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SANTA BARBARA • SANTA CRUZ

OFFICE OF DESIGN & CONSTRUCTION SERVICES and PHYSICAL FACILITIES

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- SENT VIA:** FAX ON THIS DATE
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HOLDERS OF PLANS AND SPECIFICATIONS:

MOCVD & TCR Lab E-II Room 1141
Project No. FM080185L/981520
Addendum No. 2

January 31, 2008

Enclosed is **ADDENDUM NO. 2** to the Construction Documents on the above-captioned project.

Bid date is Thursday, February 7, 2008 at 2:30 P.M. to be held at:

CONTRACTING SERVICES
Facilities Management, Bldg. 439,
Door #E, Reception Counter
University of California, Santa Barbara
Santa Barbara, CA 93106-1030.

Late arrivals shall be disqualified. Please allow time for unforeseen traffic delays, securing a parking permit and potential parking problems.

A handwritten signature in black ink, appearing to read "Anna Galanis".

Anna Galanis
Director, Contracting Services

ADDENDUM NUMBER 2

to the

CONSTRUCTION DOCUMENTS

January 31, 2008

GENERAL

The following changes, additions or deletions shall be made to the following document(s) as Indicated; all other conditions shall remain the same.

I. SPECIFICATIONS

Item No.

1. Table of Contents "Division 15", ADD in its entirety: 'Section -15975 Energy Monitoring and Controls System 1-27.'
2. Section 09900, Painting, Part 1 - General, 1.01 "Summary", ADD "C" to read: 'All interior walls within scope of work shall be painted with semi gloss rooms 1141, 1141F, 1141G, 1119F, 1141D and boiler room 1158. All open ceilings within scope of work shall be painted with two coats of flat paint.'
3. Section 15510, Hydronic Piping, Part 2 - Products, 2.01 "Heating and Water Piping", CHANGE Title in its entirety to read: 'Chilled Water, Heating Hot Water Piping; 2" and Below.'
4. Section 15510, Hydronic Piping, Part 2 "Products", ADD "

2.09 CHILLED WATER, HEATING HOT WATER PIPING; 2-1/2" and ABOVE

A. Steel Pipe: ASTM A53, standard weight, Grade A or B seamless or ERW

1. Fittings: Standard weight carbon steel, butt weld, ASTM B16.3.

2. Joints: Butt welded, AWS D1.1, or flanged.

5. Section 15890, Ductwork, Part 2 “Products”, ADD 2.04 to read: ‘**Chilled Water, Heating Hot Water Piping; 2-1/2” and Above.**’
6. Section 15890, Ductwork, Part 3 – Execution, 3.02 “Cleaning”, “A” DELETE in its entirety #A.
7. Section 15890, Ductwork, Part 3 – Execution, 3.02 “Cleaning”, “B” DELETE in its entirety #B.
8. Section 15890, Ductwork, Part 3 – Execution, 3.02 “Cleaning”, “C” DELETE in its entirety #C.
9. Section 15890, Ductwork, Part 3 – Execution, 3.03 “Schedules”, “A” Ductwork Material Schedule “All” CHANGE to read: **HVAC Supply Ducting.**’
10. Section 15890, Ductwork, Part 3 – Execution, 3.03 “Schedules”, “A” Ductwork Material Schedule, ADD new row to read: ‘**HVAC Return Ducting, Steel, galvanized.**’
11. Section 15890, Ductwork, 3.03 “Schedules”, “A” Ductwork Material Schedule, ADD new row to read: ‘**Laboratory Exhaust Ducting, Steel, stainless.**’
12. Section 15975, Energy Monitoring and Controls System, ADD new section in its entirety. Attached.

II. DRAWINGS

Item No.

1. Sheet A-1 (Architectural Floor Plan) “REFERENCE NOTES”:
 - A. **ADD 2B to read as following: ‘See sheet A-3 for new ceiling conditions.’**
 - B. **CHANGE Reference Note 9 to read as following: ‘Two coats of semi-gloss paint finish throughout lab. All interior surfaces shall be painted. See specification section 09900.’**
2. Sheet A-1 (Architectural Floor Plan) “ARCHITECTURAL FLOOR PLAN”:
 - A. **ADD Reference Note 2 to plan at gowning room 1141D.**
 - B. **ADD Reference Note 9 to plan in all areas of laboratory and boiler room.**
3. Sheet A-2 (Sections and Details) “WALL SECTION DETAIL”:
 - A. **CHANGE detail reference from “A” to “B” for bottom detail at lower right-hand corner detail.**

