SKILLED NURSING CARE / MENTAL HEALTH UNIT / HIV - AIDS UNIT & RENOVATION OF RELATED SUPPORT FACILITIES FOR

ELAYN HUNT CORRECTIONAL CENTER

LA STATE PROJECT NO. 08-413-97B-1, Part 7

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Volume One

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SECTION 15000 - MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. These Specifications are intended to provide complete and in proper operation all cooling, heating, ventilating, fire protection and plumbing systems, all as specified herein or shown on the accompanying Drawings, or reasonably implied in either, and including roughing-in services and connections for equipment furnished under other contracts or by the Owner, unless shown otherwise. The term "the Contractor" as used in this Section shall denote the Mechanical Sub-Contractor.

B. All electrical work will be done under the Electrical Section of these Specifications, except where indicated. See "MOTORS AND STARTERS" and "TEMPERATURE CONTROLS." Furnish wiring diagrams and any other information required for all wiring in connection with Mechanical Equipment and Controls.

C. Painting, except for special coats as herein specified, is included in other sections of these Specifications. (See "PAINTING.") The Mechanical Contractor is to coordinate and inform the General and Painting Contractor for the painting of all non-insulated or coated piping, support steel and fittings including valves. This piping shall include steel piping, supports, valves, flanges and hangers. It does not include cast iron or plastic or copper piping. It shall include touch up on welding for equipment having factory finishes. It is intended that all piping not insulated or manufacturer pre-coated (as for example, galvanized) and all other metals furnished and installed under this subcontract that are subject to rusting or discoloration be painted. Before finished coat of painting is applied, items outdoors and indoors shall have a base coat of cold galvanizing compound or industrial grade rust inhibiting primer (compatible with final coating).

D. For color coding of mechanical items, coordinate with painting sub-contractor and provide the color list as required, see Section 15010.

E. The Contractor shall verify all utility tie-in points for exact location, elevation and size and shall verify all routings and determine any interferences with existing obstructions or obstructions that might result from other work in this project.

1.2 GENERAL CONDITIONS

A. The Instructions to Bidders, General Conditions and Special and Supplementary Conditions, all contained in the General Specifications, shall be part of this Section of the Specifications the same as if attached hereto. The Mechanical Contractor is instructed to read and be thoroughly familiar with all provisions of the General Specifications.

B. It is understood that these Specifications and the accompanying Drawings, contemplate complete apparatus, fully erected and in successful operating condition. All work must be performed in the best and most substantial manner.
1.3 MANUFACTURERS OR TRADE NAMES

A. Where the Drawings and Specifications mention the products of specific manufacturers, it is intended that the Contractor shall furnish the items as specified, or a substitute listed by addendum to the Specifications. Request for substitution shall be made in writing at least seven days before bids are taken unless required otherwise in the Architectural Specifications. Requests shall include exact model numbers proposed or they will not be considered for review.

1.4 ORDINANCES, RULES AND REGULATIONS

A. All material and construction shall conform to the requirements of all building codes, sanitary codes and laws and ordinances in force in the locality in which the work is to be done. All materials and construction shall also conform to the rules and regulations of the National Fire Protection Association, Underwriter's Laboratories and National Electrical Manufacturers' Association.

1.5 PERMITS, FEES AND INSPECTIONS

A. Contractor shall obtain all permits and inspections required in connection with this work and shall pay any fees or other costs involved. Inspections shall include (but not be limited to) fire protection systems, boilers, water heaters, etc., as required by State and/or Local Regulating Authorities for the system(s) to be installed.

1.6 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship under this contract for a period of one year from date of final acceptance of his work and shall repair and replace any such defective materials and workmanship without cost to the Owner.

B. The Contractor shall guarantee all equipment to be of the quality and capacity specified and shall also further guarantee specific portions of the installation, such as heat exchangers, refrigerant systems, etc., as specified hereinafter.

C. The Owner will be responsible for routine maintenance such as, oiling, greasing and changing of filters during the warranty period under the Contractor's instructions. Contractor shall furnish the Owner a list of routine maintenance items and shall inspect the project and report to the Architect, in writing, if Owner maintenance is not being performed.

1.7 WARRANTIES

A. Refer to Division 1 General Conditions and Supplementary Conditions for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. Compile and assemble the warranties specified in the "MECHANICAL WORK" into a separated set of vinyl covered and suitable three ring type permanent binders, tabulated and indexed for easy reference. Provide complete warranty information for each item to include product or equipment; date of beginning of warranty or bond; duration of warranty or bond; and names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.
1.8 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide three copies of typewritten system operating instructions and three copies of operating and maintenance brochures for each piece of equipment including manufacturer's descriptive bulletins with wiring diagrams, parts lists and specific lubricating and maintenance instructions. Brochures shall be bound in suitable vinyl covered, three ring type permanent binders, tabulated and suitably indexed.

PART 2 - PRODUCTS

No products are specified under this Section of the Specifications.

PART 3 - EXECUTION

3.1 REVIEW OF EQUIPMENT AND MATERIALS

A. Within fifteen days of award of the contract, the Contractor shall submit ten copies of manufacturers' data and descriptive literature and drawings for all equipment and materials. All literature and data on all equipment shall be submitted at the same time: this material shall contain complete capacity data, curves, dimensions and all other pertinent information necessary for the Architect to properly evaluate the item. No item of equipment or material shall be placed on order until Final Review comments are received from the Architect. In the event the Contractor submits equipment requiring electrical service other than shown in the Drawings and Specifications, the Contractor shall bear all costs of revisions to the electrical service.

3.2 COORDINATION OF TRADES

A. Where work is in close proximity to the work of other contractors, the Contractor shall review plans of other contractors and coordinate his work with theirs. The Contractor shall verify the location of lighting fixtures, beams, conduit, pipes and other obstructions before beginning his work in the area. Notify the Architect where proper clearances do not occur or where the work of others would interfere with the safe and/or proper operation of this work.

3.3 START-UP AND INSTRUCTIONS

A. The Contractor shall furnish qualified personnel to start-up the installation and to train the Owner's operator in operation of the system.

3.4 BALANCING AND OPERATING TESTS

A. The Contractor shall procure the services of an independent air balance and testing agency, approved by the Architect and Facility Planning and Control to do work on State projects and specializing in the balancing and testing of HVAC systems. Contractor shall coordinate all activities of balance contractor and other sub-contractors affected throughout the balancing process. See "FINAL COORDINATION."

B. The agency shall balance, adjust and test all air and all water equipment and distribution systems as herein specified. The work shall include verifying the function of all modes of
operation. All work by this agency shall be done under direct supervision of a qualified heating and ventilating engineer employed by the agency. All instruments used by this agency shall be accurately calibrated and maintained in good working order.

C. It is the responsibility of the air balance and testing agency to test, adjust and verify the operation of all items of the air and water distribution systems.

D. Air balance and testing shall not begin until all systems have been completed and are in full working order and in full operation. Systems found out of calibration, missing, broken or otherwise inoperative shall be listed and a report of initial testing shall be submitted to the Contractor and to the Architect. Balance and testing shall resume after all items are in full operation. Obtain test kits, probes and other accessories necessary to do the work.

E. It is the responsibility of the air balance and testing agency to test and verify that the complete cycle of operation of all equipment, heating, cooling, smoke and exhaust modes is operable as per these Specifications.

F. If requested, the tests shall be conducted in the presence of the Architect.

G. Air balance work shall include additional adjustment of components during the season following the initial balance to include rebalance of any items influenced by the season changes or directed by Architect.

H. The scope of the balancing and operating tests shall apply to all new work and shall also apply to the existing systems where any changes are being made in this project.

I. At the time of final inspection, the balancing agency may be required to recheck, in the presence of the owner's representative, specific and random selections of data, air quantities, and air motion recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, shall not exceed 10% of the total number tabulated in the report."

J. **Balance Report:** Submit four copies of final balance report. Comply with review comments made by Architect and re-balance and resubmit as required.

1. **Warranty:** Test and balance agency shall include an extended warranty of 90 days, after completion of test and balance work, during which time the Architect at his discretion may request a re-check, or resetting of any outlet, supply air fan, or exhaust fan as listed in test report. The agency shall provide technicians to assist the Architect in making any tests he may require during this period of time.

