 2 wiring is run exposed, wiring to be run parallel along a surface or perpendicular to it, and NEATLY tied at 3m (10 ft.) intervals.

G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

H. CONTRACTOR shall plug or cap all unused conduit openings and stub-ups. CONTRACTOR shall not use caulking compound.

I. CONTRACTOR shall route all conduit to clear beams, plates, footings and structure members. Do not route conduit through column footings or grade beams.

J. Set conduits as follows:
1. Expanding silicone fire stop material sealed watertight where conduit is run between floors and through walls of fireproof shaft.
2. Oakum and lead, sealed watertight penetration through outside foundation walls.

K. CONTRACTOR shall cap open ends of conduits until conductors are installed.

L. Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.

M. Where exposed to the elements or in damp or wet locations, waterproof flexible conduit shall be installed. Installation shall be as specified for flexible metal conduit.

N. CONTRACTOR shall provide floor, wall, and ceiling plates for all conduits passing through walls, floors or ceilings. Use prime coated cast iron, split-ring type plates, except with polished chrome-plated finish in exposed finished spaces.

3.4 TEMPERATURE SENSORS

A. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such manner as to allow for quick, easy replacement and servicing without special tools or skills.

B. Strap-on mountings shall not be permitted.

C. Outdoor installations shall be of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. Protective shield shall be stainless steel.

D. Sensors shall be with enclosure where located in finished space.

E. Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces or positions obstructed by ducts, equipment, and so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element. Ducts shall be securely sealed where elements or connections penetrate ducts to avoid measuring false conditions.

F. All sensors measuring temperatures in pipes larger than 2 inches in diameter or in pressure vessels shall be supplied with wells properly fabricated for the service. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand pressures and velocities to which they are subjected. Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to effect proper flow across the entire area of the well.

3.5 ACTUATORS

A. CONTRACTOR shall mount and link control damper actuators per manufacturer's instructions.

B. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.6 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.

B. CONTRACTOR shall permanently label or code each point of field terminal strips to show the instrument or item served.

C. CONTRACTOR shall identity control panels with minimum 1" letters on nameplates.

D. CONTRACTOR shall identity all other control components with permanent labels. Identifiers shall match record documents.

E. CONTRACTOR shall identify room sensors relating to terminal box or valves with nameplates.

3.7 PROGRAMMING

A. CONTRACTOR shall provide sufficient internal memory for the specified control sequences and trend logging.

B. Point Naming: System point names shall be consistent with the CITY's standard naming convention, if provided. If a standard naming convention is not provided by the CITY, contractor shall submit proposed naming conventions to the CITY for approval before implementation.

C. Software Programming

1. CONTRACTOR shall provide programming for the system as per specifications and adhere to the strategy algorithms provided. The EMS Contractor shall also provide all other system programming necessary for the operation of the system but not specified in this document. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements reflect the language used in the sequence of operations.

3.8 CLEANING

A. CONTRACTOR shall clean up all debris resulting from his or her activities daily. CONTRACTOR shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Contract Administrator/designee.

B. At the completion of work in any area, CONTRACTOR shall clean all of his/her work, equipment, etc., making it free from dirt and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.9 PROTECTION

A. CONTRACTOR shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. CONTRACTOR shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. CONTRACTOR shall protect his/her work against theft or damage, and shall carefully store material and equipment received on-site that is not immediately installed. CONTRACTOR shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.10 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in scope of work.

B. CONTRACTOR shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and/or wiring runs shall be installed parallel to building lines and properly supported.

C. CONTRACTOR shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.11 CHECK OUT, START UP AND TESTING

A. The control system shall be properly commissioned prior to acceptance. The Contractor shall coordinate with others (including mechanical, electrical and test and balance) to properly start up and verify the operation of the system. Provide as-built documentation as detailed in Part 1 of this Section.

3.12 ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and CITY (or designated representative). Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Contract Administrator/designee. Such tests shall then be performed as part of the warranty.

PART 4 – SEQUENCES OF OPERATION

4.1 SUMMARY

A. CONTRACTOR shall coordinate control functions, such as scheduling and supervisory-level global control, points list and control sequences needed for this installation as listed below. Provide automatic control for system operation. Manual operation is limited only where specifically described, however, provide manual override for each automatic operation. Functions called for in the specified sequence of operations are minimum requirements and do not limit additional capabilities the DDC system can be provided with. All additional features and capabilities implemented shall be clearly documented in the submittals.

B. Provide the following functions which are not specifically mentioned in each sequence of operation for each item of equipment:
   a. Start-Stop, manual and scheduled.
   b. Minimum on/off timers for system and staged equipment.
   c. Adjustable setpoints and control parameters.
   d. Sequenced starting of all motors.
   e. Lead/Lag Changeover.
   f. Equipment Failure Alarms.
   g. High/Low Temperature Alarms.
   h. Freeze and High Pressure Protection and Alarms.

C. The following sequences are typical for each type of system. They should be carefully reviewed to assure that they are properly applied and fit the particular systems and objectives. Any control sequences not specifically identified here, but implied in Attachment 1 – Building Specific Scope of Work, shall be developed and submitted by Contractor to City for approval.

D. **CHILLED WATER AND CONDENSER WATER SYSTEMS (with Optional Heat Exchanger)**

PLANT ENABLE COMMAND

1. Anytime a building zone being served by the central plant is operating on its occupied schedule, or during after-hours for night setback or temporary occupied mode, and requires chilled water, the central plant will be enabled. Once enabled, the central plant will remain enabled for a minimum of 30 minutes (adjustable).

MODES OF CHILLED WATER PLANT OPERATION

1. Chiller Mode (normal chilled water operation) – When the central plant receives an enable command, and the outdoor wet bulb temperature is above the Heat Exchanger enable setpoint of 55° (adjustable), the plant will operate in chiller mode. During chiller mode the controls will open chiller control valves required for the lead chiller and close control valves for the heat exchanger. Once the valves are indexed as determined by valve position feedback the Lead Primary and Lead Condenser pumps shall start and the lead chiller will be enabled. During the Chiller Mode the cooling tower is controlled to maintain the "Chiller Mode" condenser water supply temperature setpoint of 80° (adjustable).

2. Heat Exchanger Mode (economizer operation) – When the central plant receives an enable command, and the outdoor wet bulb temperature is below the Heat Exchanger enable setpoint of 55° (adjustable), the plant will operate in the heat exchanger mode. When heat exchanger mode is indexed on, the controls will disable the chiller(s), open the valves on the condenser water side of the heat exchanger, and index the cooling tower(s) to full capacity. The chilled water loop to the building will continue to operate with the chilled water side of the heat exchanger closed until the condenser water temperature is low enough to cool the chilled water. During the Heat Exchanger Mode the cooling tower is controlled to maintain the "Heat Exchanger Mode" condenser water supply temperature setpoint. The condenser water setpoint will initialize to 5° (adjustable) above the outdoor wet bulb temperature, and will reset based on the building chilled water temperature to maintain the chilled water reset setpoint. The plant will remain in Heat Exchanger mode for a minimum time delay of 20 minutes (adjustable), after which time it will be terminated when the chilled water supply temperature rises above a high limit setpoint of 50° (adjustable) for 5 minutes (adjustable). Once Heat Exchanger mode is terminated, it will be locked out of operation for a minimum of 4 hours (adjustable).

3. Condenser Water Warm Up Mode – When the central plant transitions between Heat Exchanger Mode and Chiller Mode, Condenser Water Warm Up Mode is enabled. During this mode all pumps and valves are kept in the Heat Exchanger Mode positions and the cooling tower fan is disabled. The Condenser Water Warm Up Mode will remain active until the condenser water supply temperature reaches 60° (adjustable), or after a maximum time delay of 15 minutes (adjustable). At that point the plant will switch to chilled water mode.

CHILLED WATER RESET

1. The control system shall provide setpoint reset of the chilled water supply temperature based on the building chilled water return temperature. A reset action will be provided with operator adjustable input and output ranges so that the chilled water setpoint (output) will increase as the building chilled water temperature (input) decreases.

SECONDARY CHILLED WATER PUMP OPERATION

1. The lead secondary chilled water pump is energized any time the central plant is in Chiller Mode, Heat Exchanger Mode or Condenser Water Warm Up Mode.

a. Variable Speed Control - The pump motor speed is controlled to maintain a differential pressure setpoint of 20 PSI (adjustable) between the building chilled water supply and return lines.

b. Lead/Lag Control - The lead pump is alternated by time schedule, run time or as selected by the operator. If the lead pump fails, the lag pump will become lead pump and start.

REFRIGERANT MONITORING

1. An emergency ventilation switch, alarm horn and beacon shall be located at each of the chiller room exits, and chiller room refrigeration monitoring shall be provided for leak detection alarming and chiller room ventilation.
2. Warning Level: Upon sensing refrigerant above the acceptable environmental level (AEL), the system shall activate the warning beacons and generate a Refrigerant Gas Warning at the EMS.
3. Alarm Level: Upon sensing refrigerant above the threshold limit value (TLV), or upon activation of a emergency ventilation switch, the system shall activate the warning beacons and horns and generate a Refrigerant Gas Alarm at the EMS. The system will open any ventilation mode damper(s), and enable the ventilation exhaust fan(s) to purge the area. Purge mode shall remain active for a minimum of 20 minutes or until safe levels are detected by the refrigerant monitoring system.

E. HEATING HOT WATER SYSTEMS

PLANT ENABLE COMMAND

1. Anytime a building zone being served by the boiler plant is operating on its occupied schedule, or during after-hours for night setback or temporary occupied mode, and requires heating hot water, the boiler plant will be enabled. Once enabled, the boiler plant will remain enabled for a minimum of 30 minutes (adjustable). The system will provide a boiler plant lockout mode based on outdoor air temperature with a setpoint of 60° (adjustable).

BOILER OPERATION

1. When the boiler plant receives an enable command, the Lead boiler is enabled. The boiler control valve(s) will be commanded open. Once the valves are indexed as determined by valve position feedback, the Lead Boiler will be commanded to start and will operate under its internal temperature controls. If the Lead Boiler fails as indicated by low heating water temperature, the Lag Boiler will become the Lead and start.

SECONDARY BOILER PUMP OPERATION

1. The lead secondary heating hot water pump is energized any time the boiler plant is enabled.
   a. Variable Speed Control - The pump motor speed is controlled to maintain a differential pressure setpoint of 20 PSI (adjustable).
   b. Lead/Lag Control - The lead pump is alternated by time schedule, run time or as selected by the operator. If the lead pump fails, the lag pump will become lead pump and start.

F. VAV AIR HANDLING UNITS

UNIT ENABLE COMMAND

1. Anytime a terminal unit being served by the VAV Air Handling Unit is operating on its occupied schedule, or during after-hours for night setback or temporary occupancy mode, the VAV Air Handling Unit will be enabled.

GENERAL OPERATION

1. When enabled by the control system, the AHU dampers will be indexed to their minimum OSA position and the supply fan will start. The variable frequency drive (VFD) will modulate the speed of the supply fan to maintain duct static pressure at 1.2" w.c. (adjustable).

RETURN FAN CONTROL (if available)

1. The return fan shall run any time the supply fan operates. In applications providing building pressure monitoring, the variable frequency drive (VFD) will modulate the speed of the return fan to maintain building pressure at 0.05" w.c. (adjustable). In applications without building pressure monitoring, the return fan speed shall track the supply fan speed by an adjustable differential (i.e. 80%).

SUPPLY TEMPERATURE CONTROL

1. The chilled water and hot water control valves shall modulate to maintain the supply air temperature at the supply setpoint providing a deadband of 5° (adjustable). The supply temperature setpoint will be reset based on the zone demand for cooling/heating. A reset action will be provided with operator adjustable input and output ranges so that the supply temperature setpoint (output) will increase as the zone demand (input) decreases.

ECONOMIZER MODE CONTROL

1. The system shall modulate the outside/return/relief air dampers between minimum and 100% to utilize outside air for "free cooling" of the supply air when the return air temperature is greater than that of the outside air temperature. Mechanical cooling shall be available to aid the economizer operation at all ambient conditions and during unoccupied mode operation.

DEMAND VENTILATION CONTROL

1. During occupied mode operation, the system shall reset the minimum OSA damper position based on the space or return air CO2 level. When the measured CO2 level is greater than 900 ppm (adjustable), the minimum OSA position will be reset to introduce more outside air into the unit, up to a user-definable maximum position.