4. Sheet A-2 (Sections and Details) “CHASE OPENING DETAIL”:
 - A. **CHANGE** detail as shown on attached Addendum #2 drawing, A-2 ADD#2.
5. Sheet A-3 (Ceiling Plan and Details) “REFERNCE NOTES”:
 - A. **CHANGE** Reference Note 7B to read as following: **‘Existing light fixtures shall be re-lamped and re-installed per the electrical ceiling plan. Clean and re-install existing light fixtures in room 1141D.’**
6. Sheet A-3 (Ceiling Plan and Details) “CEILING PLAN”:
 - A. **ADD** Reference Note 7 to plan at gowning room 1141D.
 - B. **CHANGE** Reference Note 10 to read as following: **‘Remove 2-hour rated shaft ceiling in room 1119 to gain access to ducting. Replace with shaft materials to match existing.’**
7. Sheet M1.2 (Piping and Instrumentation Diagram) “TEACHING CLEANROOM AIR HANDLER PROCESS & INSTRUMENTATION DIAGRAM”:
 - A. **CLARIFICATION:** “Room Digital Display Module” may consist of two panels each located on the wall where indicated. One panel shall display temperatures/humidty within TCR, while the other shall consist of the two differential pressure readings.
8. Sheet M2.0 (First Floor Mechanical Demolition Plan) “FIRST FLOOR MECHANICAL DEMOLITION PLAN”:
 - A. Note 15 **CHANGE** to note 10 in room 1141F at (E) 16x12 duct.
9. Sheet M2.1 (First Floor Mechanical Remodel Plan) “MECHANICAL REMODEL FIRST FLOOR LAB PLAN”:
 - A. Note 19 **CHANGE** to note 14 in equipment aisle 1141E.
10. Sheet M2.1 (First Floor Mechanical Remodel Plan) “REFERNCE NOTES”:
 - A. Note 19 **CHANGE** to read as following: **‘Not Used.’**
 - B. Note 12 **CHANGE** to read as following: **‘(N) 2” diameter EA drop with ball valve and cap for future connection.’**

- C. Note 22 **CHANGE** to read as following: **'Connect (N) 8" diameter EA duct from (E) gas cabinet at 450 CFM max. with MVD into (N) 20" diameter EA duct. (Typ. 3).'**
11. **Sheet M3.0(Second Floor Mechanical Demolition Plan) "PARTIAL 1ST FLOOR MECHANICAL REMODEL PLAN":**
- A. Note 39 **CHANGE** from detail 9, sheet M5.1 to **'detail 6, sheet M5.1.'**
12. **Sheet M3.0(Second Floor Mechanical Demolition Plan) "REFERENCE NOTES":**
- A. Note 38 **CHANGE** to read as following: **'(N) VFD located on (N) air handler in NEMA 1 enclosure. Located across from doorway to maintain required clearance. See electrical plans.'**
13. **Sheet M3.1(Third Floor Mechanical Demolition Plan) "REFERENCE NOTES":**
- A. Note 6 **CHANGE** to read as following: **'See remodel plan 2, sheet M3.1 for modified shaft openings.'**
14. **Sheet M4.0(Penthouse Demolition Plan) "REFERENCE NOTES":**
- A. Note 2 **CHANGE** to read as following: **'Remove existing HHWS/R piping from existing boiler to tee after normally closed valves in existing 2" HHWS/R piping and down thru floor to second floor mechanical room. See sheet M4.0, detail 2, for new boiler and piping installation.'**
15. **Sheet M4.0(Penthouse Demolition Plan) "PARTIAL PENTHOUSE MECHANICAL REMODEL PLAN":**
- A. **CHANGE** equipment schedule reference from EF-2 to **'EF-2A.'**
16. **Sheet M5.0(Mechanical Details) "#12 PIPE SUPPORT":**
- A. **CHANGE** from '(N) CHW piping with 2" thick thermo-12 gold, calcium silicate insulation w/ AP-T plus jacket encased with two 180 degrees galvanized sheet metal protectors over/under pipe strap. Seal and join insulation joints per mechanical specifications' to **'(N) piping with 2" thick, thermo 12 gold, calcium silicate insulation w/ AP-T plus jacket with one 180 degree galvanized sheet metal protector under pipe support. Join and seal insulation joints per mechanical specifications.'**

17. Sheet M5.1(Mechanical Details) “#3 DUCT DROP WITH MVD”:
 - A. **CHANGE** detail as shown on attached Addendum #2 drawing, M5.1 ADD#2.
18. Sheet M5.2(Mechanical Details) “#A MECHANICAL ROOM SECTION”:
 - A. **CHANGE** detail as shown on attached Addendum #2 drawing, M5.2 ADD#2.
19. Sheet E2.1 (First Floor Mechanical Power Plan) “ELECTRICAL KEY NOTES”:
 - A. **Add D15** to Electrical Key Notes to read as following: ‘**All new electrical connections in room 1158 shall be part of main contract.**’

END OF ADDENDUM NO. 2

SECTION 15975

ENERGY MONITORING AND CONTROLS SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Facilities Management System (FMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the FMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.02 REFER TO SECTIONS

- A. Division 15: Mechanical - Installation of wells, water and gas flow meters and other mechanical devices, etc., shall be by Division 15.
- B. Division 16: Electrical - Installation of devices integral to motor control centers, starters, disconnects, and power circuits for controls shall be by Division 16. Division 16 to supply all necessary 120V power wiring

1.03 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level each separated by a defined deadband. Digital Inputs and Digital Outputs are examples.
- C. Facility Management System (FMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division FMS Contractor and to be interfaced to the associated work of other related trades.
- D. FMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the FMS work.