2. **Air Systems:** The air balance agency shall perform the following test of each air unit and fan system and balance the systems in accordance with the following requirements:
   a. Test and adjust RPM to design requirements.
   b. Test and record motor full load amperes.
   c. Make pitot tube traverse of main supply ducts and obtain design CFM as required.
   d. Test and record system static pressure, suction and discharge.
e. Test and adjust system for design recirculated air CFM.

f. Test and adjust system for design outside air CFM.

g. Test and record entering air dry bulb and wet bulb temperatures.

h. Test and record leaving air dry bulb and wet bulb temperatures.

i. Adjust all main supply and return air ducts to proper design CFM.

j. Test and adjust each diffuser, grille, and register to within 10% of design requirements. Readings and tests of diffusers, grilles and registers shall include required CFM and test resultant CFM after adjustments.

k. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

l. As part of the work of this contract, the Contractor shall make any changes of any air unit in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by Air Balance Agency, at no additional cost to the Owner.

3. **Variable Air Volume and Terminal Air Boxes:** The air balance agency shall perform the following tests to each variable air volume and terminal air box system:

   a. Test, adjust and calibrate the maximum and minimum box air quantities.

   b. Insure the entering static pressure is sufficient for normal, proper box operation.

   c. Set the thermostat and box pressure controllers for proper heating and cooling setpoint operation.

   d. Readjust all terminal air box and variable air volume box supply systems as required such that all outlets of a box simultaneously reach design values.

4. **Water Systems:** The balance engineer or technician shall prepare the water systems for balancing in the following manner. Work shall include all air handling units and all water coils located remote from air units. Water balance shall be made after air balance is completed.

   a. Open all valves to full open position. Close coil bypass stop valves. Set mixing valve to full coil flow.

   b. Have the Contractor remove and clean all strainers.

   c. Check all air vents at high points of water systems and determine all are installed and operating freely.

   d. Set temperature controls so coils are calling for full coil flow. This should close automatic bypass valves at coil.
e. Verify operation of automatic coil valve.

f. Balance each chilled water and hot water coil.

g. Upon completion of flow readings and adjustments at coils, mark all settings and record data.

h. Set pressure drop across bypass valves to match coil full flow pressure drop.

i. Check and set water flow and pressure differential at pumps.

j. Check and record cooling tower entering and leaving water temperatures and entering and leaving dry bulb and wet bulb air temperatures.

k. Adjust each cooling tower inlet valve to the proper flow such that all cells of multiple cell units are receiving equal water.

l. Test and record pump motor full load amperes.

m. Test and adjust cooling tower sump heaters and thermostats.

K. Final Coordination: Mechanical sub-contractor shall provide for final coordination with balancing contractor, control sub-contractor and other affected sub-contractors. After occupancy, Architect shall have the option of revising criteria to satisfy occupant comfort.

L. Facility Planning and Control (FP&C) reserves the right to hire a second balancing contractor to review the report of the first. FP&C also reserves the right to hire a second balancing contractor to check the work of the first firm.

3.5 SITE CONDITIONS

A. The Contractor shall visit the building site to determine existing conditions and will be held responsible for allowing for these conditions in his bid. This will include above or below grade items that may affect the work.

3.6 EXISTING BUILDING CONDITIONS

A. Note that this area of work has existing storm drainage, mechanical and electrical utilities located underground and within and under the building. It is part of this work for the Contractor to determine the scope and location of all existing utilities and the scope and location of all new utilities to be installed concurrent with this project and to arrange his work around others.

B. Contractor shall inspect all existing conditions and space limitations at the site and shall include in his bid all required special adjustments because of site conditions. Verify conditions during construction before fabrication of system components. Early fabrication will not be justification for extra payments for changes due to job conditions.
3.7 SALVAGEABLE MATERIALS

A. The Owner shall have priority for the selection of the salvageable materials and equipment from the building. Any equipment and materials selected to remain the property of the Owner shall be removed and delivered to a location on the building site as designated by the Architect.

3.8 SHUT DOWN OF EXISTING SERVICES

A. Where existing mechanical systems are to remain operational during construction, all interruptions of such systems shall be held to a minimum reasonable time. Coordinate outages using a written request to the Architect through the General Contractor. Request shall be submitted to Architect at least 72 hours prior to outage time requested.

END OF SECTION 15000
SECTION 15010 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 LABELS

A. Provide a label on each piece of apparatus and each controlling device. Labels shall identify item and number and have identifying function and position settings. Labels shall be pressure sensitive adhesive mount type, 1/16 inch minimum thickness, engraved type laminated plastic, black with white lettering.

1.2 PIPING IDENTIFICATION

A. Provide markers on piping which is either exposed or concealed in accessible spaces, with Seton Setmark, EMED Co. Kwik Koil, or equal plastic snap-around markers. For insulated piping, markers may be Seton Opti-Code, EMED Co. Econo Mark pressure sensitive vinyl markers with matching self-adhesive "arrow" banding tape applied circumferentially at each end of marker. For piping system, other than drain and vent lines, include generic name of system or its abbreviation, either by pre-printed markers or stenciled marking, and include arrows to show direction of flow. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floors, walls or ceilings or otherwise pass into inaccessible spaces, and at 50 feet maximum intervals along exposed portions of lines. Marking of short branches and repetitive branches for equipment connections is not required. Markers shall comply with ANSI A13.1 Standard.

1.3 PIPE COLOR CODING

A. Pipe colors shall be ANSI Standards Red, Blue, Green, Yellow or Aluminum according to function. Pipe supports shall be painted. Provide, where exposed or accessible, colored molded fire/smoke rated PVC pipe jackets over pipe and/or insulation for identification. Refer to Section 15000.

1.4 VALVE IDENTIFICATION

A. General: Provide valve tags on all valves of each piping system, excluding check valves, valves within equipment unit and faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Provide shape-coded and stamped brass tags on chain or S-hook fasteners. Tags to be 0.032 inch thick brass with minimum 1/4 inch high letters.

1.5 VALVE SCHEDULE

A. For each piping system, on standard-size bond paper, tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed or modulating) and variations for identification. Each schedule to be framed in an extruded aluminum frame suitable for mounting on masonry walls. Mount in equipment rooms or as directed by the Architect.
1.6 MATERIALS IN AIR DUCTS AND PLENUMS

A. No plastic or other non-metallic materials as defined by NFPA 90A shall be used in air ducts or plenums unless specifically rated for such service.

PART 2 - PRODUCTS

2.1 MOTORS AND MOTOR STARTERS

A. Electric motors with characteristics as shown on the Drawings shall be provided by the Contractor for all pieces of driven equipment. Electric motors shall be submitted for approval and shall conform to the following: Single phase motors shall generally be as recommended by the manufacturer of the driven equipment. Three phase motors shall be squirrel-cage induction type motors unless otherwise specified. Motors shall have characteristics as listed on the Drawings and shall be selected to be non-overloading and capable of normal scheduled operation without requiring operating in the service factor range. Motors shall be designed for a 40°C rise from 40°C ambient and shall have NEMA design B normal starting torque unless otherwise specified. Enclosures shall be open, drip-proof for all applications not exposed to outside weather conditions and totally enclosed, fan-cooled for motors located outside, or exposed to outside conditions. All motors shall be rated at full load conditions and be high efficiency, high power factor type, copper wound, premium grade: Motors from 1 HP to 2 HP to have 82% minimum efficiency with 0.85 minimum power factor; Motors 3 HP to 10 HP to have 85% minimum efficiency with 0.85 minimum power factor; Motors 15 HP and above to have 90% minimum efficiency with 0.85 minimum power factor.

B. In addition, motors for invertor, variable frequency drive use shall be definite purpose invertor fed motor rated NEMA mG-1, Part 31 compliant and rated.

C. Motor starters for factory assembled units shall be provided for by the manufacturer and be completely factory wired and mounted. All contactors to be NEMA rated and generally conform to the specifications below. All separate motors and motors not otherwise packaged with a starter unit as part of a factory assembly shall have a starter as specified below. Provide labels for each starter: white etched letters on black laminated plastic base.

D. The motor controller for single phase motors shall be a manual motor starter unless otherwise indicated with melting alloy type thermal overload protection. When a magnetic starter is specifically called for, it shall be an A.C. magnetic contactor, NEMA rated, with melting alloy thermal overloads, Square D, Type 8536 Series, Allen-Bradley Bulletin 509, Cutler Hammer Freedom Series, General Electric CR306, Siemens-Furnas 14 Series, or equal as listed by addendum.