G. MULTI-ZONE AIR HANDLING UNITS

UNIT ENABLE COMMAND

1. Anytime a zone being served by the Multi-Zone Air Handling Unit is operating on its occupied schedule, or during after-hours for night setback or temporary occupancy mode, the Multi-Zone Air Handling Unit will be enabled.

GENERAL OPERATION

1. When enabled by the control system, the outside air dampers will be indexed to their minimum OSA position and the supply fan will start.

DECK TEMPERATURE CONTROL

1. The chilled water and hot water control valves shall modulate to maintain the cold deck and hot deck temperatures at their respective setpoints providing a minimum deadband of 5° (adjustable). The deck temperature setpoints will be reset based on the zone demand for cooling/heating. A reset action will be provided with operator adjustable input and output ranges so that the deck temperature setpoints (output) will adjust as the zone demand (input) changes. Heating will be locked out when the outside air temperature rises above the heating lockout setpoint of 68° (adjustable).

ECONOMIZER MODE CONTROL

1. The system shall modulate the outside/return/relief air dampers between minimum and 100% to utilize outside air for "free cooling" of the cold deck supply air when the return air temperature is greater than that of the outside air temperature. Mechanical cooling shall be available to aid the economizer operation at all ambient conditions and during unoccupied mode operation.

DEMAND VENTILATION CONTROL (if available)

1. During occupied mode operation, the system shall reset the minimum OSA damper position based on the space or return air CO2 level. When the measured CO2 level is greater than 900 ppm (adjustable), the minimum OSA position will be reset to introduce more outside air into the unit, up to a user-definable maximum position.

ZONE DAMPERS CONTROL

1. The zone damper for each zone will modulate between the hot deck and cold deck position to maintain their respective zone temperature setpoint. During occupied mode, the zone damper will maintain zone temperature to occupied cooling/heating setpoints. During unoccupied mode, the zone damper will maintain unoccupied cooling/heating setpoints.
2. During scheduled unoccupied mode, pressing the temporary override button on the zone thermostat will place the zone into occupancy bypass mode for a pre-defined time period (1 hour, adjustable).

H. SINGLE ZONE AIR CONDITIONING UNITS (FCU'S, ACU'S, RTU'S, HPU'S, ETC.)

UNIT ENABLE COMMAND

1. Unit will be enabled from an occupancy schedule for normal occupied/unoccupied mode. During scheduled unoccupied mode, pressing the temporary override button on the zone thermostat will place the unit into occupancy bypass mode for a pre-defined time period (1 hour, adjustable).
2. During occupied mode, the unit will maintain zone temperature to occupied cooling/heating setpoints. During unoccupied mode, the unit will maintain unoccupied cooling/heating setpoints.

OCCUPIED MODE CONTROL

1. During occupied or bypass periods, the control system shall maintain zone temperature based on individual occupied mode cooling and heating setpoints defined at the EMS. A deadband will be maintained between the setpoints where no cooling or heating is required. The supply fan shall operate at all times during occupied mode.
2. When the zone temperature rises above the occupied cooling setpoint, cooling will be enabled (i.e. cooling coil modulation/open, compressor staging, etc.). When the zone temperature falls below the occupied cooling setpoint, cooling will be disabled. Adjustable minimum On/Off timers shall provide short cycling protection.
3. When the zone temperature falls below the occupied heating setpoint, heating will be enabled (i.e. heating coil modulation/open, electric heat staging, etc.). When the zone temperature rises above the occupied heating setpoint, heating will be disabled. Adjustable minimum On/Off timers shall provide short cycling protection.

UNOCCUPIED MODE CONTROL

1. During unoccupied periods, the control system shall maintain zone temperature based on individual unoccupied mode cooling and heating setpoints defined at the EMS. The supply fan shall operate only when cooling or heating is required during unoccupied mode.

2. When the zone temperature rises above the unoccupied cooling setpoint, cooling will be enabled (i.e. cooling coil, compressor staging, etc.). Units with modulating hydronic (chilled water) cooling shall be fully open during unoccupied cooling mode to satisfy the zone as quickly as possible. When the zone temperature falls below the unoccupied cooling setpoint, cooling will be disabled. Adjustable minimum On/Off timers shall provide short cycling protection.
3. When the zone temperature falls below the unoccupied heating setpoint, heating will be enabled (i.e. heating coil, electric heat staging, etc.). Units with modulating hydronic (hot water) heating shall be fully open during unoccupied heating mode to satisfy the zone as quickly as possible. When the zone temperature rises above the unoccupied heating setpoint, heating will be disabled. Adjustable minimum On/Off timers shall provide short cycling protection.

ECONOMIZER MODE CONTROL (If available)

1. The system shall modulate the outside/return/relief air dampers between minimum and 100% to utilize outside air for "free cooling" of the supply air when the zone or return air temperature is greater than that of the outside air temperature. Mechanical cooling shall be available to aid the economizer operation at all ambient conditions and during unoccupied mode operation.

DEMAND VENTILATION MODE CONTROL (If available)

1. During occupied mode operation, the system shall reset the minimum OSA damper position based on the space or return air CO_2 level. When the measured CO_2 level is greater than 900 ppm (adjustable), the minimum OSA position will be reset to introduce more outside air into the unit, up to a user-definable maximum position.

I. VAV TERMINAL UNITS

UNIT ENABLE COMMAND

1. Unit will be enabled from an occupancy schedule for normal occupied/unoccupied mode. During scheduled unoccupied mode, pressing the temporary override button on the zone thermostat will place the unit into occupancy bypass mode for a pre-defined time period (1 hour, adjustable).
2. During occupied mode, the unit will maintain zone temperature to occupied cooling/heating setpoints. During unoccupied mode, the unit will maintain unoccupied cooling/heating setpoints.

OCCUPIED MODE CONTROL

1. During occupied or bypass periods, the control system shall maintain zone temperature based on individual occupied mode cooling and heating setpoints defined at the EMS. A deadband will be maintained between the setpoints where no cooling or heating is required.
2. As the zone temperature rises above the occupied cooling setpoint, the control system shall increase the supply air setpoint from minimum to maximum design CFM relative to the zone temperature error. When the zone temperature falls below the occupied cooling setpoint, the supply air damper will be positioned to maintain the minimum design CFM setpoint.
3. When the zone temperature falls below the occupied heating setpoint, the supply air damper will be positioned to maintain the heating design CFM setpoint, and heating will be enabled (i.e. heating coil modulation/open, electric heat staging, etc.). When the zone temperature rises above the occupied heating setpoint, heating will be disabled. Adjustable minimum On/Off timers shall provide short cycling protection. Electric heating elements shall not be permitted to operate unless adequate air flow is measured through the box.

UNOCCUPIED MODE CONTROL

1. During unoccupied periods, the control system shall maintain zone temperature based on individual unoccupied mode cooling and heating setpoints defined at the EMS.
2. When the zone temperature rises above the unoccupied cooling setpoint, cooling will be enabled, triggering a delayed start of the VAV Air Handling Unit. During unoccupied cooling mode, the supply air damper shall be open to maximum design CFM to satisfy the zone as quickly as possible. When the zone temperature falls below the unoccupied cooling setpoint, cooling will be disabled, and the supply air damper shall be positioned to an adjustable minimum position (i.e. 0-50%).
3. When the zone temperature falls below the unoccupied heating setpoint, heating will be enabled, triggering a delayed start of the VAV Air Handling Unit. The supply air damper will be positioned to maintain the heating design CFM setpoint. Units with modulating hydronic (hot water) heating shall be fully open during unoccupied heating mode to satisfy the zone as quickly as possible. When the zone temperature rises above the unoccupied heating setpoint, heating will be disabled, and the supply air damper shall be positioned to an adjustable minimum position (i.e. 0-50%).

J. GENERAL EXHAUST FANS CONTROL

1. Bathroom and general exhaust fans shall be enabled from a building occupancy schedule. Fan status shall be monitored by the EMS and an alarm shall be generated at the workstation when the fan fails to operate as indicated by the fan status.

K. ZONE LIGHTING CONTROL

INTERIOR / EXTERIOR LIGHTING ZONES

1. Each lighting zone controlled by the EMS shall be enabled from a zone schedule. Lighting zone schedules shall provide standard weekly scheduling as well as date-specific special event scheduling. Exterior lighting zones will be disabled based on the daylight level detected from a photocell (if specified) or from an astronomical timeclock which calculates daylight hours.

EXHIBIT C
PRICING FORMS

City of Chandler
Energy Management System
Scope 1.A Base-Bid Proposal Cost Form

Scope 1.A - Integration

Task Description	Materials	Engineering Labor	Technical & Installation Labor	Subtotal	Taxes	Total
Community Center / Senior Center	$ 80,637.00	$11,237.15	$58,099.52	$ 149,973.67	$7,603.66	$157,577.33
Hamilton Aquatic Center	$6,192.12	$1,1026.34	$4,301.44	$11,519.90	$584.06	$12,103.96
Information Technology / Municipal Services	$86,877.00	$23,632.22	$97,805.12	$208,314.34	$10,561.54	$218,875.87
Downtown Library	$59,145.00	$11,742.42	$48,503.00	$119,391.42	$6,053.15	$125,444.57
Desert Breeze Police Substation	$22,568.00	$19,787.38	$32,299.30	$74,654.68	$3,374.99	$78,439.67
Police Headquarters / City Courts / 9-1-1 Center	$121,445.00	$41,369.54	$139,120.00	$301,934.54	$15,308.08	$317,242.62
Police Property & Evidence	$34,553.00	$4,189.59	$22,620.16	$61,362.75	$3,111.09	$64,473.84
Snedigar Sportsplex	$17,067.00	$2,263.22	$9,324.80	$28,655.02	$1,452.81	$30,107.83
Task Sub-Total	$428,484.12	$115,247.85	$412,074.34	$ 955,806.31	$48,459.38	
Base Scope Total						$1,004,265.69

City of Chandler
Energy Management System
Scope 1.B Base-Bid Proposal Cost Form

Scope 1.B - Building Controls

Task Description	Materials	Engineering Labor	Technical & Installation Labor	Subtotal	Taxes	Total
Community Center / Senior Center	$.00	$4,060.26	$.00	$4,060.26	$205.86	$4,266.12
Hamilton Aquatic Center	$.00	$601.52	$.00	$601.52	$30.50	$632.02
Information Technology / Municipal Services	$.00	$10,225.84	$.00	$10,225.84	$518.45	$10,744.29
Downtown Library	$.00	$5,037.73	$.00	$5,037.73	$255.41	$ 5,293.14
Desert Breeze Police Substation	$.00	$3,082.79	$.00	$3,082.79	$156.30	$3,239.09
Police Headquarters / City Courts / 9-1-1-Center	$.00	$18,872.69	$.00	$18,872.69	$956.85	$19,829.54
Police Property & Evidence	$.00	$2,105.32	$.00	$2,105.32	$106.74	$2,212.06
Snedigar Sportsplex	$.00	$1,503.80	$.00	$1,503.80	$76.24	$1,580.04
Task Sub-Total	$.00	$22,744.98	$.00	$45,489.95	$2,306.34	
Base Scope Total						$47,796.29

EXHIBIT D
CABLING SPECIFICATIONS

Chandler · Arizona	CITY OF CHANDLER **IT STANDARD OPERATING PROCEDURE FOR (NOS)**	**EFFECTIVE DATE:** 03/01/08 **NEXT REVIEW DATE: (2 YEARS MAXIMUM)** **03/01/08** **DATE LAST REVIEWED AND VERSION:** V2 **SOP NUMBER:** NOS-S-010
Cabling Specifications		

PURPOSE

Provide building telephone, video and data terminal backboards, raceways, cable tray, racks, patch panels, station wiring, cross connect wiring, termination devices and plates, and connections to deliver complete and operable data/telecommunications system as indicated.

RESPONSIBILITY

A. Primary: NOS – Network Analyst, Telecommunications Analyst
B. Secondary: NOS- Management

PROCEDURE

Associated documents are:
A. Data Center Standards – NOS
B. MDF Closet Standards – NOS
C. IDF Closet Standards - NOS

1.1 SUBMITTALS

A. Pre installation meeting will be held prior to work commencing.

B. Submit material lists (not quantities), and equipment cut sheets of components.

C. Submit scaled detailed plans and elevations of all walls of all Voice/Data rooms on reproducible prints, including terminal block layouts, cable routings, etc. Provide both printed and electronic files (files readable by AutoCAD V14 or newer version and by Visio2003 or newer version).