- E. Control Sequence: An FMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the FMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. FMS Network: The total digital on-line real-time interconnected configuration of FMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the FMS network.
- I. FMS Integration: The complete functional and operational interconnection and interfacing of all FMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent FMS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, verify, warrant, document and supply the associated required services ready for operation.
- K. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the FMS Contractor's cost to the designated third party trade contractor for installation. FMS Contractor shall connect furnished items to the FMS, calibrate, test, verify, warrant and document.
- L. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the FMS wiring and terminations.
- M. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- N. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between FMS network nodes.
- O. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the FMS industry for real-time, on-line, integrated FMS configurations.
- P. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

- Q. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents. They do not form a formal part of the Documents and may not be consistent or complete in their use throughout the Documents.
- R. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
AWG	-	American Wire Gauge
CFM	-	Cubic Feet Per Minute
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	(Binary) Digital Input
DO	-	(Binary) Digital Output
EEPROM	-	Electrically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAH	-	Outdoor Air Humidity
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Detector
SPDT	-	Single Pole Double Throw

SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Detector
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.04 FMS DESCRIPTION

- A. The FMS shall be a complete system designed for use on Intranets and the Internet. This functionality shall extend into the equipment rooms. Primary nodes located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure existing in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the FMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the FMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser such as Internet Explorer or Netscape.
- C. EXISTING server(s) shall be used for the purpose of providing a location for archiving system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft Data Engine (MSDE) or Microsoft SQL Server as dictated elsewhere in this specification.
- D. The work of the single FMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents as are listed in Part 1 of this Section.
- E. The FMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items as Specified in these Division documents which are required for the complete, fully functional and commissioned FMS.
- F. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided for this Project.

- G. Manage and coordinate the FMS work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work of associated trades.
- H. The FMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions at any Operator's console without the need to purchase special software from the FMS manufacturer for those consoles.
 - 2. Enterprise-level information and control functions.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of FMS functions.
 - 5. Offsite monitoring and management
 - 6. Energy management

1.05 QUALITY ASSURANCE

A. General

- 1. The contractor shall expand the existing Johnson Controls, Inc., "Metasys" Energy Management and Control System (EMCS) to provide monitoring, stand alone direct digital control (DDC) and effective and efficient operation of the project's HVAC system. EMCS shall be provided by Johnson Controls, Inc. (factory office), located at 5770 Warland Drive, Cypress, CA 90630. Please contact Ryan Cheng at 562-594-3314 with questions.
- 2. The Facility Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management Systems of similar size, scope and complexity to the FMS specified in this Contract.
- 3. The FMS Contractor shall be a recognized national manufacturer, installer and service provider of FMS. Distributors, manufacturer's representatives and wholesalers will not be acceptable.
- 4. The FMS Contractor shall have a branch facility within a [150-mile] radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. This branch facility shall provide the work for this project. This support facility shall have spare parts and all necessary test and diagnostic equipment required to install, commission, and service the specified FMS.
- 5. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the FMS

business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.

6. The system specified herein shall be supplied and installed by the factory offices of Johnson Controls, Inc. located at 5770 Warland Drive Cypress, CA 90630 to match and extend the existing system.
7. The FMS software residing in Nodes and servers shall be updated to the latest currently available revision at the start of Warranty.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents..
2. The Contractor and its employees and sub trades comply with federal, state and local safety regulations.
3. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
4. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
5. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Provide a competent and experienced FMS Project Manager employed by the FMS Contractor. The Project Manager shall be supported as necessary by other FMS Contractor employees in order to provide professional management service for the work. The Project Manger shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the FMS Contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Maintain the scheduling of the work and report monthly in writing to the Architect on progress.
 - c. Manage the financial aspects of the FMS Contract.
 - d. Coordinate with the FMS Site Supervisor and with the Architect and other trades as necessary to maintain progress of the Contract.

2. Maintain a legible copy on-site, accessible to the owner upon request of, at minimum, the following documentation:
 - a. The FMS Contract Documents including all approved Change Orders.
 - b. All FMS related written Requests for Information and responses.
 - c. All approved Shop Drawings and other submittals.
 - d. A copy of the FMS Project Schedule.
 - e. Primary FMS related correspondence and minutes
 - f. A record of daily on-site manpower deployment
 - g. Other records as pertinent and required by the Contract Documents.

1.06 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
 1. National Fire Protection Association (NFPA) Standards.
 2. National Electric Code (NEC) and applicable local Electric Code.
 3. Underwriters Laboratories (UL) listing and labels.
 4. UL 864 UUKL Smoke Control
 5. UL 268 Smoke Detectors.
 6. UL 916 Energy Management
 7. NFPA 70 - National Electrical Code.
 8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 9. NFPA 92A and 92B Smoke Purge/Control Equipment.
 10. Factory Mutual (FM).
 11. American National Standards Institute (ANSI).
 12. National Electric Manufacturer's Association (NEMA).
 13. American Society of Mechanical Engineers (ASME).
 14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

15. Air Movement and Control Association (AMCA).
 16. Institute of Electrical and Electronic Engineers (IEEE).
 17. American Standard Code for Information Interchange (ASCII).
 18. Electronics Industries Association (EIA).
 19. Occupational Safety and Health Administration (OSHA).
 20. American Society for Testing and Materials (ASTM).
 21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 22. Americans Disability Act (ADA)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.07 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
1. The FMS Contractor shall submit a list of all shop drawings with submittal dates within 30 days of contract award.
 2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect for Contract compliance.
 3. Allow 15 working days for the review of each package by the Engineer in the scheduling of the total FMS work.
 4. The FMS Contractor shall correct any errors or omissions individually noted in the first review. The FMS Contractor shall revise the submittal and resubmit for review.
 5. At a minimum, submit the following:
 - a. FMS network architecture diagrams including all nodes and interconnections.
 - b. Schematics, sequences and flow diagrams.
 - c. Samples of Graphic Display screen types and associated menu penetrations to show hierarchy and functional interrelationships.

- d. Detailed Bill of Material list for each Node, identifying quantity, part number, description, and optional features.
- e. Control Valve Schedules including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.
- f. Room Schedule including a separate line for each VAV box and terminal unit indicating minimum/maximum CFM, pickup gain, box area, and bias setting.
- g. Product data sheets for all products including software.