E. Each three phase electric motor shall be provided with a full voltage non-reversing combination magnetic motor starter disconnect type with adjustable trip motor rated circuit protector unless noted otherwise on Drawings as furnished elsewhere. The starter shall be NEMA rated and have three thermal overload relays, one for each leg and shall have auxiliary contacts as required. Overload relays shall be NEMA Class 10 for HVAC compressor type use and Class 20 for fan and pump use. Use NEMA Class 30 overload relays only for high starting torque use. Enclosures shall be NEMA 1 general purpose for all indoor applications and NEMA 3R rainproof for all applications exposed to outdoor conditions.
conditions. Provide mechanical operators capable of being locked. Each shall have a hand-off-automatic switch and operating pilot light mounted in the face of the enclosure. Provide fused control voltage transformer for 120 Volt or lower coil controls. Verify with Temperature Control requirements. Submit shop drawings on starters and switches. Units shall be Allen-Bradley Bulletin 513, General Electric CR387, Square D Class 8539, Cutler Hammer Freedom Series, Siemens-Furnas 18 Series, or equal as listed by addendum.

F. Motor starters for motors over 10 HP shall have a line power monitor to protect the motor from overcurrent and voltage and loss of phase protection. Include with starter, factory wired and U.L. listed.

G. Motors and motor starters 30 horsepower and larger are to be of the reduced voltage, solid state soft start type.

2.2 SOFT START SOLID STATE STARTERS

A. For all starters 30 hp and above, provide a combination motor starter disconnect type. Units shall be microprocessor controlled, reduced voltage, stepless, solid state, soft start and non-reversing. Overload protection shall be electronic type field selectable for Class 10 (for HVAC compressor type use), Class 20 (for fan and pump use), or Class 30 (for high starting torque use) type relay curves with protection provided with each phase. Motor service factor shall be selectable at 1.0, 1.15 or 1.25. Starter shall have single phase, overvoltage, undervoltage, phase rotation, stalled motor, ground fault and line-to-line current imbalance protection. Starter shall have a control power transformer for 120 volt or lower control voltage.

B. Starters shall have a start ramp time adjustable from 0-120 seconds, adjustable deceleration profile, 0-60 seconds, auto ranging watt/watt-hour meter, elapsed time meter and scrolling volt/ammeters, accumulated event recorder (25 minimum events) time and date stamped, battery backed up menu parameters and static non-volatile operating settings with pass code protection.

C. Starter shall have LCD and/or LED status and diagnostics displays with full fault annunciation, push to test type indicating light to indicate motor operation and Hand-Off-Auto control switch.

D. Software selectable relay outputs shall consist of a general fault relay and a minimum of two relay outputs user selected to any of the following functions: Run, Up to Speed, Motor Trip, Motor Pre-Trip alarm. Provide auxiliary contacts as required for interlock purposes as required by the control system.

E. The starter shall have a circuit breaker (motor rated circuit protector) disconnect operable from outside the enclosure with the enclosure closed, padlockable in off position.

F. All components (controller, bypass contractor and motor rated circuit protector) shall be housed in a single enclosure, NEMA Type 1 for indoor locations, NEMA Type 4X stainless steel for outside locations.

G. Soft start starters shall be by Square D Class 8660, Cutler-Hammer Type IT, Model ECS Series, or equal as listed by addenda.
2.3 VARIABLE FREQUENCY MOTOR SPEED CONTROLLERS

A. The Contractor shall supply a variable frequency, variable torque, Alternating Current, solid state, induction motor speed controller for each VAV air unit where shown on Drawings. Controllers shall be Yaskawa (formerly MagneTek) GPD, Graham VLT 6000, General Electric AF-300-F11 Series, ABB ACH-400 Series, or equal as listed by addendum. The speed controller, the bypass switch, contactor and controls shall be by the same manufacturer, factory installed, and be self-contained, totally enclosed in a single convection cooled NEMA 12 cabinet and be capable of operation between 0°C and 40°C. The unit shall be fully rated for the horsepower of the motor connected at the voltage specified.

B. Controller shall include all necessary motor starter functions. Unit shall have a loss of phase protection to prevent drive operation on loss of phase. Threshold on phase monitoring shall be adjustable. Provide external to the drive unit a three-contactor manual power bypass arrangement to manually bypass the variable speed controller. The controller shall be out of the circuit when in the bypass mode. The unit shall have full power for 100% motor speed while variable speed drive is removed. The manual bypass switch to be a switch to operate fully NEMA rated bypass contactors that will transfer the input power to the motor starter circuit and allow complete removal from the enclosure of the drive electronics package in an energized state. Manual bypass to have auxiliary contacts for connection by the Temperature Controls Contractor, such that in the bypass position, the contact makes and all VAV boxes go to full open. In the bypass position, all start, stop, auto functions will be connected and maintained. In the normal position, bypass starter, overloads and controls are deactivated and the load of the motor is transferred to the output of the variable frequency drive.

C. The physical size of the unit shall be verified to physically fit the space allowed before bid. Units that do not fit or do not comply with Code clearances will be rejected. The bypass arrangement, drive and cabinet shall be a single source responsibility and be manufactured and factory supplied by the drive manufacturer. No shop assembled or field fabricated assembly of components is acceptable.

D. Input voltage of the unit shall be the same as the voltage required by the motor. No voltage level transformation is allowed unless specifically noted otherwise. The unit to be capable of input voltage variations of 10%, 3 phase and frequency 2% at rated voltage and 60 Hz.

E. The output voltage to vary from zero to the rated motor voltage, and the output frequency to vary from zero to 120 Hz minimum. The output voltage-frequency combination shall insure the optimum volts per Hertz ratio for best operating efficiencies and minimum motor heating. The output must be a voltage source type generating a sine coded PWM waveform utilizing an asynchronous carrier frequency. This carrier frequency shall be adjustable to minimize harmonically induced noise or vibration. This must be accomplished using a microprocessor based technique which forms a true sine coded current waveform to the motor for smooth performance at all speeds.

F. The variable frequency motor speed controller shall provide the necessary conversion and control of incoming line voltage to the variable frequency, variable voltage output via the following general scheme:

1. The power input stage shall convert three-phase AC line power to a fixed DC bus voltage. Provide a solid state three-phase full wave diode rectifier with metal oxide varistor (MOV) three-phase protection. Minimum full load power factor
shall be 0.90. Drive shall not cause voltage line notching nor introduce noise to the mains.

G. The drive shall not produce more than 3% total voltage demand harmonic distortion (THD) (except central plant VFD's may be 5%), voltage as measured on the line side of the drive. Provide for DC bus reactor in the positive line of the DC section of the drive. Locate in the drive cabinet.

H. Provide for a factory trained service technician to supervise start-up of each motor speed controller.

I. Once the DC bus voltage is established, the power is internally delivered to the intermediate stage. The intermediate power stage shall be interfaced with the drive's diagnostics to provide continuous monitoring for the drive power component protection. The DC bus shall be fused for short circuit power protection. The DC bus shall have capacitive filtering to provide smooth DC power to the output power stage. The power is then routed to the drive's output stage.

J. The drive's output stage shall utilize switching transistors to convert DC bus power to sine-coded or voltage-vector pulse width modulated (PWM) voltage source power for motor control. Current transformers (CT's) shall be utilized to detect the output current of all three phases to the motor.

K. The drive shall have a 4 to 1 speed range as a minimum. The unit must be specifically designed for Air Handling unit service and be matched to the motors of the unit, size and characteristics scheduled and as specified herein. Unit must be solid state, microprocessor controlled, and use the pulse-width modulated technology to remanufacture the output waveform.

L. The motor speed controller shall be automatically controlled by a pneumatic (3-15 psig) control signal or a DC control signal. The DC control signal shall either be 4 - 20 ma or 0 - 10 volts. Manual operation capability must be provided.

M. Motor speed controller must provide for a slow speed start (soft start) with adjustable starting frequency. Minimum and maximum speed shall be capable of adjustment.

N. Motor speed controller shall have built-in current limiter with automatic shutdown if motor current exceeds 110% of design, but will allow momentary overloads of 150% of design current. Set at start-up for actual motor nameplate rating.