D. Contractor to provide cable routing diagram to be reviewed at the pre-installation meeting. Contractor will revise and resubmit at owner's direction at Contractor's cost. Cable routing diagram includes: Scale drawings with bundle routes and sizes down to and including the single drop location. Drawing must differentiate between phone, video and data drops and provide numbering scheme for drops. Drawings are also expected to identify to scale location of motors, fixtures, conduit paths, stairs, ducting, cable trays, etc.

E. Revised scaled plans and elevations, and final terminal identification submittals to reflect "as-built" conditions. Documentation (**4 paper copies, 1 electronic copy**) of all drop locations and cable routing paths shall be provided to the city in a computer generated graphical format readable by AutoCAD V14 or newer version and by Visio2003 or newer version.

F. At preconstruction conference with Contract Project Manager shall be held before the work commences. A schedule illustrating the sequence to the work and the time periods of the tasks shall be provided at the preconstruction conference. The Contractor is required to update the schedule weekly.

1.2 QUALITY ASSURANCE

A. The Contractor shall have as its primary business, the installation and maintenance of data/telecommunications cable.

B. The Contractor selected for this Project must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project. All installation personnel will be under the direct supervision of an individual certified by the manufacturer of the products.

C. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of Category 6, premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.

D. A resume of qualifications shall be submitted with the Contractor's proposal indicating the following:

1. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
2. A list of test equipment proposed for use in verifying the installed integrity of metallic cable systems on this project.
3. A technical resume of experience for the Contractor's Project Manager and on-site installation supervisor who will be assigned to this project.
4. A list of technical product training attended by the Contractor's personnel that will install the wiring system shall be submitted with the response.
5. Sub-contractors are not allowed to assist the cabling Contractor or perform any of the duties for the sub-Contractor.

E. The Contractor must possess the ability to read schematics and operated advance diagnostic equipment for cable certification and troubleshooting.

F. A weekly progress meeting shall be held with the Contract Project Manager.

G. The Contractor should notify the Contract Project Manager at least 48 hours before the installation of backboards, IDF and MDF boards.

H. The Contractor shall check 10% of the cabling and wiring installed for working order and the proper numbering in the presence of the Owner's Information Technology staff.

I. The Contractor must certify 100% of all cabling and provide documented results for twisted pair cabling.

J. The cable manufacturer must have a minimum of (5) years experience and shall be ISO 9001 Certified.

K. Contractor will check 100% of the fiber to satisfactory working order and provide testing results

1.3. Warranty

A. A fifteen (15) years or greater Extended Product Warranty and Systems Assurance Warranty for this wiring system shall be provided.

B. Warranty service will be provided 8:00 AM to 5 PM, Monday through Friday, City Holidays excluded. Contractor shall define response time to warranty repair.

C. The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA 568B.2-1 and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of ANSI/TIA TSB 67 and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss and bandwidth requirements of ANSI/TIA TSB 67 and ISO/IEC IS 11801 for fiber links/channels, for a fifteen (15) years or greater period. The warranty shall apply to all passive components.

D. The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the ANSI/TIA 568B.2-1 or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a fifteen (15) year period.

E. The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a period of fifteen (15) years.

2.1 MATERIALS

A. Materials: shall be new, listed as suitable for the intended purposes by UL or other approved testing agency, and complying with industry standards. Where more than one unit is required of the items, they are to be of consistent make and manufacture.

B. Building materials: (boxes, conduit, fittings, raceways, etc.) shall comply with other sections of this division.

C. Terminal Backboards: 3/4" X 4' X 8' AC fire treated plywood, minimum 2, Will be installed on all walls of the communications room. Each wall will be painted with Non-lead (Fire Rated) paint in either of the (2) following colors: Black or White

D. Station Cables: All voice and data cables shall be 4 pair Category 6 (or greater) cables and shall conform to ANSI/TIA-568-B.2-1 (22-24 AWG gauge) Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section Applications standards supported should include, but be not limited to, IEEE 802.3, 10BASE-T / 100BASE-TX and 1000BASE-T; IEEE 802.5, 4 Mbps, 16Mbps and TP-PMD. Data cables shall be blue in color and voice cable shall be white in color. Cables serving systems furniture workstations will be a continuous run from the communications room rack to the faceplate on the base of the furniture.

E. Patch Panels for UTP: Leviton, Category 6 rated patch panels or approved equivalent, with 110 type IDC connectors.

F. Cable Management Hardware: as appropriate to maintain an orderly system, including ladder racking in the Voice/Data rooms.

G. Data Outlets: Leviton, 110 Connect System for Category 6 or approved equivalent, which meets the minimum 100 MHz transmission speed standard. Appropriate faceplates for either wall or floor boxes will be used. Data jacks and data cables must be blue in color.

- UL® Verified Category 6 Electrical Performance
- Comply with FCC Part 68
- ISO 9001 Certified Manufacturer

H. Voice Outlets: Leviton, Category 6 jacks that integrate cleanly within the Data Outlet specifications as detailed above. Voice Jacks should be clearly distinguishable from data jacks within same plate. All telephone cables stations and riser cables must be terminated on 66 blocks, unless specified by the Telephony Supervisor. Voice jacks and voice cables must be white in color. If the telephony decision is to go to VOIP, do not use either 66 or 110 block. A patch panel is required instead.

I. Power Outlets: Power supplied to the IDF/MDF must be (208/230v) for UPS units (Single Phase) with a minimum of (2) directly located behind each rack. Also 110v with a minimum of (4) outlets; one (1) to each wall

J. Power Plates: Each (208/230v) circuit will need to have a "**RED**" face plate and receptacles; see (2.1 Materials, letter "G"). Receptacle type: **L6-30R**

K. Power Outlet location: A minimum of (2) 208/230v outlets is required and should be a minimum of (6) feet from the ground or level with the ladder tray (Approximately 84").

L. Face Plates: Wall mounted face plates will be the same size and color as the electrical convenience outlets and constructed of nylon. Voice and data outlets terminating in systems furniture will have faceplates of the same color as the furniture base.

M. Equipment Racks: Provide industry standard quality 19" equipment rack in the communications rooms. **Provide and install a minimum of 2 racks with a minimum of 30 inches from any wall closest to the (208/230v) receptacle. Also "L" brackets will be required to attach the ladder to the rack for stability.** (Subject to change based on COC IT Management)

N. Vertical Cable Management: Provide Chatsworth Products Incorporated (CPI) Master Cabling Section product line cable management products. The vertical cable management will be six (6) inches wide, and will be of the same height as the equipment racks. Must be double sided and black in color. Vertical cable management will be installed between equipment racks and on both side of each end equipment rack. An example would be CPI part number 30094-703. (LonWorks)

O. Horizontal Cable Management: Provide Panduit NetManager product line horizontal cable management. The horizontal cable management will be three (3) inches in height and will be double sided. Cable management will be installed in between all patch panels and will be installed above the first patch panel and below the last patch panel.

P. Telephone Riser Cable: Depending on the location and previously agreed upon by City Telecom, provide a 50, 100, 200, or 400 pair telephone riser cable between the communication rooms. **Terminate both ends on 66 blocks**. If the feed cable is an underground cable ran between buildings it must be terminated on 66 type lightning protection blocks**Termination block locations to be determined by Owners representative.

Q. Data Riser Cable: Depending on the location and previously agreed upon by IT, provide industry standard quality 12, 24 or 48 strand fiber-optics cable, single mode, between communications rooms. Leave a 10 foot service loop on both ends. Connect to telecomm equipment on both ends. Fiber will be terminated using SC style connectors.

R. Data Riser Cable Equipment: Terminate fiber to rack with Corning brand closet connector housing. Fiber will be terminated using SC style connectors. An example would be CCH-04U. When fiber is being attached to the rack, the LIU will always be on the top of the rack

S. Ladder Rack: Provide industry standard quality ladder rack for distribution of cable within the communications room. The tray will run the length of the room over the equipment racks. The tray will run from all cable entry points to the tray over the equipment racks.

T. Cable Tray: Provide Flex tray brand cable tray. The tray will be a minimum of twelve (12) inches in width and a minimum of two (2) inches in height. The tray will be center post mounted. All 90-degree turns will use a 90-degree kit from Flex tray.

U. Patch Cables: Provide Category 6 Modular Patch Cords for each terminated port on the patch panel. (8P8C) modular connectors are required with T568B cable. All cords shall conform to the requirements of ANSI/TIA 568B.2-1 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section. Cords shall be equipped with an 8 pin modular connector on each end and length to be determined by City of Chandler Information Technology staff not to exceed 20 feet. Data cables shall be blue in color.

V. Workstation Patch Cables: Provide Category 6 Modular Patch Cords, with male connectors on both ends, for each port terminated within the project. Cables will be blue in color and will be twenty (20) foot in length.

W. CATV Cable: Provide coaxial plenum rated cable, RG6U classification, 18 gauge solid copper center conductor, duel foil shielding of 95%+, and tinned copper braided shielding of 100%. Direct Current Resistance of 21.7 ohms/meter or better. Each connection is required to be terminated and tested with results forwarded to the City of Chandler Project Manager.

EXECUTION

3.1 Installation

A. Contractor shall provide and install **a minimum** of (2) 19" X 72" relay rack in the voice/data room. Connect the relay equipment racks to the wall using 12" wide ladder rack. Secure to wall and rack using appropriate hardware and methods. All racks are required to be (Anchored) to the floor. Equipment mounting screws to be included and at a minimum (100)

B. Voice and data install: Penetrations through or into existing firewalls must be sleeved and sealed according to fire code.

1. Provide the wire management apparatus and labor necessary to ensure a neat installation w/in all voice data room and all data/telecommunication drops.
2. Long radius bends or elbows shall be used on communication conduits 1.5" and larger in size or on conduit runs over 100'.
3. Conduit located within concrete floor will be a minimum of 1.5" inches in size.
4. Conduit located within interior walls will be a minimum of 1" in size.
5. Run parallel or perpendicular to the walls. Diagonal runs shall not be accepted. Cable shall not lie on ceiling tile.
6. Install cables in conduit, raceways, and cable trays as indicated.
7. Provide pull boxes and communication conduit runs spaced not greater than 100' apart.
8. Closed loop D-rings (2", 4" and 6" as required) shall be installed in locations and quantities sufficient to produce an orderly, quality cable installation.
9. Equipment shall be securely fastened to mount boards.
10. Terminal blocks for riser cables shall be permanently marked with pair count number. One end of all data drops will terminate at the wiring closet on a Category 6 ANSI/TIA 568B.2-1 compliant

patch panel and Category compliant RJ45 (8P8C) data jacks. The terminal end of the data drop will terminate using a Category 6 ANSI/TIA 568B.2-1 compliant RJ45 (8P8C) data jack housed within a 4-plex modular faceplate.

11. Provide Category 6 ANSI/TIA 568B.2-1 compliant patch cables from patch panel to data/com equipment.
12. Standard RJ45 (8P8C) phone jack and housed within a 4-plex modular faceplate. Wall phone jacks shall be stainless steel plate subject to approval of owner.
13. Provide and install voice and data drops using 4 pair plenum Category 6 ANSI/TIA 568B.2-1 compliant UTP cabling.
14. All cable direction changes shall be made at a swept 90 degree turns consistent with ANSI/TIA 568B.2-1 standard. No cable may be place diagonally across a ceiling. Station cables installed within ceiling spaces shall be routed at right angles to electrical power circuits.
15. In suspended ceilings where duct, cable trays or conduit are not available, the Contractor shall bundle, **in bundles of 50 or less**, station wiring with plastic cable ties snug, but not deforming the cable geometry. The cable bundling shall be supported via (J) hooks attached to the existing building structure and framework. (Trusses). Plenum rated cable will be used in all appropriate areas. The Contractor shall adhere to the manufacture's requirements for bending radius and pulling tension of all data and voice cables.
16. Cables shall be routed in such a way as to minimize interference with the cross connect wiring. D-rings shall be utilized to route cable away from the top and sides of terminal blocks.
17. Station cables, data cables and riser cables shall not be spliced or bent.
18. All station jacks shall be fed from data/voice closet.
19. Cable running through open ceilings shall be run along a common path within cable tray where provided.
20. Conduits: External entrance - Minimum (4) 6" conduits, which enter through the floor into each closet. Each core cut access will each require a sleeve. Internal runs require (2) 4" conduits with a 1.25 inch inner-duct fiber cables.
21. Provide nylon pull cord in empty conduits. Measured pull cords for all conduits leaving the closet to outside vaults.
22. Faceplates must be flush mounted and installed at the same standard height as adjacent phone and electrical faceplates unless otherwise noted.
23. Cables, including patch cables, shall be labeled at both ends. Labels shall be placed within 6"-8" away from terminal point.
24. Cables to systems furniture workstations shall be extended as required through modular furniture raceways. Terminate jack on modular furniture raceway with owner approved device that is intended to be compatible with furniture manufacturer.