1.08 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

- 1. [Three (3)] copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the FMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturers product data sheets for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. FMS network diagrams.
 - g. Wiring termination schedules.
 - h. Interfaces to all third-party products and work by other trades.
- 2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the project record drawings and data sheets. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents. The CD-ROM(s) shall contain adequate space for future system updates.

1.09 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the FMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the FMS Contractor at the cost of the FMS Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during FMS Contractor's normal business hours.
4. Maintain an on-site record of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all re-calibrations required as a result of Warranty service.

PART 2 – PRODUCTS

2.01 FMS ARCHITECTURE

A. Overall Conceptual Description

1. The FMS shall be designed entirely for use on intranets and internets. All networking technology used at the Tier 1 level shall be off the shelf, industry standard technology fully compatible with other owner provided networks in the facility.
2. All aspects of the user interface, whether to servers or to Tier 1 solid state devices, shall be via browsers. Any PCs used as operator interface points shall not require the purchase of any special software from the manufacturer in order to provide the complete user interface as described herein.
3. The user interface will be complete as described herein, providing complete tool sets, operational features, multi-panel displays, and other display features. Systems which merely provide HTML based web pages as the operator interface will not be acceptable.
4. The primary components of the system will be the Primary Application Nodes and Servers located at the highest level of the network architecture. Both will use the same user interface and provide the same level of accessibility via the network. The only distinction between the user interface used on servers as compared to Primary Application Nodes will be select menu items used for accessing long term storage features on the servers or on their respective archive devices (CD/RW, etc.)

B. General

1. The FMS shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.
2. The FMS network shall at minimum comprise of the following:
 - a. Operator PCs – fixed or portable.
 - b. Network processing, data storage and communication equipment including file servers.
 - c. Routers, bridges, switches, hubs, modems and like communications equipment.
 - d. Active processing Nodes including field panels.
 - e. Intelligent and addressable elements and end devices.
 - f. Third-party equipment interfaces.
 - g. Other components required for a complete and working FMS.
3. All FMS features shall be accessible via Enterprise Intranet and Internet browser with equivalent FMS access control for user access.
4. The FMS shall support auto-dial/auto-answer communications to allow FMS Nodes to communicate with other remote FMS Nodes via standard telephone lines. Refer to drawings for type of line to be used, DSL or voice grade. Where no preference is indicated, DSL is the preferred grade.
5. Provide licenses for all software residing in the FMS system and transfer these licenses to the Owner prior to completion.

C. Network

1. The FMS shall incorporate a primary Tier 1 network. At the Contractor's option, the FMS may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.
2. The FMS Network shall utilize an open architecture capable of all of the following:
 - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
 - b. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
 - c. Connecting via the N2 Protocol at the Tier 2 level.

- d. Connecting via LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
 3. The FMS network shall support both copper and optical fiber communication media.
- D. Third-Party Interfaces
1. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the FMS contractor in a timely manner at their cost to ensure complete data integration.
- E. Power Fail / Auto Restart
1. Provide for the automatic orderly and predefined shutdown of parts or all of the FMS following total loss of power to parts or all of the FMS.
 2. Provide for the automatic orderly and predefined startup of parts or all of the FMS following total loss of power to those parts or all of the FMS. Archive and annunciate time and details of restoration.
 3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
- F. Downloading and Uploading
1. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at any Operator PC, and the means to download same to the associated Application Node.
 2. Application software tool used for the generation of custom logic sequences shall be resident in both the application node and the server(s) where indicated on the drawings.
 3. Provide the capability to upload FMS operating software information, database items, sequences and alarms to the designated server.
 4. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual FMS application.

2.02 OPERATOR INTERFACE

A. General

1. The FMS Operator Interface shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the FMS by authorized users at the OWS.

2. It shall be possible to designate any PC on the Tier 1 network as an Operator Interface point. No special software will need to be purchased from the FMS manufacturer for any such PC.
3. User access to the FMS shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups. Provide the means to define unique access privileges for each individual authorized user. Also provide the means to establish general password groups to which an individual will then be assigned. Once assigned to the group each individual will assume all the capabilities and restrictions of that group. Provide the means to on-line manage password access control under the control of a Master Password.
4. The user interface shall be able to combine data from any and all of the system components in a single browser window. This shall include historical data stored on a server.
5. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - a. User access for selective information retrieval and control command execution
 - b. Monitoring and reporting
 - c. Alarm, non-normal, and return to normal condition annunciation
 - d. Selective operator override and other control actions
 - e. Information archiving, manipulation, formatting, display and reporting
 - f. FMS internal performance supervision and diagnostics
 - g. On-line access to user HELP menus
 - h. On-line access to current FMS as-built records and documentation
 - i. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
6. Provide FMS reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations and the like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the FMS.
7. All PC-based configurations shall operate on Microsoft® Windows 2000 or Windows XP.

8. Each fixed and portable PC shall be on-line configurable for specific applications, functions and groups of FMS points.

B. Navigation Trees

1. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
2. Provide the ability for the operator add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
3. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

C. Dividable display panels

1. It shall be possible for the operator to divide the display area within a single browser window into multiple display panels. The content of each display panel can be any of the standard summaries and graphics provided by the system.
2. Provide each display panel with minimize, maximize, and close icons.