O. The motor speed controller shall provide simple connections for interface with the temperature controls panel, the fire alarm system, and equipment safety cut-outs. A visible front mounted indicator light must indicate if fire, smoke or freeze conditions have shut down unit.

P. Motor speed controller must be capable of running through momentary power outages up to 5 cycles in duration. Unit will shutdown if power fails for greater than 5 cycles but will automatically restart when power is reapplied.

Q. Provide for a factory trained service technician to supervise start-up of each motor speed controller. This is mandatory and is to be part of the overall instructions to the Owner. Schedule through the Architect.

R. The motor speed controller must meet the following Specifications in operation:
1. Instantaneous shutdown on current overloads in excess of 150%.

2. Momentary current overload capability up to 120% for 60 seconds (adjustable).

3. All control circuitry must be electrically isolated from inverter logic and power sections.

4. Output shall be current limited.

5. Current limiting fuses shall be supplied on AC input lines.

6. Shall have under-voltage, over-voltage, loss of phase, over-temperature, short circuit, DC bus and electronics protection.


8. External to drive unit bypass switch for emergency motor operation in case of unit failure. Provide 3-contactor isolating bypass arrangement with separate set of thermal motor overload relays and full size NEMA rated motor starter for operation in the bypass condition. See Temperature Controls and above. Bypass switch shall include the fully NEMA rated external bypass motor starter, bypass contactors, overloads and disconnect switch.

9. Provide Hand-Off-Auto switch with manual speed potentiometer on the unit. This Hand-Off-Auto switch is to be operable in both the normal and bypass position.

10. Provide unit mounted disconnect switch operable in the normal condition or bypass position. If a thermal-magnetic circuit breaker is used as the system disconnect switch, it shall be sized for across-the-line starting of the motor when in the bypass position.

11. Input electrical lug and output electrical lugs shall accommodate the wiring type, number per phase and size as per the Drawings.

12. Cabinet assembly with drive and all components to have lockable door with all normal operating controls on the door face and be NEMA 12 constructed.


15. Built-in diagnostics and indicators to provide fault condition trouble shooting by field personnel without the use of external measurements.

S. The overall noise level of the unit and motor combination must be acceptable to the Owner. Noisy units or motors that produce objectionable noise under normal operating conditions as judged by the Architect shall be replaced or repaired with quieter units at no cost to Contract.

T. Refer to Drawings for additional work. The Electrical Contractor is to provide for all power wiring with the Temperature Controls Contractor providing the interlock wiring, the interface and interlock devices, and all pneumatic work.
2.4 INSULATION

A. **General:** All surfaces shall be clean and dry when covering is applied. Covering shall not be applied before piping and equipment have been tested and proven free of leaks. On piping carrying cold fluids, the covering shall pass full thickness through or over hangers and the Contractor shall provide a galvanized steel bearing plate at each support. Plates shall be 8 inches long, formed to fit the outside of covering and shall extend halfway around the covering. Plates shall be of 18 gauge steel for piping up to 4 inches and 16 gauge steel for piping 4 inches and larger. All plates, sleeves and hanger devices to be sized and applied without damaging or deforming the insulation or puncturing the vapor barrier.

B. Unless indicated otherwise, all insulation installed within the building enclosure(s) shall have a composite (insulation, jacket and adhesive, as applicable) flame spread rating of 25 or less and a smoke developed rating of 200 or less, unless required otherwise by local Codes. Insulation within air ducts, plenums or other similar compartments used as part of an air distribution system shall be of materials approved for plenum service and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, as per NFPA 90A. Plastic materials are not allowed in plenum spaces unless specifically rated for such service.

C. Insulate all interior above ground chilled water supply and return piping, including valves, fittings and connections with molded insulation. Pipe covering shall have factory applied vaporproof flame bar jacket. Pipe covering shall be applied with all joints buttered with vapor barrier mastic; jacket laps shall be sealed with vapor barrier adhesive. On pumps and all piping 4 inches and larger use 1-1/2 inch thickness. On piping 3 inches and smaller use 1 inch thickness. Insulation shall be 4-pound density molded glass fiber material having composite flame and smoke spread rating acceptable for return air environment. Use high density insulation inserts at hangers to prevent sagging.

D. All underground chilled water, condenser water and heating hot water piping shall be factory insulated. Refer to Section 15040, Paragraph 2.1.

E. Insulate all interior heating hot water supply and return piping, fittings, valves and equipment with 4 pound density molded glass fiber pipe covering with factory applied vaporproof flame bar jacket. Pipe insulation shall be 1-1/2 inch thickness, except that the final 12 ft. segment of branch runout piping to individual units/VAV boxes may have 1 inch thickness insulation. Seal and staple laps and butt joint strips and apply lagging as required to seal and receive paint. Use high density insulation inserts at hangers to prevent sagging. Raw ends of insulation shall be tapered and finished to match covering.

F. All chilled and heating hot water valves (excluding valves at hot water heating VAV terminal boxes) shall be insulated with a factory fabricated removable/reusable valve cover. Cover must be fabricated of 1 inch thickness flexible elastomeric cellular (foam) insulation, conforming to C534 Type I or II (as applicable), complete with Velcro closures as manufactured by CORICK, Baton Rouge, Louisiana, or equal as approved by addendum. Provide manufacturer's recommended weather protective coating for outdoor applications.

G. Insulate chilled water and heating hot water pumps with 1-1/2 inch flexible elastomeric cellular (foam) insulation or 2 inch cellular foamed glass to form a removable and reusable insulated equipment cover (similar to the detail on Plate No. 48 of the National Commercial and Industrial Insulation Standards, Third Edition) encasing the pump. The box enclosure shall be constructed of 0.032 inch (minimum) thickness aluminum steel.
metal to which the insulation is applied. Insulation may be adhered directly to surfaces which do not require maintenance removal. Care shall be taken to provide a tight seal at all seams and joints. Allow for chilled water pump base plate to be piped to extend beyond insulated box. In lieu of that indicated above, chilled and heating hot water pumps may be insulated with a factory fabricated removable/reusable pump cover fabricated of 1 inch thickness flexible elastomeric cellular (foam) insulation, complete with Velcro closures as manufactured by CORICK, Baton Rouge, Louisiana. Provide manufacturer's recommended weather protective coating for outdoor applications.

H. Insulate chilled water and heating hot water expansion tanks with 1 inch thick flexible elastomeric cellular (foam) insulation applied with adhesive to a clean, dry surface. Provide manufacturer's recommended coating for outdoor applications.

I. Insulate evaporator condensate drain piping, horizontal runs of interior waste piping carrying cold fluids or evaporator condensate, and refrigerant suction piping with 1/2 inch thick flexible elastomeric cellular (foam) insulation applied by the slip on method with glued and sealed joints. Where routed within a return air environment, insulation shall have an acceptable composite flame and smoke rating. Provide manufacturer's recommended coating for outdoor applications.

J. Insulate all domestic hot water piping except exposed runouts at fixtures, with molded glass fiber insulation having factory fire retardant vaporproof jacket (stapled and glued) or pre-slit/pre-glued flexible elastomeric cellular (foam) molded insulation with peel-off adhesive. Except where indicated otherwise, insulation shall be 1 inch thickness for piping 2 inch diameter or less, and 1-1/2 inch thickness for piping 2-1/2 inch diameter and larger. Branch run-out piping (to individual fixtures) that is 2 inch diameter or less and is less than 12 feet total accumulated length from the piping main may be insulated with 1/2 inch thickness insulation in lieu of 1 inch. Domestic cold water piping at inlet to water heaters shall be insulated same as specified for domestic hot water piping; insulation shall extend from inlet of heater to inlet of piping (in-line) heat trap. Except as indicated above for water heaters, domestic cold water lines in attics, outside walls, and unconditioned equipment spaces shall be insulated same as specified for domestic hot water, except may be 1/2 inch thickness. Insulate all such fittings with molded fitting sections to match or with fire rated plastic fitting cover sections filled with glass fiber. Plastic fitting covers shall not be used in plenum spaces. Provide bearing plates, same as specified above, at hangers for insulated domestic water piping larger than 3/4 inch diameter.

K. Insulate domestic cold water piping exposed to weather with 1 inch thickness flexible elastomeric cellular (foam) insulation applied by the slip-on method with joints glued and sealed. Provide manufacturer's recommended coating for outdoor applications.