3.2 IDENTIFICATION

A. All cross connects and faceplates shall be permanently identified with station type and number using machine-printed labels. Labels should be in the following format:

- first character represents (D)ata, (V)oice or (A)udio/Visual
- second character represents floor. Either 1, 2 or 3
- Characters 3-5 represent cable number. 001-999

EXAMPLE: D2010 would constitute the **10**th **d**ata line on the **2**nd floor.

B. DROPS: Drops are defined by IT Wiring standards.

- Data Drop: cabling for data connectivity
- Phone Drop: cabling for telephony connectivity
- Cat 6 for data
- Cat 3 or 6 for telephony – set by telephony Supervisor and required equipment based on analog phone or VOIP standards

3.3 TESTING

A. All data cable should be tested to insure compliance to the ASNI/TIA 568B.2-1 standard. Near End Crosstalk (NEXT) and Attenuation-to-Crosstalk Ratio (ACR) should be measured from both wiring closet and workstation ends.

B. Each jack in each outlet shall be tested for Category 6, TSB 67 compliance using an appropriate Level 2 testing instrument, to verify both the integrity of all conductors and correctness of the termination sequence. Testing shall be performed between modular jacks at the outlets and the modular jacks at the Voice/Data Closet.

C. Voice cable should be tested for wire map and continuity

D. Copies of all results for testing and compliance are to be provided.

3.4 DOCUMENTATION

A. Documentation (4 paper copies, 1 electronic copy) of all drop locations, identification and cable routing paths shall be provided to the City in a computer generated graphical format readable by AutoCAD V14 or newer version and by Visio2003 or newer version.

B. Documentation of cable testing shall be required and the engineer shall be present during all tests. The Contractor shall provide a table of test results in a 3-ring binder submitted with the as-built drawings. The table shall include:

- 200 MHz sweep tests, continuity, polarity checks, Far & Near End Cross Talk, and attenuation and the installed length for all, Data/Voice station cables, backbone cables, and pairs.

- The table shall indicate all defective pairs and test results of all pairs listed above. Cables not complying with ANSI/TIA 568B.2-1 Category 6 tests for 100 Mb/s rating or passing TSB 67 test guidelines, shall be identified to the Project Manager for corrective action which may include replacement at no additional expense to the City of Chandler.

Written by: RALPH VALDEZ
Approved By:
Dated: 02/28/2008

EXHIBIT E1
PERFORMANCE BOND

STATUTORY PERFORMANCE BOND PURSUANT TO
TITLE 34, CHAPTER 2, ARTICLE 2,
OF THE ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Bond amount)

KNOW ALL MEN BY THESE PRESENTS: That, _____ (hereinafter called the Principal), as Principal, and _____ a corporation organized and existing under the law of the State of _____ with its principal office in the City of _____, (hereinafter called the Surety), as Surety, are held and firmly bound unto the City of Chandler, County of Maricopa, State of Arizona, in the amount of _____Dollars ($_____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severely, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the City of Chandler, Dated the _____ day of _____, 2009, for **ENERGY MANAGEMENT SYSTEM**, **Agreement No. BF9-220-2745**, which Contract is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and fulfill all the undertakings, covenants terms, conditions, and agreements of said contract during the original term of said Contract and any extensions thereof, with or without notice to the Surety, and during the life of any warranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of conditions of said Contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligations shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2 of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of said Title, Chapter and Article, to the extent as if it were copied at length herein.

The prevailing party in a suit on this bond shall be entitled to such reasonable attorney's fees as may be fixed by a judge of the Court.

Witness our hands this ____ day of _____, 2009.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

BY _____

_____
SURETY SEAL

_____
AGENT ADDRESS

EXHIBIT E2

PAYMENT BOND

ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, OF THE ARIZONA REVISED STATUTES
(Penalty of this Bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

THAT: _____(hereinafter "Principal"), as Principal, and _____ _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto the City of Chandler, (hereinafter "Obligee") County of Maricopa, State of Arizona, in the amount of _____ _____ Dollars ($_____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the City of Chandler, dated the _____ day of _____ , 2009, for **Energy Management System; Agreement No. BF9-220-2745**, which Contract is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLICATION IS SUCH, that if the Principal promptly pays all moneys due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in said contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2 Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 2009.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

BY_____

_____
SURETY SEAL

_____
AGENT ADDRESS

ATTACHMENT 1
COMMUNITY CENTER SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 2000 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Building has accessible drop ceilings throughout.

5. Ethernet drops/switches are available (coordinate connections with IT administrator).

6. Inter-connect LonTalk channels between Community Center and Senior Center buildings.

7. Hours of operation: Mon-Fri 7am-5pm, Sat 9am-2pm. All work shall be performed during normal daytime hours.

CENTRAL PLANT: (Also serves Senior Center)

1. (2) Chillers, (2) Primary CHW Pumps, (1) Booster Pump with VFD for Senior Center CHW loop, (2) Condenser Pumps, (1) Cooling Tower Fan with VFD, (1) Plate-and-Frame Heat Exchanger.

2. Add LonTalk interface card to tower fan VFD (if available)

3. Add LonTalk interface card to each chiller (if available)

4. Add LonTalk interface card to Water Treatment panel (if available)

5. Remove and replace refrigerant gas monitoring panel.

VAV AIR HANDLING UNITS:

1. (3) Hydronic cooling, Minimum outside air dampers.

2. Provide and install new VFD's with LonTalk interface on all 3 AHU's.

3. Replace CHW valve actuators on all 3 AHU's with Belimo actuators with feedback.

4. Add return air CO2 sensors for demand ventilation.

VAV TERMINAL UNITS:

1. (25) Pressure independent VAV boxes with electric reheat.
   13 on AH-1
   7 on AH-2 (3 of which are slaved)

5 on AH-3

2. Add discharge air temperature sensors.
3. Re-use damper actuators – (replace controller only).
4. Do not use box heater transformer to power controller.

FAN COIL UNITS:

1. (8) Hydronic cooling (2-position valves), with electric heat.
2. Add discharge air temperature sensors.
3. Add fan status current sensing switches.
4. Do not use box heater transformer to power controller.

LIGHTING:

1. Add (1) outdoor photocell.
2. (5) Exterior lighting zones.
3. (8) Interior lighting zones.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Community Center
System: Central Plant
Control Sequence:
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Chiller				2	X	X					X		X			X									Hard wire
CHW Reset			2																						LON if available
Chiller Demand Limit			2																						LON if available
CHW Supply Temp	2							X	X																LON if available
CHW Return Temp	2							X	X																LON if available
CW Supply Temp	2							X	X																LON if available
CW Return Temp	2							X	X																LON if available
Chiller Amps	2																								LON if available
Chiller General Alarm		2			X																				LON if available
Chiller Head Pressure	2							X	X																LON if available
CHW Iso. Valve FB		4																							Open & Close Position
CW Iso. Valve FB		4																							Open & Close Position
HX-CHW Valve FB		4																							Open & Close Position
HX-CW Valve FB		4																							Open & Close Position
HX-CHW Supply Temp	2							X	X																
CHW Iso. Valve				2																					
CW Iso. Valve				2																					
HX-CHW Valve				1																					
HX-CW Valve				1																					
Common CHW Supply Temp	1				X			X	X																
Common CHW Return Temp	1							X	X																
Common CW Supply Temp	1							X	X																
Common CW Return Temp	1							X	X																
CHW Flow		2																							
CW Flow		2																							
CHW Pump				2		X																			
CHW Pump Status		2																							
CW Pump				2		X																			
CW Pump Status		2																							
Tower Fan				1		X																			
Tower Fan Status		1																							
Tower Fan Speed			1																						
Tower VFD Alarm		1			X																				LON if available
Tower VFD % Load	1																								LON if available
Water Treatment Enable				1																					

Ref. Monitor Level Alarm		2			X			X																		
Senior Center Booster Pump				1																						
Senior Center Booster Pump Status		1																								
Senior Center Booster Pump Speed			1																							
Senior Center Booster Pump VFD Alarm		1			X																					LON if available
OSA Temp	1																									
OSA Humidity	1																									

System Digital Outputs:	15
System Analog Outputs:	6
System Digital Inputs	32
System Analog Inputs	21
Total System Points:	74

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Community Center
System: AHU 1, 2 & 3
Control Sequence: VAV AHU
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				3	X	X					X		X			X			X	X					
Supply Fan Status		3																							
Supply Fan Speed			3																						
Supply Fan VFD Alarm		3			X																				LON if available
Supply Fan VFD % Load	3																								LON if available
Min. OSA Damper			3																						
Cooling Valve			3																						Provide new actuators with FB
Supply Air Temp	3							X	X																
Return Air Temp	3																								
CHW Valve Position FB	3																								
Duct Static Pressure	3							X	X																
Return Air CO2	3							X																	

System Digital Outputs:	3
System Analog Outputs:	9
System Digital Inputs	6
System Analog Inputs	18
Total System Points:	36

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Community Center
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

Page 1 of 1

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Boxes on AHU-2											X								X						
Velocity Pressure	7																								
Damper Position FB	7																								
Reheat				7																					
Damper Drive Open				7																					
Damper Drive Close				7																					
Supply Air Temp	7																								
Space Temp	4							X	X																with Display, Adjust & Ovrd. (3 slave boxes)
Boxes on AHU 1 & 3											X								X						
Velocity Pressure	18																								
Damper Position FB	18																								
Reheat				19																					One box has 2 htg stages
Damper Drive Open				18																					
Damper Drive Close				18																					
Supply Air Temp	18																								
Space Temp	18							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	76
System Analog Outputs:	0
System Digital Inputs	0
System Analog Inputs	97
Total System Points:	173

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Community Center

System: FC-101, 102, 103, 105
FC-201, 202, 203, 204
Control Sequence:
Fan Coil Units

System Graphic Required: Yes

Page 1 of 1

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function												Trending	
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				8	X	X					X														
Supply Fan Status		8																							
Cooling Valve				8																					2 pos
Heating Stage				8																					
Supply Air Temp	8																								
Space Temp	8							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	24
System Analog Outputs:	0
System Digital Inputs	8
System Analog Inputs	16
Total System Points:	48

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Community Center
System: MISC
Control Sequence:
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Photocell		1																							
Exterior Lighting Zones				5							X		X												
Interior Lighting Zones				8							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel

System Digital Outputs:	14
System Analog Outputs:	0
System Digital Inputs	3
System Analog Inputs	3
Total System Points:	20

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 2
HAMILTON AQUATIC CENTER SCOPE OF WORK

GENERAL:

1. Remove existing wall mounted thermostats and wiring for the two heat pump units in the office/locker building and add BMS controls, wiring and sensors as specified.
2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 100 feet (does not include communication wiring between buildings, which is presumed to utilize Ethernet/routers for network connection).
3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.
4. Building has accessible drop ceilings throughout.
5. Ethernet drops/switches are available in the pump house and in the IDF room on the West side of the office/locker building (coordinate connections with IT administrator).
6. Hours of operation: Mon-Fri 8am-5pm. All work shall be performed during normal business hours.

ROOFTOP HEAT PUMP UNITS:

1. (1) Split HP serving the life guard office/locker room area.
2. (1) Packaged HP serving the conference room.

LIGHTING:

1. Add (1) outdoor photocell.
2. (1) Exterior lighting zone.
3. (1) Interior lighting zone.
4. (1) Pool niche lighting zone.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Hamilton Aquatic Center
System: HP-1 (Life Guard Area)
HP-2 (Conf. Room)
Control Sequence:
Heat Pump Units
System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X				X	X														
Supply Fan Status		2																							
Compressor				2																					
Rev. Valve				2																					
Supply Air Temp	2																								
Space Temp	2							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	6
System Analog Outputs:	0
System Digital Inputs	2
System Analog Inputs	4
Total System Points:	12

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Hamilton Aquatic Center
System: MISC
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Photocell		1																							
Exterior Lighting Zones				1							X		X												
Exterior Niche Lighting Zones				1							X		X												
Interior Lighting Zones				1							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel

System Digital Outputs:	4
System Analog Outputs:	0
System Digital Inputs	3
System Analog Inputs	3
Total System Points:	10

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 3
INFORMATION TECHNOLOGY SCOPE OF WORK

GENERAL:

NOTE: Future remodel of this building is anticipated. The following scope may change.