D. Alarms

1. Alarms shall be routed directly from primary application nodes to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the OWS software shall, at the minimum, provide the following functions
 - a. Log date and time of alarm occurrence.
 - b. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
 - c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - e. Provide the ability to direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop up window described

above. Systems which use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

- f. Any attribute of any object in the system may be designated to report an alarm.
2. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
3. The FMS shall annunciate application alarms at minimum, as required by Part 3.

E. Reports

1. Reports shall be generated and directed to one or more of the following: User interface displays, printers, or archive at the user's option. As a minimum, the system shall provide the following reports:
 - a. All points in the FMS.
 - b. All points in each FMS application.
 - c. All points in a specific AN.
 - d. All points in a user-defined group of points.
 - e. All points currently in alarm in an FMS application.
 - f. All points locked out in an FMS application.
 - g. All FMS schedules.
 - h. All user defined and adjustable variables, schedules, interlocks and the like.
 - i. FMS diagnostic and system status reports.
2. Provide all applicable standard reports of the FMS manufacturer.
3. Provide for the generation by the user of custom reports as specified in Part 3.

F. Dynamic Color Graphics

1. An unlimited number of graphic displays shall be able to be generated and executed.
2. Graphics shall be based on Scalar Vector Graphic (SVG) technology.
3. Values of real time attributes displayed on the graphics shall be dynamic and updated on the displays.

4. The graphic displays shall be able to display and provide animation based on real-time FMS data that is acquired, derived, or entered.
5. The user shall be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.
6. FMS system shall be provided with a complete user expandable symbol library containing all of the basic symbols used to represent components of a typical FMS system. Implementing these symbols in a graphic shall involve dragging and dropping them from the library to the graphic.

G. Schedules

1. The system shall provide multiple schedule input forms for automatic FMS time-of-day scheduling and override scheduling of FMS operations. At a minimum, the following spreadsheet types shall be accommodated:
 - a. Weekly schedules.
 - b. Temporary override schedules.
 - c. Special "Only Active If Today Is A Holiday" schedules.
 - d. Monthly schedules.
2. Schedules shall be provided for each system or sub-system in the FMS. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
3. Monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

H. Historical trending and data collection

1. Trend and store point history data for all FMS points and values as selected by the user.
2. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools.
3. At a minimum, provide the capability to perform statistical functions on the historical database:
 - a. Average.

- b. Arithmetic mean.
 - c. Maximum/minimum values.
 - d. Range – difference between minimum and maximum values.
 - e. Standard deviation.
 - f. Sum of all values.
 - g. Variance.
- I. Paging:
- 1. Provide the means of automatic alphanumeric paging of personnel for user-defined FMS events.
 - a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.
 - b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
 - c. System shall utilize pager schedules to send pages to the personnel that are "on-call".

2.03 APPLICATION NODES

A. Primary Application Nodes

- 1. The primary application node shall perform the function of monitoring all system variables, both from real hardware points, software variables, and controller parameters such as setpoints.
- 2. Application nodes shall be entirely solid state devices. No rigid disk drives will be permitted in the equipment rooms.
- 3. The primary application nodes shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier2 networks, and to servers.
- 4. Any node on the Tier 1 network shall be equipped with all software necessary to drive the complete user interface including graphics on a browser connected to the node via the network or directly via a local port on the node.
- 5. The operating system of the application node shall support multi-user access. At minimum four users shall be able to access the same application node simultaneously.
- 6. Communication between nodes shall be per-to-peer via 10/100 Ethernet using the BACnet protocol.

7. The AN shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the controller not support multiple field busses, install two primary nodes side by side.
 - a. An RS-485 serial field bus such as MSTP or the manufacturer's proprietary field bus.
 8. The primary nodes will integrate data from both field busses into a common object structure. Data from both field busses will appear in common displays throughout the user interface in exactly the same format. It shall not be possible to determine which field buss the data originated on without reviewing the system configuration data.
 9. AN shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.
 10. The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
 11. A failure at an AN shall not cause failures or non-normal operation at any other system AN other than the possible loss of active real-time information from the failed AN.
 12. Ancillary AN equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
 13. AN shall comply with FCC Part 15 subpart J class A emission requirements.
- B. HVAC Node
1. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.
 2. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box)
 3. Each HVAC Node shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
 4. Each HVAC Node shall report its communication status to the FMS. The FMS shall provide a system advisory upon communication failure and restoration.
 5. For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.

6. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.
7. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.
8. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

2.04 APPLICATION SOFTWARE

A. HVAC Application Software

1. **Event Messaging:** Provide for the automatic execution of user-defined messages on the occurrence of each predefined FMS real-time event including equipment/point status change, approaching limit or alarm, time of day and the like. Direct messages to any number of operator PCs, e-mail destinations, and pagers.
2. **Optimum Start/Stop:** Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions, to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.
3. **Auto Alarm Lockout:** Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm and the like.
4. **Energy monitoring:** Provide software to monitor and totalize consumption as measured by pulse meters.
5. **Event Initiated Programs and custom logic:** Provide software to define custom logic sequences that will reside in the nodes. The definition software will also reside in the node and be accessible via the standard user interface via a browser.
6. **System Restart:** Upon restoration of the AC power to an HVAC Node, automatically restart all equipment and restore all loads to the state as required by the FMS. Provide appropriate time delays to prevent demand surges or overload trips.
7. **Heavy Equipment Delays:** The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

8. Runtime Totalization: Automatically sample, calculate and store runtime hours for binary input and output points as listed in the point schedule of this specification.
9. Analog/Pulse Totalization: Sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

PART 3 – PERFORMANCE / EXECUTION

3.01 FMS SPECIFIC REQUIREMENTS

A. FMS Reports

1. Define custom reports required for this project here. Examples: tenant billing, chiller efficiency reports, alarm reports, run time summaries,

B. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. Provide Historical Data Viewer functionality.
2. User shall access the various system schematics and floor plans via a graphical penetration scheme and/or menu selection.