L. Except for piping insulated with elastomeric cellular (foam), chilled water piping, heating hot water piping and all insulated domestic water piping within mechanical rooms shall be covered with PVC jacketing in addition to the "factory applied vaporproof flame bar jacket." Piping concealed within wall space or concealed above ceiling is not required to have PVC jacketing. PVC jacketing shall be 0.020 inch minimum thickness applied with approved PVC adhesive over all seams; fill any unavoidable openings in jacketing with silicone sealant. Jacketing shall be 25/50 Flame/Smoke Rating as per ASTM E-84 and shall have factory color coding scheme, as selected by Owner/Architect from manufacturer's standard color selection chart. Fittings are to have factory colored PVC jacketing to match piping.
M. Where required by these Specifications or not otherwise provided, insulate water chillers as per manufacturer's recommendations. Use 1 inch thick flexible elastomeric cellular (foam) insulation applied with adhesive to a clean and dry surface. Insulate chiller piping, chiller vessel, fittings and other surfaces subject to sweating.

N. Insulate duct pressure relief doors with 1/2 inch thick glue-on fire rated flexible elastomeric cellular (foam) sheet insulation. Apply with approved adhesive to a clean, dry surface, and install in a manner that will not interfere with operation of door. Insulate all surfaces sufficient to prevent sweating.

O. Insulate all exterior above ground condenser water lines with 1 inch thickness flexible elastomeric cellular (foam) insulation, applied for weatherproof installation. Provide 45 mil thick self-stick protective wrap with a laminated film bonded over aluminum foil. Wrap to be Protecto Wrap Insul-Seal 45, Hardcast AM 401, or equal as listed by addendum.

P. Cover all straight runs of all outdoor piping insulation other than flexible elastomeric cellular (foam) insulation with 0.016 inch thick smooth aluminum jacket using strap method as recommended by the manufacturer. The aluminum jacket shall be in addition to the previously specified jackets. Fittings for piping receiving aluminum jacket shall be covered with pre-formed aluminum jacketing. Seal all joints and seams with silicone based caulking.

Q. Insulate all unlined supply ductwork (including flexible duct connections on fan coil units, and heating coils at discharge of VAV boxes), unlined return air ductwork, outside air ductwork, unlined exhaust ductwork and all lined ductwork routed in attics or unconditioned spaces, with 2 inch thickness, 3/4 pound glass fiber blanket with glass fiber reinforced aluminum foil vapor barrier. Staple joints and apply pressure-sensitive tape (matching the insulation facing and designed for use with the insulation) all around joints and at longitudinal seams. Where insulation is applied to oval or rectangular ducts with horizontal dimension greater than 24 inches, provide clips on the underside at 18 inches on centers both ways. Refer to Section 15020 for additional information.

R. For supply air or return air ductwork exposed to the weather, insulate with two layers of 1 inch thickness flexible elastomeric cellular ("armaflex") sheet insulation applied with manufacturer's recommended adhesive, overlap joint. Paint all exposed surfaces (including top surface) with two coats "Armaflex" finish, vinyl lacquer protective coating or equivalent manufacturer's recommended coating. Cover entire top surface of insulation with 20 gauge aluminum sheet metal, install to shed rainwater; secure to duct with stainless steel straps.

S. Insulate tops of air diffusers occurring in spaces not conditioned nor part of return air space. Insulation shall be 2 inch thick 3/4 pound glass fiber with reinforced aluminum foil vapor barrier. Overlap diffuser 6 inches all around. Scribe to neck size and attach with aluminum tape.

T. Insulation materials shall meet the following minimum standards:

1. Fiberglass piping insulation: ASTM C 547, CLASS 1, 0.25 K-factor at 100 F mean temperature.

2. Flexible elastomeric cellular insulation: ASTM C 534, TYPE I (for Piping), ASTM C 534, TYPE II (for Sheets)

4. Cellular glass thermal insulation: ASTM C552

U. Insulating materials shall be as made by Dow, Knauf, Owens-Corning, Pittsburgh Corning, Johns Manville, Armstrong, Rubatex, or equal as listed by addendum, and shall be installed as per manufacturer's recommendations.

2.5 ELECTRIC HEAT TRACING

A. The self-regulating heating cable shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to entrance the heating cable's ruggedness, the heating cable shall have a braid of tinned-copper and an outer jacket of modified polyolefin, as required per Section 427-23 of the NEC - 1996.

B. In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 40 degrees F pipe temperature operation to 150 degrees F pipe temperature operation.

C. The heating cable shall operate on line voltages of 120 volts without the use of transformers.

D. The heating cable shall be sized according to the table below. The required heating cable output rating is in watts per foot at 50 degrees F. (Heating cable selection based on 1 inch fiberglass insulation on metal piping.)

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Minimum Ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; or less</td>
<td>5 watts</td>
</tr>
<tr>
<td>4&quot;</td>
<td>5 watts</td>
</tr>
<tr>
<td>6&quot; to 8&quot;</td>
<td>8 watts</td>
</tr>
</tbody>
</table>

E. The heating cable shall be Raychem Corporation XL-Trace, Thermon FLX, or equal as listed by addendum.

F. Power connection, end seal, splice and tee kit components shall be applied in the field.

G. Heating cable circuit shall be protected by a ground fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC - 1996.

H. The system shall be controlled by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate NEMA rated contactor; provide contactor.

I. Apply the heating cable linearly on the pipe after piping has been successfully pressure-tested. Secure the heating cable to piping with cable ties or fiberglass tape.

J. Apply "Electric Traced" signs to the outside of the thermal insulation.
K. After installation and before and after installing the thermal insulation, subject heating cable to testing using a 2500 Vdc Megger. Minimum insulation resistance shall be 20 to 1000 megohms, regardless of length.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately. Maintain and seal carefully and completely all vapor barriers.

3.2 FOUNDATIONS AND SUPPORTS

A. The Contractor shall, unless otherwise specified, provide all foundations, supports, etc., necessary for properly supporting his work and equipment furnished by him and shall furnish and install all isolation materials to prevent transmission of vibration to the building structure. Isolation of equipment as shown on Drawings is the minimum required and any additional isolation required to prevent transmission of vibration or sound shall be provided by the Contractor, in accordance with the equipment manufacturer's recommendations. All floor mounted equipment shall have a 4 inch high minimum housekeeping concrete pad.

B. Where applicable, under no circumstances is the Contractor to attach to or support from any structural systems without approval by the Architect. All supplemental angle or channel iron required to support equipment of this Specification is to be furnished by the Contractor and is to be independent of any other supports.

3.3 OPENINGS, CUTTING AND PATCHING

A. Cut all openings as required for the work under this subcontract. Patching will be done by the various crafts whose work is involved. Furnish and install all necessary sleeves, thimbles, hangers, inserts, etc., at such times and in such a manner as not to delay or interfere with the work of other contractors. Seal, caulk and otherwise make air tight all duct and pipe penetrations through walls and floors. Caulk, flash or otherwise make weatherproof all penetrations through the roof and exterior walls. No pipe opening shall be sealed around the pipe or insulation without the penetration isolated from the wall system.

B. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

C. For all openings larger than 16 inches horizontal dimension in existing masonry walls, provide 3 inch x 6 inch x 1/4 inch steel angle lintel with 8 inch minimum bearing length extending beyond each side of opening.

D. All openings shall be protected by a rated protection system listed for the specific application for the type of material penetrating the fire barrier and the type of construction of barrier penetrated. Sealants used in floor penetrations shall be waterproof.
E. Where piping, ductwork or other items that are provided for under this contract penetrate fire rated walls or floors, the Contractor is to seal around the item to maintain the integrity of the rated system. All openings shall be protected by a rated protection system listed for the type of material penetrating the fire barrier and the type of construction of barrier penetrated. Sealants used for floor penetrations must be waterproof. Systems must be U.L. rated for two hours minimum. Submit for system proposed for review. Provide documentation to the General Contractor and Architect for each type fire protection sealing system utilized in this project. The Fire Marshal Inspector may perform random destructive sampling of the sealant system installation; Contractor shall repair seal at sampling locations.