1. This building is provided chilled water by the central plant located in the adjacent Municipal Services building. The I.T. building has its own boiler for heating hot water.
2. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.
3. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 500 feet.
4. Ensure that all new and existing wiring conforms to NEC wiring guidelines.
5. Building has accessible drop ceilings throughout.
6. Ethernet switches are available and an Ethernet drop is available in the mechanical room with the multizone air handling unit in room 116 (coordinate connections with IT administrator).
7. Inter-connect LonTalk channels between Information Technology and Municipal Services buildings.
8. Hours of operation: Mon-Fri 8am-5pm. All work shall be performed during normal daytime hours. Some secure areas will require pre-planned access.

BOILER PLANT:

1. (1) Boiler, (1) HW Pump.

MULTIZONE AIR HANDLING UNIT:

1. (1) Hydronic cooling and heating, Mixed Air and dampers.
2. Add (1) Return Air CO2 sensor for demand ventilation.
3. (5) Zone dampers.
4. Add (5) zone supply air temperature sensors.

FAN COIL UNITS:

1. (12) Hydronic cooling and heating.

COMPUTER ROOM A/C UNIT:

1. (1) 2-stage DX cooling.

DUCTLESS ROOM A/C UNITS:

ATTACHMENT 3
INFORMATION TECHNOLOGY SCOPE OF WORK

1. (1) Mini-split DX cooling – (Room temperature monitor only).

SUPPLY FAN:

1. (1) Supply fan.

LIGHTING:

1. (1) Exterior lighting zone.
2. (3) Interior lighting zones.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).
2. Monitor Generator – (add Vendor LonTalk interface option).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Information Technology
System: Boiler
Control Sequence: Boiler
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Boiler				1	X	X					X		X												
Boiler General Alarm		1																							
HW Pump				1																					
HW Pump Status		1																							Replace D.P. with Current Switch
HW Supply Temp	1																								
HW Return Temp	1							X	X																

System Digital Outputs:	2
System Analog Outputs:	0
System Digital Inputs	2
System Analog Inputs	2
Total System Points:	6

Symbol key: Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Information Technology
System: AHU-1
Control Sequence: Multizone AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X		X			X				X					
Supply Fan Status		1																							
Cooling Valve			1																						
Heating Valve			1																						
Mixed Air Damper																									
Cold Deck Temp	1							X	X																
Hot Deck Temp	1							X	X																
Mixed Air Temp	1																								
Return Air Temp	1																								
Return Air CO2	1							X																	
CHW Diff Pressure	1																								
CHW Supply Temp	1																								
CHW Return Temp	1																								
Zone Dampers																									
Zone Damper			5																						
Zone Supply Air Temp	5																								
Space Temp	5							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	1
System Analog Outputs:	7
System Digital Inputs	1
System Analog Inputs	18
Total System Points:	27

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Information Technology
System: AHU-2
Control Sequence: A/C Unit
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Compressor			2																						
Compressor Status			2																						
Supply Air Temp	1							X	X																
Return Air Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	1
System Analog Outputs:	4
System Digital Inputs	1
System Analog Inputs	3
Total System Points:	9

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Information Technology

System: FC-1,2,3,4,5,7,8,9 (Typ.1)
FC-6,10,11,12 (Typ.2)
Control Sequence:
Fan Coil Units
System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Typical 1 FCU					X	X					X														
Supply Fan				8																					
Supply Fan Status		8																							
Cooling Valve			8																						
Heating Valve Drive Open				8																					
Heating Valve Drive Close				8																					
Supply Air Temp	8																								
Space Temp	8							X	X																with Display, Adjust & Ovrd.
Typical 2 FCU																									
Supply Fan				4																					
Supply Fan Status		4																							
Cooling Valve			4																						
Heating Valve			4																						
Mixed Air Damper			4																						
Supply Air Temp	4																								
Space Temp	4							X	X																with Display, Adjust & Ovrd.
Make-Up Air Fan				1																					
Make-Up Air Fan Status		1																							

System Digital Outputs:	29
System Analog Outputs:	20
System Digital Inputs	13
System Analog Inputs	24
Total System Points:	86

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Information Technology
System: MISC
Control Sequence:
System Graphic Required: Yes

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	System I/O Controller				System Software / Control: Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Exterior Lighting Zones				1							X		X												
Interior Lighting Zones				3							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Generator Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Data Room Space Temp	1							X																	

System Digital Outputs:	6
System Analog Outputs:	0
System Digital Inputs	4
System Analog Inputs	7
Total System Points:	17

Symbol key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 4
DOWNTOWN LIBRARY SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 2000 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Building has accessible drop ceilings throughout.

5. Ethernet drops/switches are available (coordinate connections with IT administrator).

6. Hours of operation: Mon-Sat 10am-9pm, Sun 12pm-5pm. All work shall be performed during normal daytime hours. Coordinate with City at least 5 working days prior to scheduled use.

7. Lift will be required to reach some VAV terminal units.

CENTRAL PLANT:

1. (1) Chiller, (2) Primary CHW Pumps, (2) Condenser Pumps, (2) 2-speed Cooling Tower Fans, (1) Plate-and-Frame Heat Exchanger.

2. Replace (4) CHW/CW isolation valve actuators with Belimo actuators with feedback.

3. Remove and replace refrigerant gas monitoring panel.

VAV AIR HANDLING UNITS:

1. (5) Hydronic cooling , Min Outside Air dampers.

2. Replace IAQ sensors with CO2 sensors.

3. Add LonTalk interface for all VFD's (if available)

FAN POWERED VAV TERMINAL UNITS:

1. (34) Pressure independent fan powered VAV boxes with electric reheat.

2. Add discharge air temperature sensors.

3. Add fan status current sensing switches.

4. Remove existing controller/actuator assemblies, and replace with separate new actuators with feedback and controllers.

5. Do not use box heater transformer to power controller.

ATTACHMENT 4
DOWNTOWN LIBRARY SCOPE OF WORK

SPLIT A/C UNIT:

1. (1) DX cooling.

LIGHTING:

1. Add (1) outdoor photo cell.
2. (7) Exterior lighting zones.
3. (16) Interior lighting zones.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Downtown Library
System: Central Plant
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Chiller				1	X	X					X		X			X									Hard wire
CHW Reset			1																						LON if available
Chiller Demand Limit			1																						LON if available
CHW Supply Temp	1							X	X																LON if available
CHW Return Temp	1							X	X																LON if available
CW Supply Temp	1							X	X																LON if available
CW Return Temp	1							X	X																LON if available
Chiller Amps	1																								LON if available
Chiller General Alarm		1			X																				LON if available
Chiller Head Pressure	1							X	X																LON if available
CHW Iso. Valve FB		2																							Open & Close Position
HX-CHW Valve FB		4																							Open & Close Position
HX-CW Valve FB		2																							Open & Close Position
CHW Diverting Valve				2																					
CW Iso. Valve				1																					
HX-CW Valve				1																					
CHW Pump				2																					
CHW Pump Status		2																							
CW Pump				2																					
CW Pump Status		2																							
CHW Flow		1																							
CW Flow		1																							
Tower Fan Low Speed				2																					
Tower Fan High Speed				2																					
Tower Fan Status		2																							
Ref. Monitor Level Alarm		2			X			X																	
OSA Temp	1																								
OSA Humidity	1																								

System Digital Outputs:	13
System Analog Outputs:	2
System Digital Inputs	19
System Analog Inputs	8
Total System Points:	42

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Downtown Library
System: AHU 1, 2, 3, 4 & 5
Control Sequence: VAV AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				5	X	X				X	X		X			X			X	X					
Supply Fan Status		5																							
Supply Fan Speed			5																						
Supply Fan VFD Alarm		5			X																				LON if available
Supply Fan VFD % Load	5																								LON if available
OSA Damper			5																						
Cooling Valve			5																						
Supply Air Temp	5							X	X																
Return Air Temp	5																								
CHW Return Temp	5																								
Duct Static Pressure	5							X	X																
Return Air CO2	5							X																	
Supply Smoke Detector		5			X																				
Return Smoke Detector		5			X																				
OSA Fan				4									X												Not on AHU-5
OSA Fan Status		4																							Not on AHU-5
Exhaust Fan 6				1									X												Interlock with AHU-2
Exhaust Fan 6 Status		1																							

System Digital Outputs:	10
System Analog Outputs:	15
System Digital Inputs	25
System Analog Inputs	30
Total System Points:	80

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Downtown Library

System: VAV Boxes

Control Sequence:
Fan Powered VAV
Terminal Units

System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	34										X								X						
Damper Position FB	34																								
Reheat				36																					Two with 2-stg htg, 1 clg only
Damper			34																						
Fan				34																					
Fan Status		34																							
Supply Air Temp	34																								
Space Temp	34							X	X																with Display, Adjust & Ovrd. (3 slave boxes)

System Digital Outputs:	70
System Analog Outputs:	34
System Digital Inputs	34
System Analog Inputs	136
Total System Points:	274

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Downtown Library
System: AC-1 (Video Room)
Control Sequence: A/C Unit
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Page 1 of 1
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Compressor			1																						
Supply Air Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	1
System Analog Outputs:	1
System Digital Inputs	1
System Analog Inputs	2
Total System Points:	5

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Downtown Library
System: MISC
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Lighting																									
Photocell		1																							
Exterior Lighting Zones				2							X		X												
Interior Lighting Zones				7							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Data Room Temp	1																								
Exhaust Fans																									
Exhaust Fan				5		X																			
Exhaust Fan Status		5																							

System Digital Outputs:	15
System Analog Outputs:	0
System Digital Inputs	8
System Analog Inputs	4
Total System Points:	27

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 5
MUNICIPAL SERVICES SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 1500 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Most areas in building have accessible drop ceilings. Access panels are available to access VAV terminal units above hard lid ceilings.

5. Ethernet switches are available in various areas including the basement in room B04. Data drops are also available in the chiller room (coordinate connections with IT administrator).

6. Inter-connect LonTalk channels between Information Technology and Municipal Services buildings.

7. Hours of operation: Mon-Fri 8am-5pm. All work shall be performed during normal daytime hours.

CENTRAL PLANT: (Also serves Information Technologies building for CHW)

1. (2) Chillers, (1) Primary CHW Pump, (2) Secondary CHW Pumps with VFD's, (1) Condenser Pump, (1) Cooling Tower Fan with VFD, (1) Plate-and-Frame Heat Exchanger.

2. (2) Boilers, (2) HW Pumps.

3. Add LonTalk interface card to each chiller.

4. Remove and replace refrigerant gas monitoring panel.

5. Replace (4) Secondary CHW Pressure Transmitters with Diff. Pressure.

VAV AIR HANDLING UNITS:

1. (2) Hydronic cooling, Mixed Air dampers.

2. Add LonTalk interface for all VFD's (if available)

VAV TERMINAL UNITS:

1. (18) Pressure independent VAV boxes with hydronic reheat (9 cooling only).

2. Add discharge air temperature sensors.

3. Re-use damper and HW actuators – (replace controller only).

MULTIZONE AIR HANDLING UNITS:

1. (6) Hydronic cooling and heating, Mixed Air and dampers.
2. (37) Zone dampers.
3. Add (37) zone discharge air temperature sensors.

SINGLE ZONE AIR HANDLING UNIT:

1. (1) Hydronic cooling and heating, Mixed Air dampers.

A/C UNIT:

1. (1) DX Cooling.

EXHAUST FANS:

1. (4) General exhaust fans.