C. Data Visualization Displays

1. Display Requirements
 - a. Binary Bar Chart: Provide a single binary bar chart that includes all points as indicated on the point list.
 - b. Analog Bar Chart: Provide an individual analog bar chart for each system including all points as indicated on the point list. Provide Historical Data Viewer functionality.
 - c. Color Gradient Chart: Provide an individual color gradient chart for each system indicated on the point list, including all points associated with that system as shown on the point list.
 - d. Pattern Display: Provide a set of pattern displays. Each pattern display shall contain multiple systems and include all points as indicated on the point list. Provide Historical Data Viewer functionality.
 - e. System Chart: Provide an individual system chart for each system indicated on the point list, including all points associated with that system as shown on the point list. Provide Historical Data Viewer functionality.
2. Provide two backup copies of the Data Visualization programming in Microsoft Excel or approved equal on CD-R.

D. Actuation / Control Type

1. Primary Equipment
 - a. Controls shall be provided by equipment manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
2. Air Handling Equipment
 - a. All air handlers shall be controlled with DDC controllers
 - b. All damper and valve actuation shall be electric.
3. Terminal Equipment:
 - a. Terminal Air Boxes (VAV, etc.) shall have electric damper and valve actuation.

3.02 INSTALLATION PRACTICES

A. FMS Wiring

1. Low Voltage conduit, wiring, accessories and wiring connections required for the installation of the Facility Management System, as herein specified, shall be provided by the FMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section. All 120V wiring is to be by Division 16.
2. All FMS wiring materials and installation methods shall comply with FMS manufacturer recommendations.
3. The sizing type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the FMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the FMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
 - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.

5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
 - a. All circuits are continuous and free from short circuits and grounds.
 - b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
 - c. All circuits are free from induced voltages.
 7. Provide complete testing for all cables used under this Contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
 8. Provide for complete grounding of all signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- B. FMS Line Voltage Power Source
1. 120-volt AC circuits used for the Facility Management System shall be taken from panelboards and circuit breakers provided by Division 16.
 2. Circuits used for the FMS shall be dedicated to the FMS and shall not be used for any other purposes.
 3. DDC terminal unit controllers may use 120-volt AC power from motor power circuits.
- C. FMS Raceway
1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
 3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- D. Penetrations

1. Provide firestopping for all penetrations used by dedicated FMS conduits and raceways. All other project firestopping to be by other trade.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
5. No penetrations in structural elements shall be made before receipt of written approval from the architect.

E. FMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node location.
2. Cable shall be labeled at a minimum of every 18" with the FMS System manufacturer's name and the type of signal carried within the cable, i.e. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC.
3. Each of the cable types specified in Item A shall be of a different color coding for easy identification and troubleshooting. Recommended color coding:
 - a. Analog Input Cable Yellow
 - b. Analog Output Cable Tan
 - c. Binary Input Cable Orange
 - d. Binary Output Cable Violet
 - e. 24 VAC Cable Gray
 - f. General Purpose Cable Natural
 - g. Tier 1 Comm Cable Purple
 - h. Other Tier Comm Cable Blue
4. Raceway Identification. All the covers to junction and pull boxes of the FMS raceways shall be painted with the appropriate color.
5. Wire Identification. All low and line voltage FMS wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.

F. FMS Node Installation

1. The FMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The FMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the FMS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the FMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
6. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
7. Duct Temperature 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.

- b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
8. Space Sensors:
- a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
9. Air Differential Pressure Status Switches:
- a. Install with static pressure tips, tubing, fittings, and air filter.
10. Water Differential Pressure Status Switches:
- a. Install with shut off valves for isolation.
- I. HVAC Output Devices
- 1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, etc.
 - 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 - 3. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 - 4. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Facility Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.03 TRAINING

- A. The FMS contractor shall provide the following training services:
 - 1. Provide (8) hours of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the FMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.04 COMMISSIONING

- A. Fully commission all aspects of the Facility Management System work.
- B. Acceptance Check Sheet
 - 1. Prepare a check sheet that includes all points for all functions of the FMS
 - 2. Submit the check sheet to the Engineer for approval one month prior to testing.
 - 3. Complete the check sheet for all items and functions of the FMS and initial each entry with time/date as record of having fully calibrated and tested the FMS. Submit to Engineer.
 - 4. The Engineer will use the check sheet as the basis for acceptance testing with the FMS Contractor.
- C. VAV box performance verification and documentation:
 - 1. The FMS Contractor shall test each VAV box for where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box air flows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 - 2. The FMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.
- D. Provide all necessary specialist labor, materials and tools to demonstrate to the Engineer that the FMS has been commissioned and is operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the FMS Contractor.
- E. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION

NEW 5/8" THICK GYPSUM BOARD OVER NEW 2-1/2" X 18 GA. METAL STUD @ 16" O.C.

NEW 2-1/2" X 18 GAUGE HORIZONTAL METAL STUD WELDED OR SCREWED TO NEW VERTICAL STUDS.

EXISTING 3-1/4" X 1-5/8" VERTICAL UNISTRUT CHANNEL @ 32" O.C.