F. For openings containing non-metallic material, piping, conduit or wiring, and penetrating a floor-ceiling assembly, the system shall include intumescent material and shall be a listed "through penetration" assembly tested in accordance with ASTM E-814.

G. For precast concrete floor and wall systems, openings 8 inches round or 8 inches square and larger shall be by the precast concrete supplier. Openings smaller than 8 inches round or 8 inches square shall be by the Mechanical Contractor and shall be core drilled or saw cut in the field.

3.4 ACCESS PANELS

A. Access panels in ceilings and walls shall be steel doors with heavy duty concealed hinges of the pinless type and screw driver locks. Doors shall be prime coat finish.

B. Provide access panels in the ceilings and walls for duct dampers, terminal boxes, coils, valves, etc. These access panels are for installation by others, but the Contractor is responsible for their proper location.

C. Access panels in fire rated ceiling/walls shall be U.L. labeled to meet the requirements of the rated assembly and shall have a closer device to automatically close and latch the door upon release from any open position. Fire rated access panels shall have key operated locks with spare set of keys (turn over to Owner).

D. Where lay-in ceilings exist, no access panels are required.

3.5 EXCAVATING, TRENCHING AND BACKFILLING

A. Protect trench and handle materials in accordance with good safety practice. All pipes shall be installed with minimum 24 inch cover wherever possible and in no case less than 12 inch cover.

B. The bottom of the trenches shall be accurately graded. Bell holes and depressions for joints shall be dug after the trench bottom has been graded. Wherever unstable soil is encountered, such soil shall be removed and the trench backfilled to proper grade with coarse sand or fine gravel.

C. After all required tests and inspections have been performed, the trenches shall be carefully backfilled with materials approved for backfilling, deposited in 9 inch layers and thoroughly and carefully tamped. Repeat backfill as required after any subsequent settlement.
D. For insulated chilled water and heating hot water piping to be installed underground (including underslab), trench shall be excavated to allow 6 inch minimum clearance all around the final outside diameter of the piping insulation. Provide sand bedding and backfill material to an elevation at least 6 inches above the top of the insulated piping. Apply bedding in layers as specified above. The remainder of the trench shall be backfilled with suitable material approved for backfilling. Temporary piping supports (such as concrete or timber blocking) required for the installation of the pipe and insulation within the trench are to be removed during the backfill sequence.

E. Refer to Division 2 "SITE WORK" of this Specification for additional requirements for trenching, backfill, bedding, compaction, etc.

3.6 CLEANING AND STERILIZATION

A. When all work has been finally tested, clean all fixtures, pipes and exposed work. All pipes shall be free of all obstructions. Thoroughly clean and polish all plated and other finished products.

B. All new potable water piping systems shall be thoroughly sterilized with a solution containing 40 to 50 ppm of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hypochlorite solution. The sterilizing solution shall be allowed to remain in the system for a period of six hours or longer, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 ppm. All work shall meet requirements of applicable codes.

C. All new piping, vessels and heat exchangers in the project shall be thoroughly flushed of all debris and foreign objects with appropriate fluids before systems are placed in operation. After flushing, all strainers and dirt traps shall be checked and cleaned.

END OF SECTION 15010
SECTION 15020 - SHEET METAL WORK

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and erect in a neat, workmanlike manner all ducts and sheet metal work shown on Drawings. Verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Obtain approval of the Architect on all deviations from the contract Drawings and Specifications, as may be necessitated by job conditions otherwise. Unless noted otherwise, all SMACNA section, plate and table references are from SMACNA HVAC Duct Construction Standards, 2nd Edition, 1995, with 1997 Addendum No. 1. Conform to the requirements for metal thickness, reinforcing (types and intervals), tie rod applications (types and intervals), and joint construction (types and intervals).

PART 2 - PRODUCTS

2.1 MATERIALS, GAUGES AND CONSTRUCTION

A. Except as otherwise specified herein, or on Drawings, construct all sheet metal work of galvanized steel, lock-forming quality, ASTM A653/A653M, A924/A924M Coating Designation G90, as manufactured by U.S. Steel, Wheeling or Pittsburgh Steel.

2.2 SUBMITTALS

A. Provide detailed CAD shop drawings of all sheet metal work drawn to the same scale and sheet size as the Contract Drawings. Indicate on each floor plan the duct sizes, fittings, building walls and partitions, floor penetrations, fire dampers, access doors, sizes and bottom elevations of all ducts, pressure classifications, terminal sizes and types, air quantities, room names and numbers. In addition to these floor plan drawings, include the following:

1. Fabrication, assembly and installation details, including plans previously mentioned, sections, elevations, details of components and attachment to other work.
2. Reinforcing details and spacing.
3. Seam and joint construction details.
4. Penetration through fire-rated and other partitions.
5. Terminal unit, coil and humidifier installations.
6. Hangers and supports, including methods for building attachment, vibration isolation and duct attachment.

B. No sheet metal work shall be started without approved shop drawings.
C. Unless indicated otherwise, air velocity shall not exceed 2500 fpm.

2.3 PRIMARY SUPPLY AIR DUCTWORK

A. Primary supply air ductwork shall consist of all supply air ductwork from air units to VAV and Fan Powered Terminal boxes. Rectangular primary supply air ductwork shall be constructed in accordance with SMACNA HVAC Duct Construction Standards, 2nd Edition, 1995, for 6 Inch Water Gauge Pressure Class. Unless noted otherwise, rectangular ductwork shall be 24 gauge minimum construction; provide reinforcement in accordance with Section I. **Transverse (girth) joints Type T-1 through Type T-14 shall not be allowed** for rectangular primary supply ductwork; instead use Type T-17 through T-24, as applicable, or Ductmate 35/25 System (with 440 Butyl gasketing) installed as per manufacturer's requirements. Unless indicated otherwise on Drawings, rectangular primary supply duct longitudinal seams shall be "Pittsburgh Lock" type, sealed with mastic sealant.

B. Round and flat oval primary ductwork shall be constructed in accordance with Section 15021.

2.4 LOW PRESSURE DUCTWORK

A. All rectangular low pressure supply ductwork downstream from VAV boxes and Blower Powered Terminal boxes, and all return, outside air and exhaust ductwork unless otherwise indicated shall be constructed in accordance with SMACNA HVAC Duct Construction Standards for 2 Inch Water Gauge Pressure Class. Unless noted otherwise, rectangular ductwork shall be 26 gauge minimum construction; provide reinforcement in accordance with Section I.

2.5 FLEXIBLE DUCTWORK

A. Branch run-outs shall be rectangular ducts or round rigid metal ducts insulated as hereinbefore specified. Elbows of the duct system shall not utilize flexible ductwork; use rigid round as specified above. The final 4 feet of round ducts in primary supply air system shall be factory pre-insulated round flexible ducts. The final 5 feet may be flexible duct in low pressure supply air run outs. Connect flexible ducts to rigid ducts using a separate fire rated nylon duct strap on inner lining and on outer lining. Cover all edges and seams of insulation with aluminum foil backed duct tape. Round run-out size denotes inside diameter. Pre-insulated ducts shall be Class 0 or Class 1 duct material in accordance with U.L. 181 and shall be U.L. labeled. Ducts shall have airtight coated, woven glass fiber or aluminum reinforced plastic laminate inner liner with reinforced non- peel steel ribbing. Flexible ductwork with plastic only liner not acceptable. Pressure rating shall be equal to rating called for under "RECTANGULAR DUCTS." All jackets shall be fireproof glass fiber reinforced aluminum foil. Insulation shall be 2 inch thick fiberglass, R value of 6 minimum. Pressure drop shall not exceed 0.12 inches water gage per 100 foot run for a 12 inch diameter duct moving 500 CFM with a manufacturer's recommended positive operating pressure of 10 inches water gauge minimum. Systems connecting to primary supply ducts shall be Thermaflex M-KC, Flexmaster Type 4M, or equal as listed by addendum.

B. For systems connecting to low pressure ducts, use Thermaflex M-KE, Flexmaster Type 5M or 8M, Omniair 1200 with a manufacturer's recommended positive operating pressure of 6 inches water gauge minimum, or equal as listed by addendum.
C. Submit all flexible ductwork for approval.

2.6 ELBOWS AND OFFSETS

A. Provide turning vanes for elbows 30 degrees or greater in all rectangular ductwork in accordance with SMACNA Standard for single vanes. Transition panels shall not have offset angle exceeding 20 degrees unless specifically shown.