LIGHTING:

1. Add (1) outdoor photocell.
2. (3) Exterior lighting zones.
3. (8) Interior lighting zones.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).
2. Monitor emergency generator (add LonTalk interface if available).
3. Add (2) Communication room temperature sensors (monitor only).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services
System: Central Plant
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Page 1 of 2
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Chiller				2	X	X					X		X			X									Hard wire
CHW Reset			2																						LON if available
Chiller Demand Limit			2																						LON if available
CHW Supply Temp	2							X	X																LON if available
CHW Return Temp	1							X	X																LON if available
Secondary CHW Supply Temp	3				X			X	X																Two plant loops plus 1 in West bldg.
Secondary CHW Return Temp	3																								Two plant loops plus 1 in West bldg.
Chiller Amps	2																								LON if available
Chiller General Alarm		2			X																				LON if available
Chiller Head Pressure	2							X	X																LON if available
CHW Iso. Valve FB		4																							Open & Close Position
CW Iso. Valve FB		5																							Open & Close Position
HX-CHW Valve FB		2																							Open & Close Position
Common Secondary CHW Return Temp	1																								
HX-CHW Supply Temp	1							X	X																
CHW Valve				3																		O			Off=Chiller, On=HX
CW Valve				1																		O			Off=Chiller, On=HX
Compressor Status		2																							
CHW Return Pressure	1																								
Decoupler Loop Temp	1																								
CW Return Temp	2							X	X																
Common CW Supply Temp	1							X	X																
Common CW Return Temp	1							X	X																
CHW Flow		2																							
CW Flow		2																							
CHW Pump				1		X																			
CHW Pump Status		1																							
CW Pump				1		X																			
CW Pump Status		1																							
Tower Fan				1		X																			
Tower Fan Status		1																							
Tower Fan Speed			1																						
Tower VFD Alarm		1			X																				LON if available
Tower VFD % Load	1																								LON if available
Water Treatment Enable				1																					

Ref. Monitor Level Alarm		2			X			X																	
Secondary CHW Pump				2																					Pump 1 serves IT & AH8&9. Pump 2 serves AH1-7.
Secondary CHW Pump Status		2																							
Secondary CHW Pump Speed			2																						Control per City requirements
Secondary CHW Pump VFD Alarm		2			X																				LON if available
Secondary CHW Pump VFD % Load	2																								LON if available
Secondary CHW Diff. Pressure	4																								Two on each loop. Control to lowest.
OSA Temp	1																								
OSA Humidity	1																								
Boiler				2																					
Boiler General Alarm		2																							
HW Pump				2																					
HW Pump Status		2																							
HW Supply Temp	2																								
HW Return Temp	2																								

System Digital Outputs:	16
System Analog Outputs:	7
System Digital Inputs	33
System Analog Inputs	34
Total System Points:	90

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services
System: AHU 6 & 7
Control Sequence: VAV AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				2	X	X					X		X			X			X	X					
Supply Fan Status		2																							
Supply Fan Speed			2																						
Supply Fan VFD Alarm		2			X																				LON if available
Supply Fan VFD % Load	2																								LON if available
Mixed Air Damper			2																						
Cooling Valve			2																						
Heating Valve			2																						
Supply Air Temp	2							X	X																
Return Air Temp	2																								
Mixed Air Temp	2																								
CHW Return Temp	2																								
Duct Static Pressure	2																								
Return Air CO2	2																								

System Digital Outputs:	2
System Analog Outputs:	8
System Digital Inputs	4
System Analog Inputs	14
Total System Points:	28

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	18										X								X						
Damper Position FB	18																								
Reheat Valve Drive Open				9																					
Reheat Valve Drive Close				9																					
Reheat Valve Position FB	9																								
Damper			18																						
Supply Air Temp	18																								
Space Temp	18							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	18
System Analog Outputs:	18
System Digital Inputs	0
System Analog Inputs	81
Total System Points:	117

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services
System: AHU-1, 2, 3, 4, 8 & 9
Control Sequence: Multizone AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Page 1 of 1
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				6	X	X					X		X			X				X					
Supply Fan Status		6																							
Cooling Valve			6																						
Heating Valve			6																						
Mixed Air Damper			6																						
Cold Deck Temp	6							X	X																
Hot Deck Temp	6							X	X																
Mixed Air Temp	6																								
Return Air Temp	6																								
Return Air CO2	6							X																	
CHW Return Temp	6																								
Zone Dampers																									
Zone Damper			37																						
Zone Supply Air Temp	37																								
Space Temp	37							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	6
System Analog Outputs:	55
System Digital Inputs	6
System Analog Inputs	110
Total System Points:	177

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services

System: AHU-5
Control Sequence: Single Zone AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function												Trending		Page 1 of 1
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X									X					
Supply Fan Status		1																							
CHW Valve			1																						
HW Valve			1																						
Mixed Air Damper			1																						
Supply Air Temp	1							X	X																
Return Air Temp	1																								
Mixed Air Temp	1																								
Return Air CO2	1																								
CHW Return Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.
Branch Space Temp	1							X	X																
Branch Supply Air Temp	1																								
Branch Reheat Valve				1																					
Branch Reheat Valve FB		1																							

System Digital Outputs:	2
System Analog Outputs:	3
System Digital Inputs	2
System Analog Inputs	8
Total System Points:	15

Symbol ⁓ Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services

System: AC-1
Control Sequence: A/C Unit
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Compressor				1																					
Supply Air Temp	1																								
Return Air Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	2
System Analog Outputs:	0
System Digital Inputs	1
System Analog Inputs	3
Total System Points:	6

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Municipal Services
System: MISC
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Photocell		1																							
Exterior Lighting Zones				3							X		X												
Interior Lighting Zones				8							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Generator Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Data Room Temp	2																								
Exhaust Fans																									
Exhaust Fan				4		X																			
Exhaust Fan Status		4																							

System Digital Outputs:	17
System Analog Outputs:	0
System Digital Inputs	9
System Analog Inputs	8
Total System Points:	34

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 6
DESERT BREEZE POLICE SUBSTATION SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 1000 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Building has accessible drop ceilings throughout.

5. Ethernet switches are available in phone room 171 (coordinate connections with IT administrator).

6. Hours of operation: 24/7/365. Some areas will require pre-planned access..

CENTRAL PLANT:

1. (1) Air-cooled chiller, (2) Primary CHW Pumps, (2) Secondary CHW Pumps with VFD's, (1) Boiler and (1) HW Pump.

2. Add LonTalk interface card to chiller. (if available)

3. Add LonTalk interface card to Secondary CHW Pump VFD's. (if available)

SINGLE ZONE AIR HANDLING UNIT:

1. (1) Hydronic cooling and heating, mixed air dampers, relief damper, supply and return fans with VFD's.

2. Add actuator with feedback for control of Min OSA Dampers.

3. Add LonTalk interface on fan VFD's. (if available)

VAV AIR HANDLING UNIT:

1. (1) Hydronic cooling, mixed air dampers, relief damper, supply and return fans with VFD's.

2. Add actuator with feedback for control of Min OSA Dampers.

3. Add LonTalk interface on fan VFD's. (if available)

VAV TERMINAL UNITS:

1. (19) Pressure independent VAV boxes with hydronic reheat (1 is cooling only).

2. Add discharge air temperature sensors.

3. Re-use damper and HW Valve actuators – (replace controller only).
4. Verify adequate control power availability.

EXHAUST FANS:

1. (5) General exhaust fans (3 monitor status only).

LIGHTING:

1. Add (1) outdoor photocell.
2. (1) Exterior lighting zone.
3. (1) Interior lighting zone.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks option to existing PowerTrak PT-9300).
2. Emergency Generator monitor – (add LonWorks option if available).
3. Monitor (2) Automatic Transfer Switches (Gen. & Ulit. status for each).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Desert Breeze Substation
System: Central Plant
Control Sequence:
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Chiller				1	X	X					X		X			X									Hard wire
CHW Reset			1																						LON if available
Chiller Demand Limit			1																						LON if available
CHW Supply Temp	1							X	X																LON if available
CHW Return Temp	1							X	X																LON if available
Secondary CHW Supply Temp	1							X	X																LON if available
Secondary CHW Return Temp	1							X	X																LON if available
Chiller Amps	2																								LON if available (per compressor)
Chiller General Alarm	2				X																				LON if available (per compressor)
CHW Flow		1																							
CHW Pump				2		X																			
CHW Pump Status		2																							
Secondary CHW Pump				2																					
Secondary CHW Pump Status		2																							
Secondary CHW Pump Speed			2																						
Secondary CHW Pump VFD Alarm		2				X																			LON if available
Secondary CHW Pump VFD % Load	2																								LON if available
Secondary CHW Flow		1																							
Secondary CHW Diff. Pressure	1																								
OSA Temp	1																								
OSA Humidity	1																								
Boiler Stage Enable				2																					
Boiler General Alarm		1			X																				
HW Pump				1		X																			
HW Flow		1																							Use flow switch (not pump status)
HW Supply Temp	1							X																	
HW Return Temp	1							X	X																

System Digital Outputs:	8
System Analog Outputs:	4
System Digital Inputs	10
System Analog Inputs	15
Total System Points:	37

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Desert Breeze Substation

System: AHU-1

Control Sequence:
VAV AHU

System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X		X			X			X	X					
Supply Fan Status		1																							
Supply Fan Speed			1																						
Supply Fan VFD Alarm		1			X																				LON if available
Supply Fan VFD % Load	1																								LON if available
Return Fan				1																					
Return Fan Status		1																							
Return Fan Speed			1																						
Return Fan VFD Alarm		1			X																				LON if available
Return Fan VFD % Load	1																								LON if available
Mixed Air Damper			1																						
Cooling Valve			1																						
Relief Air Damper			1																						
Supply Air Temp	1							X	X																
Return Air Temp	1																								
Mixed Air Temp	1																								
CHW Return Temp	1																								
Duct Static Pressure	1							X	X																
Return Air CO2	1							X																	
Building Static Pressure	1							X	X										X						
Duct Smoke Detector		1																							
Min. OSA Damper			1																						Replace actuator with feedback
Min. OSA Damper FB	1																								

System Digital Outputs:	2
System Analog Outputs:	6
System Digital Inputs	5
System Analog Inputs	10
Total System Points:	23

Symbol key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Desert Breeze Substation
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

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	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function												Trending	
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	19										X								X						
Damper Position FB	19																								
Reheat Valve Drive Open				18																					
Reheat Valve Drive Close				18																					
Reheat Valve Position FB	18																								
Damper			19																						
Supply Air Temp	19																								
Space Temp	19							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	36
System Analog Outputs:	19
System Digital Inputs	0
System Analog Inputs	94
Total System Points:	149

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Desert Breeze Substation
System: AHU-2
Control Sequence: Single Zone AHU
System Graphic Required: Yes

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	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				1	X	X					X									X					
Supply Fan Status		1																							
Supply Fan Speed			1																						
Supply Fan VFD Alarm		1			X																				LON if available
Supply Fan VFD % Load	1																								LON if available
Return Fan				1																					
Return Fan Status		1																							
Return Fan Speed			1																						
Return Fan VFD Alarm		1			X																				LON if available
Return Fan VFD % Load	1																								LON if available
CHW Valve			1																						
HW Valve			1																						
Mixed Air Damper			1																						
Relief Air Damper			1																						
Supply Air Temp	1							X	X																
Return Air Temp	1																								
Mixed Air Temp	1																								
Return Air CO2	1							X																	
CHW Return Temp	1																								
HW Return Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.
Duct Smoke Detector		1																							
Min. OSA Damper			1																						Replace actuator with feedback
Min. OSA Damper Position FB	1																								

System Digital Outputs:	2
System Analog Outputs:	7
System Digital Inputs	5
System Analog Inputs	10
Total System Points:	24

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Desert Breeze Substation
System: MISC
Control Sequence:
System Graphic Required: Yes

Date: 5/5/09
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Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Lighting																									
Photocell		1																							
Exterior Lighting Zones				1							X		X												In Main Electrical Room
Interior Lighting Zones				1							X														In Janitor Closet 104
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks to Existing Power Monitoring Panel
Generator Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Auto Transfer Switch Status		4																							P.D. & Fire Station ATS
Exhaust Fans																									
Exhaust Fan				1		X																			EF-6&7
Exhaust Fan Status		5																							EF-3,4,5,6,7

System Digital Outputs:	5
System Analog Outputs:	0
System Digital Inputs	14
System Analog Inputs	6
Total System Points:	25

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 7
POLICE HEADQUARTERS SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. The BTU meters located in the central plant piping are not used and are not included in the work scope. The Firing Range is also excluded from this work scope.

3. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 3000 feet.

4. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

5. Building has accessible drop ceilings throughout.

6. Ethernet switches are available in various locations (coordinate connections with IT administrator).

7. Inter-connect LonTalk channels between Police HQ, Courts and 9-1-1 buildings.

8. Hours of operation: Mon-Sun, 24 hrs/day. Work must be coordinated in advance to access this building.

CENTRAL PLANT: (Also serves Courts and 9-1-1 Buildings)

1. (2) Water-cooled chillers, (2) Primary CHW Pumps, (2) Secondary CHW Pumps with VFD's, (2) Cooling Tower Fans with VFD's, (2) Condenser Water Pumps, (1) Plate-and-Frame Heat Exchanger, (2) Boilers and (2) HW Pumps.

2. Add LonTalk interface card to chillers. (if available)

3. Add LonTalk interface card to Secondary CHW Pump VFD's and Cooling Tower Fan VFD's. (if available)

4. Remove and replace refrigerant gas monitoring panel.

5. Replace (1) Secondary CHW Pressure Transmitter with Diff. Pressure.

6. Replace (1) HW Pressure Transmitter with Diff. Pressure.

SINGLE ZONE AIR HANDLING UNITS:

1. (1) Hydronic cooling and heating, 100% OSA.