SPAN BETWEEN EXISTING 3-1/4" X 1-5/8" VERTICAL CHANNEL W/ NEW 3-1/4" X 1-5/8" HORIZONTAL UNISTRUT CHANNEL (OR EQUAL) WELDED OR BOLTED TO EXISTING.

MOVED LEADER TO POINT TO NEW 3-1/4" X 1 5/8" HORIZONTAL CHANNEL

1-1/2" X 18 GA. METAL MITERED ANGLE FRAME BOTH SIDES OF WALL.

4" X 6" X WALL DEPTH 18 GA. METAL LINER ON ALL INTERIOR SIDES OF OPENING. PROVIDE 4 OPENINGS IN WALL WITHIN 3'-0" OF EXISTING ELECTRICAL OUTLET IN CHASE 1161.

4"
6"

SECTION

SCALE: 3" = 1'-0"

ADDED NEW 3-1/4" X 1 5/8" HORIZONTAL CHANNEL

1-1/2" X 18 GA. METAL MITERED ANGLE FRAME BOTH SIDES OF WALL.

4" X 6" X WALL DEPTH 18 GA. METAL LINER ON ALL INTERIOR SIDES OF OPENING.

EXISTING 1-5/8" X 3-1/4" VERTICAL CHANNEL W/ NEW 1-5/8" X 3-1/4" HORIZONTAL UNISTRUT CHANNEL (OR EQUAL) WELDED OR BOLTED TO EXISTING.

4"
6"

6"

ELEVATION

SCALE: NTS

10
A-2

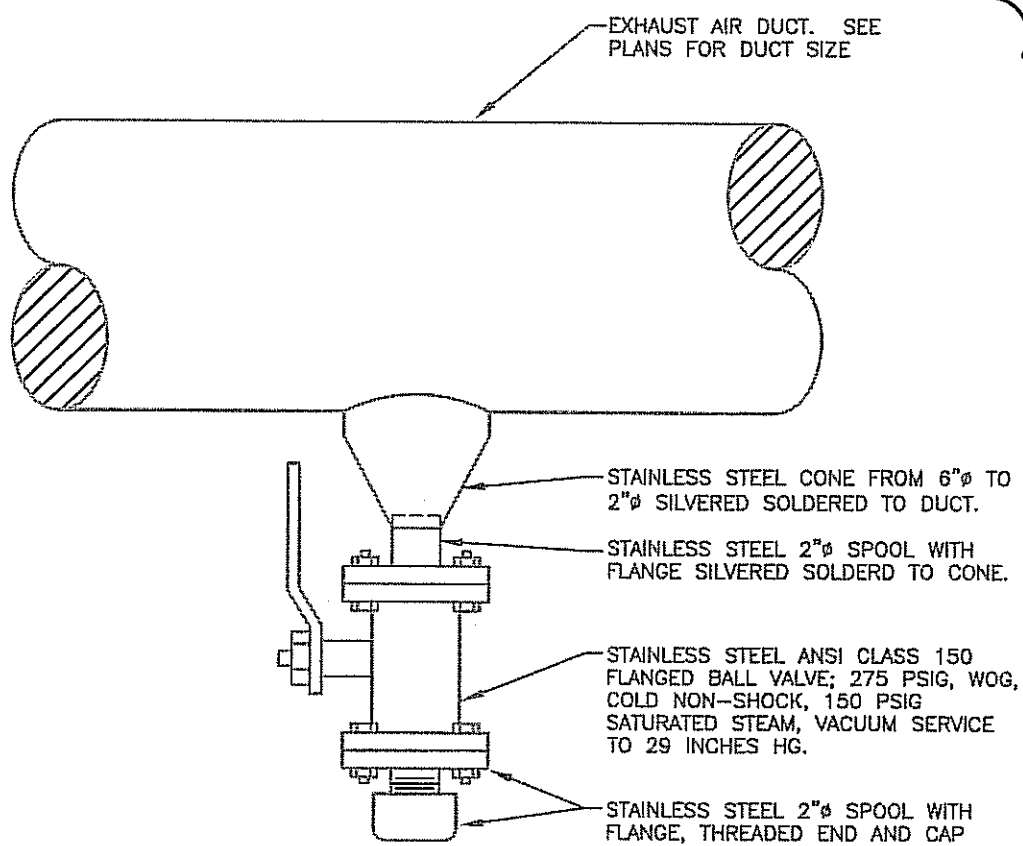
CHASE OPENING DETAIL

THE PALT COMPANY
MECHANICAL ENGINEERING AND CONSULTING

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(805) 739-1669 Fax (805) 739-1673
job no. 06069

UCSB, MOCVD AND TCR,
LAB E-11 ROOM 1141
ADDENDUM #2

JOB NO. 06069
DATE: 1-29-08
SHEET: A-2 ADD#2



PLAN VIEW

3 DUCT DROP WITH BALL VALVE

NTS

△ REPLACES PVIOUS DETAIL 3 ON SHEET M5.1

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 MECHANICAL ENGINEERING AND CONSULTING