2.7 ACOUSTIC LINING

A. Where indicated on Drawings, acoustic lining in rectangular ductwork shall be glass fiber coated liner of 1 inch thickness unless otherwise noted on Drawings. Material shall meet NFPA 90A requirements and have K factor of 0.24 measured at 75°F mean temperature and have noise reduction coefficient (NRC) not less than 0.70 (per ASTM C423, Type A mounting). Duct sizes on Drawings are metal sizes, allowances having been made for lining. Lining shall be Johns-Manville Permacote Linacoustic, CertainTeed ToughGard R, or Knauf Duct Liner E-M, submit for approval.

B. The duct liner shall conform to the requirements of ASTM specification C 1071 and shall not support the growth of fungus or bacteria, as per ASTM G21 and G22. Duct liner shall be installed in accordance with the latest edition of North American Insulation Manufacturer Association's Fibrous Glass Duct Liner Standard (NAIMA FGDLS) or Sheet Metal and Air Conditioning Contractors National Association HVAC Duct Construction Standard, Metal & Flexible (SMACNA HVAC DCS). Liner shall be installed with the surface treatment exposed to the air stream. Adhesive shall be applied to the sheet metal with minimum coverage of 90%. All transverse edges not receiving sheet metal nosing shall be coated. Exposed joints shall be coated with an adhesive or secured with mechanical fasteners in accordance with NAIMA Standards. All joints shall be firmly butted without gaps. All rips and tears on the air stream surface shall be repaired by coating damaged areas with approved adhesive or coating, or shall be replaced. Longitudinal corner joints may be folded and/or overlapped and compressed. Mechanical fasteners shall be used to secure the duct liner to the sheet metal, and shall be spaced in accordance with NAIMA FGDLS or SMACNA HVAC DCS (but not less than one for each two square feet of lining). These may be either impact-driven or weld-secured and shall include 1-1/2 inch diameter sheet metal washers or speed nuts. Metal nosings (either channel or zee profile) shall be securely installed over transverse line edges facing the air stream at fan discharge and any interval of lined duct preceded by unlined duct.

C. Generally, all ductwork is insulated externally unless indicated otherwise. Where indicated on Drawings, rectangular return air ductwork shall be lined in accordance with the above requirements. For VAV air units, rectangular low pressure supply air ductwork downstream from VAV terminal boxes and all other VAV system supply air ductwork, provide externally applied insulation, see Section 15010, "INSULATION." For constant volume air units and fan coil units, only the first 20 feet of rectangular supply air ductwork (measured along the center line of the duct main) from the discharge of the air unit shall be lined in accordance with the above requirements; other rectangular supply ductwork not to be lined shall have externally applied insulation, see Section 15010, "INSULATION." Refer to Drawings for additional applications requiring acoustic lining.
2.8 HANGERS AND SUPPORTING SYSTEMS

A. Provide hangers and supports in accordance with SMACNA Standards as applicable except that straight up nails, expansion shields, etc., will not be allowed. Use auxiliary angles spanning beams where required to position duct hangers. See Drawings for additional hanger details.

2.9 DAMPERS

A. Submittals for dampers shall include a damper schedule indicating the following for each damper:

1. System/area served to identify each individual damper
2. Damper model
3. Damper nominal (duct) size
4. Damper sleeve length, as applicable
5. Required wall/floor opening size, as applicable
6. Size of duct access door(s), as applicable
7. Indicate damper sleeve gauge and duct connection type (if other than rigid type connection), as applicable.

B. Construct multi-blade opposed action volume dampers where called for on Drawings according to SMACNA Standards.

C. Provide fire dampers where shown on Drawings. Fire dampers shall have 1-1/2 hour or 3 hour label rating, as applicable, to meet the requirements for the fire rating of the wall/floor, and shall have 212°F fusible links, all in accordance with NFPA 90A and U.L. 555 (current edition). Dampers shall be per SMACNA Standards and, unless indicated otherwise, shall be galvanized steel construction. Except where indicated otherwise, fire dampers shall be dynamic type single section curtain (interlocking blade) style. Where overall damper size exceeds the listed maximum size for a single section curtain style dynamic damper, the fire damper shall be multi-blade style dynamic type. Multiple section (multi-blade) dynamic dampers shall be factory assembled/fabricated to operate as a single unit. Except where indicated otherwise, curtain style dampers shall have blades recessed “out of the air stream.” For non-ducted return air transfer openings and ducted (grille to grille) return air transfer openings, dampers may be static type, single or multiple section, and may have frame style “A” with clear opening (height) of size as indicated on the drawings.

D. Fire dampers and combination fire/smoke dampers shall have integral factory sleeves. Except where allowed otherwise by the Construction Documents, sleeves shall be 16 gauge minimum, except use 14 gauge where damper width exceeds 36 inches or height exceeds 24 inches, in accordance with U.L. listing and SMACNA “Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems” for rigid duct connections. Sleeve shall be length to match wall thickness, plus width of retaining angles, duct connections and damper actuator brackets/linkage (as applicable), refer to Drawings for additional information. Damper frame shall be sealed to the sleeve. For dampers installed in primary supply air ductwork, all joints/seams of the damper sleeve shall be sealed (at the factory).

E. Provide combination fire/smoke dampers where shown on Drawings. Dampers shall be Ruskin Model FSD Series, Nailor 1200 Series, Greenheck FSD, or equal as listed by addendum, Leakage Class II (or Class I) fire/smoke damper (350°F temperature rating),
each with 120 Volt electric motorized actuator, 70 IN-PD (minimum) torque (no "stall" type motor actuators), Belimo Model FSNF Series, Honeywell ML or H Series, Siemens GGD Series, Siebe MA Series, or equal as listed by addendum. Combination dampers shall include 212°F fusible link. Dampers and actuators shall conform to U.L. 555S (current edition). Dampers and actuators shall be provided by Sheet Metal Contractor. Connection of actuator will be under Division 16.

F. Multiblade type fire and combination fire/smoke dampers installed within supply air ductwork shall be Class I (in lieu of Class II) air foil type if damper is positioned within 10 linear feet of the discharge of the air unit.

G. Provide U.L. 555S, Leakage Class I, air foil smoke dampers (350°F temperature rating) at all air units moving 15,000 CFM or more in accordance with NFPA 90A; actuator shall be same as specified for combination fire/smoke dampers.

H. Ceiling radiation dampers shall be U.L. 555S, Leakage Class I, classified dampers with 212°F fusible link, insulated blades, Greenheck CRD Series, Nailor Industries Series 0700, Ruskin CFD Series, or approved equal as listed by addendum. Ceiling radiation dampers shall be rated for both steel duct and flexible duct installations (include extended sheet metal sleeve for applications with flexible ductwork connecting to top side of dampers). For applications with "lay-in" style ceiling diffusers/grilles, the damper assembly shall include all required accessories (such as "back pan" thermal blanket) and the diffuser/grille shall be style/summary to meet the requirements for the listed assembly.

2.10 DUCT PRESSURE RELIEF DOOR

A. Where indicated on Drawings, provide pressure relief door in supply duct/plenum and/or return duct/plenum. Relief door shall be Ruskin PRD18, Kees BO or BI, or equal as listed by addendum, 18 inch x 18 inch galvanized steel door and frame with polyurethane foam door gasketing, adjustable spring latch and negator spring closure. For the positive differential pressure, set damper to relieve outward at 4 inch W.C. positive pressure. For the negative differential pressure, set damper to relieve inward at 2 inch negative pressure. Field applied rigid insulation shall be applied to external surfaces to prevent "sweating", but shall not interfere with proper operation of the door. Refer to "INSULATION."

2.11 FLEXIBLE CONNECTIONS

A. Wherever ducts are to be fastened to the intake or discharge of an air moving device (including fan powered terminal devices), provide a flexible connection between duct and fan. Flexible connections shall be waterproof and fireproof fabric, at least 4 inches long, and securely fastened with galvanized band iron hoops and mastic.