2. (1) Hydronic cooling, mixed air dampers.

VAV AIR HANDLING UNIT:

ATTACHMENT 7
POLICE HEADQUARTERS SCOPE OF WORK

1. (4) Hydronic cooling and heating, mixed air dampers, relief damper, supply and return fans with VFD's.
2. Add LonTalk interface on fan VFD's. (if available)
3. Replace return air IAQ sensors with CO2 sensors.

VAV TERMINAL UNITS:

1. (78) Pressure independent VAV boxes, (31) with hydronic reheat.
2. Add discharge air temperature sensors.
4. Re-use damper and HW Valve actuators – (replace controller only).

LAB AIR INTERFACE:

1. (1) Phoenix Controls Reset and (6) hydronic reheat valves and zone temperatures.

FAN COIL UNITS:

1. (2) Hydronic cooling.

HEAT PUMP UNIT:

1. (1) Split heat pump unit.

EXHAUST FANS:

1. (1) Building exhaust fan.

LIGHTING:

1. Add (1) outdoor photocell.
2. (3) Exterior lighting zone.
3. (17) Interior lighting zone.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks option to existing PowerTrak PT-9300).
2. Emergency Generator monitor – (add PowerTrak PT-9300 with LonWorks).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: Central Plant
Control Sequence:
System Graphic Required: Yes

Page 1 of 2

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Chiller				2	X	X					X		X			X									Hard wire
CHW Reset			2																						LON if available
Chiller Demand Limit			2																						LON if available
CHW Supply Temp	2							X	X																LON if available
CHW Return Temp	2							X	X																LON if available
CW Supply Temp	2							X	X																LON if available
CW Return Temp	2							X	X																LON if available
Chiller Amps	2																								LON if available
Chiller General Alarm		2			X																				LON if available
Chiller Head Pressure	2							X	X																LON if available
CHW Iso. Valve FB		4																							Open & Close Position
CW Iso. Valve FB		4																							Open & Close Position
HX-CHW Valve FB		2																							Open & Close Position
HX-CW Valve FB		2																							Open & Close Position
HX-Bypass Valve FB		2																							Open & Close Position
CHW Iso. Valve				2																					
CW Iso. Valve				2																					
HX Valve				3																					
Decoupler Loop Temp	1																								
Ref. Monitor Level Alarm					X			X																	
Common CHW Return Temp	1							X	X																
Common CW Supply Temp	1							X	X																
Common CW Return Temp	1							X	X																
CHW Flow		2																							
CW Flow		1																							
CHW Pump				2		X																			
CHW Pump Status		2																							
CW Pump				2		X																			
CW Pump Status		2																							
Tower Fan				2		X																			
Tower Fan Status		2																							
Tower Fan Speed			2																						
Tower VFD Alarm		2			X																				LON if available
Tower VFD % Load	2																								LON if available
Tower Iso. Valve			2																						

Tower Iso. Valve FB		4																							Open & Close Position
Water Treatment Enable				1																					
Secondary CHW Pump				2																					
Secondary CHW Pump Status		2																							
Secondary CHW Pump Speed			2																						
Secondary CHW Pump VFD Alarm		2																							LON if available
Secondary CHW Pump VFD % Load	2																								LON if available
Secondary CHW Supply Temp	2																								
Secondary CHW Return Temp	2																								
Secondary CHW Diff.Pressure	1																								
Secondary CHW Return GPM	1																								
Secondary CHW Supply GPM	1																								
OSA Temp	1																								
OSA Humidity	1																								
Boiler Enable				2																					
Boiler Flow		2																							
Boiler General Alarm		2																							
Boiler Reset			2																						
Boiler Supply Temp	2																								
Boiler Return Temp	2																								
Boiler Iso. Valve				2																					
HW Pump				2																					
HW Pump Status		2																							
HW Diff. Pressure	1																								
Common HW Supply Temp	1																								
Common HW Return Temp	1																								
HW Supply GPM	1																								
HW Return GPM	1																								

System Digital Outputs:	24
System Analog Outputs:	12
System Digital Inputs	41
System Analog Inputs	38
Total System Points:	115

Symbol & Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.

Trending: Values listed are sampling intervals (in minutes).

FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: AHU-3,4,5 & 6
Control Sequence: VAV AHU
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				4	X	X					X		X			X			X	X					
Supply Fan Status		4																							
Supply Fan Speed			4																						
Supply Fan VFD Alarm		4			X																				LON if available
Supply Fan VFD % Load	4																								LON if available
Relief Fan				2																					AHU-3 & 4 only
Relief Fan Status		2																							AHU-3 & 4 only
Relief Fan Speed			2																						AHU-3 & 4 only
Relief Fan VFD Alarm		2			X																				LON if available
Relief Fan VFD % Load	2																								LON if available
Mixed Air Damper			4																						
Relief Air Damper			2																						AHU-3 & 4 only
Cooling Valve			4																						
Heating Valve			4																						
Supply Air Temp	4							X	X																
Return Air Temp	4																								
Mixed Air Temp	4																								
CHW Return Temp	4																								
HW Return Temp	4																								
Duct Static Pressure	4							X	X																
Return Air CO2	4							X																	
Building Static Pressure	1							X	X										X						
Duct Smoke Detector		4																							
High Duct Static		4						X																	

System Digital Outputs:	6
System Analog Outputs:	20
System Digital Inputs	20
System Analog Inputs	35
Total System Points:	81

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

Page 1 of 1

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	78										X								X						
Damper Position FB	78																								
Reheat Valve Drive Open				31																					
Reheat Valve Drive Close				31																					
Reheat Valve Position FB	31																								
Damper			78																						
Supply Air Temp	78																								
Space Temp	78							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	62
System Analog Outputs:	78
System Digital Inputs	0
System Analog Inputs	343
Total System Points:	483

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: AHU-7 (Jail)
Control Sequence: Single Zone AHU
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O Controller				System Software / Control: Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Cooling Valve			1																						
Heating Valve			1																						
Supply Air Temp	1							X	X																
CHW Return Temp	1																								
HW Return Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.
Duct Smoke Detector		1																							
EF-17				1																					
EF-17 Status		1																							

System Digital Outputs:	2
System Analog Outputs:	2
System Digital Inputs	3
System Analog Inputs	4
Total System Points:	11

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: AHU-10 (Mech Room)
Control Sequence: Single Zone AHU
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
CHW Valve			1																						
Mixed Air Damper			1																						
Supply Air Temp	1							X	X																
Return Air Temp	1																								
Mixed Air Temp	1																								
CHW Return Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.
Duct Smoke Detector	1																								
EF-18 Status		1																							

System Digital Outputs:	1
System Analog Outputs:	2
System Digital Inputs	2
System Analog Inputs	6
Total System Points:	11

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: FC-3 & 4
Control Sequence: Fan Coil Units
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X					X														
Supply Fan Status		2																							
Cooling Valve			2																						
Supply Air Temp	2																								
Return Air Temp	2																								
Space Temp	2							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	2
System Analog Outputs:	2
System Digital Inputs	2
System Analog Inputs	6
Total System Points:	12

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: HP-1 (Range Classroom)
Control Sequence: Heat Pump Units
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Compressor				1																					
Rev. Valve				1																					
Supply Air Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	3
System Analog Outputs:	0
System Digital Inputs	1
System Analog Inputs	2
Total System Points:	6

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Headquarters
System: MISC
Control Sequence:
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Lighting																									
Photocell		1																							
Exterior Lighting Zones				3							X		X												
Interior Lighting Zones				17							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Generator Power Monitor	3	2		1																					Add LonWorks to Existing Power Monitoring Panel
Generator Enun. Panel Status Points		16																							
Shooting Range Temp	1																								
Exhaust Fans																									
Exhaust Fan				1		X																			EF-17 (Jail)
Exhaust Fan Status		1																							
Phoenix Controls (Lab)																									
Thermal Demand Reset			1																						
Space Temp	6																								
Reheat Valve			6																						

System Digital Outputs:	23
System Analog Outputs:	7
System Digital Inputs	22
System Analog Inputs	13
Total System Points:	65

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 8
CITY COURTS SCOPE OF WORK

GENERAL:

NOTE: This building currently does not have adequate relief air provisions resulting in over-pressurization of the building. This is a mechanical design problem and is not expected to be remedied as part of this work scope. It is mentioned here for informational purposes only.

1. This building is provided chilled water by the central plant located in the adjacent Police Headquarters building.
2. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.
3. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 2000 feet.
4. Ensure that all new and existing wiring conforms to NEC wiring guidelines.
5. Building has accessible drop ceilings throughout.
6. Ethernet switches are available in various locations (coordinate connections with IT administrator).
7. Inter-connect LonTalk channels between Police HQ, Courts and 9-1-1 buildings.
8. Hours of operation: Mon-Sun, 24 hrs/day. Work must be coordinated in advance to access this building.

VAV AIR HANDLING UNITS:

1. (2) Hydronic cooling and heating, mixed air dampers, relief damper, supply and return fans with VFD's.
2. Add LonTalk interface on fan VFD's. (if available)
3. Replace return air IAQ sensors with CO2 sensors.

VAV TERMINAL UNITS:

1. (45) Pressure independent VAV boxes (21) with hydronic reheat.
2. Add discharge air temperature sensors.
4. Re-use damper and HW Valve actuators – (replace controller only).

FAN COIL UNITS:

1. (2) Hydronic cooling.

LIGHTING:

ATTACHMENT 8
CITY COURTS SCOPE OF WORK

1. (2) Exterior lighting zone.
2. (13) Interior lighting zone.

MISCELLANEOUS:

1. (2) General space temperature monitoring.

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Courts Building
System: AHU-1 & 2
Control Sequence: VAV AHU
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X					X		X			X			X	X					
Supply Fan Status		2																							
Supply Fan Speed			2																						
Supply Fan VFD Alarm		2			X																				LON if available
Supply Fan VFD % Load	2																								LON if available
Return Fan				1																					AHU-1 only
Return Fan Status		1																							
Return Fan Speed			1																						
Return Fan VFD Alarm		1			X																				LON if available
Return Fan VFD % Load	1																								LON if available
Mixed Air Damper			2																						
Cooling Valve			2																						
Heating Valve			2																						
Relief Air Damper			1																						AHU-1 only
Supply Air Temp	2							X	X																
Return Air Temp	2																								
Mixed Air Temp	2																								
CHW Return Temp	2																								
HW Return Temp	2																								
Duct Static Pressure	2							X	X																
Return Air CO2	2							X																	
Building Static Pressure	1							X	X										X						
Duct Smoke Detector		2																							
High Duct Static		2						X																	
CHW Loop Diff. Pressure	1																								
Exhaust Fan				1																					AHU-2 only
Exhaust Fan Status		1																							

System Digital Outputs:	4
System Analog Outputs:	10
System Digital Inputs	11
System Analog Inputs	19
Total System Points:	44

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Courts Building
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	45										X								X						
Damper Position FB	45																								
Reheat Valve Drive Open				21																					
Reheat Valve Drive Close				21																					
Reheat Valve Position FB	21																								
Damper			45																						
Supply Air Temp	45																								
Space Temp	45							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	42
System Analog Outputs:	45
System Digital Inputs	0
System Analog Inputs	201
Total System Points:	288

Symbol key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Courts Building
System: FC-1 & 2
Control Sequence: Fan Coil Units
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X					X														
Supply Fan Status		2																							
Cooling Valve			2																						
Supply Air Temp	2																								
Return Air Temp	2																								
Space Temp	2							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	2
System Analog Outputs:	2
System Digital Inputs	2
System Analog Inputs	6
Total System Points:	12

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Courts Building
System: MISC
Control Sequence:
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Lighting																									
Exterior Lighting Zones				2							X		X												
Interior Lighting Zones				13							X														
Miscellaneous																									
Data Room Space Temp	2							X																	

System Digital Outputs:	15
System Analog Outputs:	0
System Digital Inputs	0
System Analog Inputs	2
Total System Points:	17

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 9
9-1-1 CENTER SCOPE OF WORK

GENERAL:

NOTE: The following work scope is based on present conditions. This scope is subject to change when the Police Department occupies this space in the future resulting in a possible remodel.

1. This building is provided chilled water by the central plant located in the adjacent Police Headquarters building.
2. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.
3. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 500 feet.
4. Ensure that all new and existing wiring conforms to NEC wiring guidelines.
5. Building has accessible drop ceilings throughout.
6. Ethernet switches are available in various locations (coordinate connections with IT administrator).
7. Inter-connect LonTalk channels between Police HQ, Courts and 9-1-1 buildings.
8. Hours of operation: Mon-Sun, 24 hrs/day. Work must be coordinated in advance to access this building.