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 job no. 08089

UCSB, MOCVD AND TCR,
 LAB E-11 ROOM 1141
 ADDENDUM #2

JOB NO.	06069
DATE:	1-29-08
SHEET:	M5.1 ADD#2

3

4

REFERENCE NOTES

- ① (N)3" HHWS/R TO COIL
- ② (N)3" CHWS/R TO COIL
- ③ (N)2" HHWS/R TO AH-4B IN ROOM 1150. SEE SHEET M3.0 DETAIL 3.
- ④ (N)36X36 SA DUCT TO CONNECT TO (E) TRANSITION THUR FLOOR.
- ⑤ (N)24X50 RA DUCT TO CONNECT TO (E) 24X50 THUR FLOOR.
- ⑥ FOR CONTINUATION OF (N) SA DUCTING, SEE SHEET M2.1.
- ⑦ SPILL (H) 1-1/2" INSULATED CONDENSATE DRAIN MIN. 2" ABOVE FLOOD RIM OF (E) FLOOR SINK.
- ⑧ SEE SHEET M4.0 FOR CONTINUATION OF PIPING.
- ⑨ (E)3" CHWS/R THRU FLOOR
- ⑩ (E)4" HHWS/R OVERHEAD WITH (E) NC SOV ON RISER, TO REMAIN WITH (N) 4" HHWS/R CONNECTION AFTER (E) SOVS.
- ⑪ P.O.C. NEW PIPING INTO EXISTING
- ⑫ SEE SHEET M4.0 FOR CONTINUATION OF (N) 4" CHWS/R OVERHEAD.

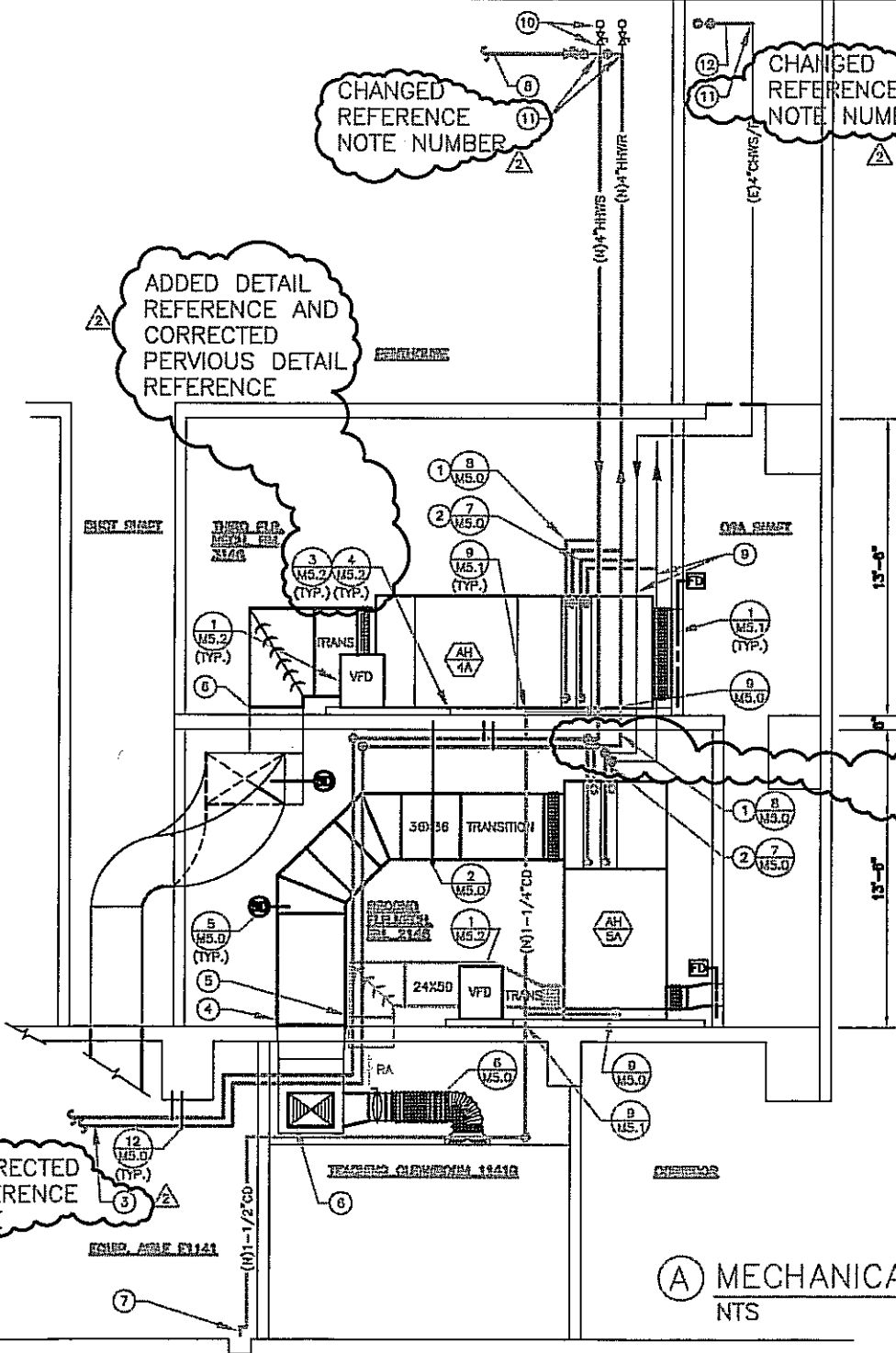
CHANGED REFERENCE NOTE NUMBER

CHANGED REFERENCE NOTE NUMBER

ADDED DETAIL REFERENCE AND CORRECTED PVIOUS DETAIL REFERENCE

CORRECTED PIPING CONNECTIONS

CORRECTED REFERENCE NOTE



(A) MECHANICAL ROOM SECTION NTS

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UCSB, MOCVD AND TCR, LAB E-11 ROOM 1141 ADDENDUM #2

JOB NO.	06069
DATE:	1-29-08
SHEET:	M5.2 ADD#2