VVT AIR HANDLING UNITS:

1. (2) Hydronic cooling and heating, mixed air dampers, supply fan with VFD's.
2. Add LonTalk interface on fan VFD's. (if available)
3. Replace return air IAQ sensors with CO2 sensors.

VVT ZONE UNITS:

1. (20) Pressure dependent VVT boxes. (These will likely be replaced with VAV boxes in a future remodel).

A/C UNIT:

1. (1) Split DX Cooling.

LIGHTING:

1. (1) Exterior lighting zone.

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: 9-1-1 Center
System: AHU 8 & 9
Control Sequence: VVT AHU
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X					X		X			X			X	X					
Supply Fan Status		2																							
Supply Fan Speed			2																						
Supply Fan VFD Alarm		2			X																				LON if available
Supply Fan VFD % Load	2																								LON if available
Mixed Air Damper			2																						
Cooling Valve			2																						
Heating Valve			2																						
Supply Air Temp	2							X	X																
Return Air Temp	2																								
Mixed Air Temp	2																								
Duct Static Pressure	2							X	X																
Return Air CO2	2							X																	
CHW Return Temp	2																								
HW Return Temp	2																								
Smoke Detector		2																							
Variable Volume Terminals																									
VVT Zone Damper			20																						
VVT Space Temp			20																						with Display, Adjust & Ovrd.

System Digital Outputs:	2
System Analog Outputs:	48
System Digital Inputs	6
System Analog Inputs	16
Total System Points:	72

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: 9-1-1 Center
System: AC-1
Control Sequence: A/C Unit
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Page 1 of 1
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X					X														
Supply Fan Status		1																							
Compressor			1																						
Supply Air Temp	1																								
Return Air Temp	1																								
Space Temp	0																								Use VVT Zone 28 space temp

System Digital Outputs:	1
System Analog Outputs:	1
System Digital Inputs	1
System Analog Inputs	2
Total System Points:	5

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: 9-1-1 Center
System: MISC
Control Sequence:
System Graphic Required: Yes

Page 1 of 1

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Lighting																									
Exterior Lighting Zones				1							X		X												
Miscellaneous																									
CHW Diff Pressure	1																								

System Digital Outputs:	1
System Analog Outputs:	0
System Digital Inputs	0
System Analog Inputs	1
Total System Points:	2

Symbol key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 10
POLICE PROPERTY & EVIDENCE SCOPE OF WORK

GENERAL:

NOTE: There are infrared smoke detectors near the ceiling of the warehouse. Take care not to trip the horizontal beam while installing wires, etc.

1. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 1500 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Building has accessible drop ceilings throughout the office areas, and open ceilings in the warehouse area.

5. Ethernet switches are available in Storage Room 102 located in the S.W. corner of the building (coordinate connections with IT administrator).

6. Hours of operation: Mon-Fri, 24 7am – 5pm. Work shall be performed during normal daytime hours.

CENTRAL PLANT:

1. (1) Air-cooled chiller, (2) Primary CHW Pumps.

2. Add LonTalk interface card to chiller.

FAN COIL UNITS:

1. (20) Hydronic cooling, mixed air dampers, (5) with electric heating.

2. Remove linkage between outside air damper and return air damper, and provide and install additional direct coupled actuator for return air damper. Control both actuators with the existing damper signal point.

A/C UNIT:

1. (1) Split DX cooling.

LIGHTING:

1. (1) Exterior lighting zone.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

2. Emergency Generator monitor – (add LonWorks power monitoring panel).

ATTACHMENT 10
POLICE PROPERTY & EVIDENCE SCOPE OF WORK

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Property & Evidence
System: Central Plant
Control Sequence:
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O Controller				System Software / Control: Alarm Processing						System Software / Control: Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Chiller				1	X	X					X		X			X									Hard wire
CHW Reset			1																						LON if available
Chiller Demand Limit			1																						LON if available
CHW Supply Temp	1							X	X																LON if available
CHW Return Temp	1							X	X																LON if available
Chiller Amps	1																								LON if available
Chiller General Alarm		2			X																				LON if available
CHW Flow		1																							
CHW Diff Pressure	1																								
CHW Pump				2																					
CHW Pump Status		2																							
OSA Temp	1																								
OSA Humidity	1																								

System Digital Outputs:	3
System Analog Outputs:	2
System Digital Inputs	5
System Analog Inputs	6
Total System Points:	16

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Property & Evidence
System: AC-1
Control Sequence: A/C Unit
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				1	X	X							X												Interlock operation with generator only
Supply Fan Status		1																							
Compressor			1																						
Compressor Status		1				X																			
Supply Air Temp	1																								
Return Air Temp	1																								
Space Temp	1							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	1
System Analog Outputs:	1
System Digital Inputs	2
System Analog Inputs	3
Total System Points:	7

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Property & Evidence
System: FC-1 thru 20
Control Sequence: Fan Coil Units
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		Notes/Comments
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	
Supply Fan				20	X	X					X														
Supply Fan Status		20																							
Cooling Valve			20																						
Heating Stage			8																						5 FC's w/htg (3 with 2 stg)
Mixing Dampers			20																						3 pos. (closed, min, max)
Supply Air Temp	20																								
Space Temp	14							X	X																with Display, Adjust & Ovrd.
																									(3 zones with 3 FC's each share common sensor)

System Digital Outputs:	20
System Analog Outputs:	48
System Digital Inputs	20
System Analog Inputs	34
Total System Points:	122

Symbol key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Police Property & Evidence
System: MISC
Control Sequence:
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Photocell		1																							
Exterior Lighting Zones				1							X		X												
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel
Generator Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel

System Digital Outputs:	3
System Analog Outputs:	0
System Digital Inputs	5
System Analog Inputs	6
Total System Points:	14

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 11
SENIOR CENTER SCOPE OF WORK

GENERAL:

1. This building is provided chilled water by the central plant located in the adjacent Community Center building. The VFD for the chilled water booster pump serving this building (located in the Community Center) is used to maintain loop differential pressure from a transmitter in this building.

2. Remove existing Andover controllers and temperature sensors. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

3. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 200 feet.

4. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

5. Building has accessible drop ceilings throughout.

6. Ethernet switches are available in various locations (coordinate connections with IT administrator).

7. Inter-connect LonTalk channels between Community Center and Senior Center buildings.

8. Hours of operation: Mon-Fri, 8am – 5pm. Work shall be performed during normal daytime hours but shall be coordinated with Senior Center activity schedule to avoid impact to occupants. Please contact Denise Demaray, Senior Center Manager at 480-782-2710.

VAV AIR HANDLING UNITS:

1. (2) Hydronic cooling, mixed air dampers, supply and relief fans with VFD's.

2. Add LonTalk interface on fan VFD's. (if available)

3. Replace CHW linear valve actuators with Belimo rotational actuators with feedback.

4. Replace CHW Pressure Transmitter at AHU-1 with Diff. Pressure.

VAV TERMINAL UNITS:

1. (11) Pressure independent VAV boxes with electric reheat.

2. Add discharge air temperature sensors.

3. Re-use damper actuators – (replace controller only).

4. Do not use box heater transformer to power controller.

LIGHTING:

ATTACHMENT 11
SENIOR CENTER SCOPE OF WORK

1. (2) Exterior lighting zone.
2. (2) Interior lighting zone.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Senior Center
System: AHU 4 & 5
Control Sequence: VAV AHU
System Graphic Required: Yes

Page 1 of 1
Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																			
	Controller				Alarm Processing						Application / Function											Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				2	X	X					X		X			X			X	X					
Supply Fan Status		2																							
Supply Fan Speed			2																						
Supply Fan VFD Alarm		2			X																				LON if available
Supply Fan VFD % Load	2																								LON if available
Relief Fan				2	X	X					X		X			X			X	X					
Relief Fan Status		2																							
Relief Fan Speed			2																						
Relief Fan VFD Alarm		2			X																				LON if available
Relief Fan VFD % Load	2																								LON if available
CHW Diff Pressure	1																								For booster pump control in Community Center Plant.
Building Static Pressure	1							X	X										X						
Mixed Air Damper			2																						
Cooling Valve			2																						Provide new actuators with FB
Supply Air Temp	2							X	X																
Return Air Temp	2																								
Mixed Air Temp	2																								
CHW Valve Position FB	2																								
Duct Static Pressure	2							X	X																
Return Air CO2	2							X																	

System Digital Outputs:	4
System Analog Outputs:	8
System Digital Inputs	8
System Analog Inputs	18
Total System Points:	38

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Senior Center
System: VAV Boxes
Control Sequence: VAV Terminal Units
System Graphic Required: Yes

Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Velocity Pressure	11										X								X						
Damper Position FB	11																								
Reheat				17																					6 with 2 stg heat
Damper			11																						
Supply Air Temp	11																								
Space Temp	11							X	X																with Display, Adjust & Ovrd. (3 slave boxes)

System Digital Outputs:	17
System Analog Outputs:	11
System Digital Inputs	0
System Analog Inputs	44
Total System Points:	72

Symbol k Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Senior Center
System: MISC
Control Sequence:
System Graphic Required: Yes

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Date: 5/5/09
Revision:
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Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Exterior Lighting Zones				2							X		X												
Interior Lighting Zones				2							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks to Existing Power Monitoring Panel

System Digital Outputs:	5
System Analog Outputs:	0
System Digital Inputs	2
System Analog Inputs	3
Total System Points:	10

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

ATTACHMENT 12
SNEDIGAR SPORTSPLEX SCOPE OF WORK

GENERAL:

1. Remove existing Andover controllers and temperature sensors. Existing wall sensors installed without wall boxes. Install new box or mud ring before mounting new wall sensor. Some room sensors may require slightly adjusted locations closer to return registers. Contractor may re-use input/output wiring, power supplies and transducers/transmitters at their own risk. Wire found to be faulty must be replaced by contractor. Any re-used items shall be covered within the warranty period.

2. Install new communication wiring for all LonTalk networks. Estimated Total LonTalk wiring: 400 feet.

3. Ensure that all new and existing wiring conforms to NEC wiring guidelines.

4. Building has accessible 9 foot drop ceilings throughout.

5. Ethernet switches are available in telephone room (coordinate connections with IT administrator).

6. Hours of operation: Mon-Thu, 8am – 9pm, Fri 8am – 5pm and Sat 9am – 2pm. Work shall be performed during normal daytime hours but shall be coordinated prior to work. Please contact Ariane Stramiello at 480-782-2641.

HEAT PUMP UNITS:

1. (8) Packaged rooftop units.

LIGHTING:

1. (1) External lighting zone.

2. (4) Internal lighting zones.

MISCELLANEOUS:

1. Monitor building power – (add LonWorks power monitoring panel).

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Snedigar Sportsplex
System: HP-401 thru 408
Control Sequence: Heat Pump Units
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Supply Fan				8	X	X				X	X														
Supply Fan Status		8																							
Compressor				8																					
Rev. Valve				8																					
Supply Air Temp	8																								
Return Air Temp	8																								
Space Temp	8							X	X																with Display, Adjust & Ovrd.

System Digital Outputs:	24
System Analog Outputs:	0
System Digital Inputs	8
System Analog Inputs	24
Total System Points:	56

Symbol Key Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback

Input/Output Point Summary Table

City of Chandler EMS Upgrade

Site: City of Chandler
Building: Snedigar Sportsplex
System: MISC
Control Sequence:
System Graphic Required: Yes

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Date: 5/5/09
Revision:
By:
Reviewed:

	System I/O				System Software / Control																				
	Controller				Alarm Processing						Application / Function												Trending		
	Analog Input	Digital Input	Analog Output	Digital Output	Remote Notification	Equipment Status	Maintenance Status	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Interlock Start/stop	Dry Bulb Economizer	Enthalpy Economizer	Temp Reset	Sequential Staging	Humidity Control	Pressure/Volume Control	Demand Ventilation		Failure Mode (see key)	Interval	Change-of-state	Notes/Comments
Lighting																									
Photocell		1																							
Exterior Lighting Zones				1							X		X												
Interior Lighting Zones				4							X														
Miscellaneous																									
Building Power Monitor	3	2		1																					Add LonWorks Power Monitoring Panel

System Digital Outputs:	6
System Analog Outputs:	0
System Digital Inputs	3
System Analog Inputs	3
Total System Points:	12

Symbol Key: Failure Modes: C = Closed/Off, O = Open/On, L = Last Command.
Trending: Values listed are sampling intervals (in minutes).
FB = Feedback