2.12 STATIONARY LOUVERS

A. Louvers shall be Arrow EA-405-P, Greenheck Model EDK-402, Ruskin ELF375X, American Warming LE-27, Air Balance A440 or equal as listed by addendum factory fabricated extruded aluminum, 0.081 in. (minimum) nominal wall thickness. Louvers shall be stationary type with K style blades in a 4 in. louver frame. The frame head member shall incorporate an integral gutter with each jamb having an integral downspout so water
drains to the ends of the head, then down the downspouts and out at the louver sill. Blades shall be positioned at 37° to 45° angle from vertical, approximately on 4 inch centers. Each louver shall be equipped with a framed, removable, rear-mounted aluminum bird screen, 0.5 to 0.75 inch mesh.

B. Each factory-assembled louver section shall be designed to withstand wind loadings of 25 PSF (100.0 MPH wind equivalent). Louver performance data (include airflow pressure loss and water penetration) shall be licensed under the AMCA Certified Ratings Program and shall bear the AMCA Certified Ratings Seal.

C. Louvers shall be supplied with a 50% (minimum concentration) Kynar finish applied on all surfaces following a thorough cleaning and pretreatment of the metal surface. Dry film thickness of the Kynar shall be approximately 1.2 mils after baking at 450°F. Color shall be as directed by Architect to match the color of the building exterior.

D. Frame construction of louver is to be compatible with wall construction. Unless indicated otherwise, louvers shall be flange type when installed in existing masonry walls, stucco walls or other similar walls with rough cut wall opening. Where louver is not installed flush with the exterior wall surface, provide extended sill. Verify frame type required for each louver prior to ordering louvers. Seal around perimeter of louver frame to building wall to make weathertight. Refer to Division 7.

2.13 SAFE PANS

A. Provide safe pans under air units and water heaters located above first floor level. Safe pans shall be constructed of 16 gauge galvanized steel, with all joints lapped, riveted and soldered. Pans shall be a minimum of 4 inches deep and shall extend a minimum of 6 inches beyond all sides of the unit. Coat inside of pan with two coats non-asbestos asphaltic coating. Coordinate safe pan location with base supports.

2.14 ACCESS DOORS

A. Provide access doors for service access to duct mounted cooling/heating coils, fans, filters and other locations where necessary for periodic service or inspection of mechanical equipment. Provide access doors for access to duct mounted fire and/or smoke dampers, and automatic (motorized) control dampers. Access doors for duct mounted cooling/heating coils shall be installed on air entering side of coils. Access doors shall be adequate size for easy access to the equipment/damper/coil.

B. Access doors shall be constructed according to SMACNA Standards for 2" (minimum) W.G. Access doors shall be removable type with paired cam locks, two cams for doors up to 14" x 14" size and four cam locks for doors 16" x 16" to 24" x 24" size. Doors shall have foam gasketing at both the door to frame and the frame to duct matting surfaces. Access doors may be sandwich type, Ductmate Sandwich Access Door or equal. Access doors in supply and return air ductwork shall be double wall type with fiberglass insulation sandwiched between the walls of the access panel.

C. Access doors in primary supply ductwork shall be constructed and installed to meet the duct pressure class referred to in Section 15021.

D. Refer to Section 15010 "ACCESS PANELS" for access panels in ceilings and walls.
2.15 FLASHING

A. Wherever sheet metal work under this contract passes through exposed walls or roof, furnish and install flashings and counter-flashings necessary for weatherproofing.

B. Make flashings and counter-flashings of sheet copper, securely soldered and fitted, except that cap flashings for ducts, hoods, etc., shall be same material as duct and isolated from dissimilar metal base flashing with roofing felt. Turn flashings out at least 10 inches.

2.16 CAULKING

A. All ductwork shall be air-tight. Unless indicated otherwise, all seams, both shop made and field installed, shall be sealed or caulked with an approved sealer. Special care shall be taken to seal corners of transverse joints and grilles or diffuser tap connection to ducts. Except for round and flat oval ductwork, seal all duct joints with woven fiber tape impregnated with a wet applied, hard setting, mineral gypsum compound in conjunction with an adhesive, Hardcast DT Tape and FTA 20 Adhesive, United McGill Unicast, or approved equal; apply per manufacturer's instructions. Refer to Section 15021 for sealing of round and flat oval ductwork.

2.17 CEILING DIFFUSERS

A. Ceiling diffusers shall be aluminum constructed (except where required otherwise for fire rated ceiling applications, see "DAMPERS"), fixed, louvered type with integral deflectors and with patterns as required. Blade configuration shall include horizontal lip or similar device for ceiling hugging pattern at varying velocities. Diffusers shall have a white, baked enamel finish and shall have opposed blade volume controls, except as described under "AIR EXTRACTORS." Frame style generally shall be "V" type, raised from ceiling face. For lay-in ceilings, use matching frames, panel size 24 inch x 24 inch unless otherwise required. For spline or other special ceiling systems, use appropriate matching frame types. Diffusers shall be Metalaire 5500 Series with Style 25 or Style 65 frames, Nailor 6200 Series with Type B or L frame, Krueger 5SH Series with F21 or F23 frame, Titus TDC-AA with Type 3 or Type 6 border, Price AMD with Type 1 or Type 3 frame, or equal as listed by addendum.

B. Diffusers for round duct neck sizes may be Metalaire Series 5800, Nailor Series ARNS, Titus TMS-AA Series, Krueger 1400 Series or Price ASCD Series, aluminum construction, with 24 inch x 24 inch nominal panel face for "lay-in" tee-bar grid ceilings. For gypsum board or plaster ceilings, provide diffuser manufacturer's matching "T-bar plaster frame" to receive the lay-in style diffuser in the ceiling mounted frame.

C. Where required for fire rated lay-in grid ceiling applications, diffusers shall be steel construction, U.L. Classified fire rated ceiling diffuser assemblies with fusible link damper and thermal protection blanket, see "DAMPERS."

2.18 LINEAR SLOT DIFFUSERS

A. Unless indicated otherwise on Drawings, linear diffusers shall be Metalaire 6600 Series, Nailor 5000 Series, Titus ML Series, Price SDS Series, Krueger 1900 Series, or approved equal, with adjustable throw pattern and white finish aluminum frame. For lay-
in ceilings, frame style shall be similar to Metalaire 12-TB, or equivalent. For surface mounted applications, frame style shall be similar to Metalaire 12-SM, or equivalent. Provide factory fabricated galvanized steel plenums with branch duct inlet collar and plenum, with size and edge condition to match diffuser; plenum shall be insulated in field with externally applied insulation, see "INSULATION" within this Specification. Where diffuser is located adjacent to recessed mounted light fixture, provide extended height plenum to allow branch duct runout duct connection to clear top of light fixture.

2.19 SIDEWALL SUPPLY GRILLES

A. Sidewall supply grilles shall be fully extruded aluminum constructed (except where required otherwise for fire rated walls, see "DAMPERS"), including frame, border, damper and blades, Metalaire 4004 Series, Nailor 51DV Series, Titus 272FS Series, Krueger 5880 Series, Price 22 Series, or equal as listed by addendum, double deflection grilles. Changing the horizontal and vertical deflection shall be feasible from the face of the grille. Grilles shall be prime coated, suitable for painting and shall have opposed blade volume controls, except as described under "AIR EXTRACTORS."

2.20 RETURN AND EXHAUST GRILLES

A. Wall grilles shall be 30 to 45 degree louvers, extruded aluminum constructed (except where required otherwise for fire rated walls, see "DAMPERS"), including frame, border and blades, with blade spacing 1/2 inch on centers with 1-1/4 inch frames, Titus 4FL, Metalaire H4002R45, Nailor 5155H, Krueger S585H, Price 635, or equal as listed by addendum. Ceiling grilles shall be 1/2 inch x 1/2 inch x 1/2 inch aluminum (except where required otherwise for fire rated ceiling applications, see "DAMPERS"), grid type, Titus 50F Series, Metalaire CC5 Series, Nailor 51EC Series, Krueger ECG-5 Series, Price 80 Series, or equal as listed by addendum. Frames shall be appropriate to type of ceilings in the projects. Finish on ceiling grilles shall be white baked enamel. Finish on wall grilles shall be prime coat suitable for painting.

B. Refer to drawings for additional requirements.

2.21 SECURITY GRILLES AND REGISTERS (MAXIMUM SECURITY)

A. Supply, exhaust and return security grilles and registers (maximum security) shall be of all steel construction. Face plate shall be 3/16" thick with 5/16" diameter holes on 7/16" staggered centers. Sleeve shall be 3/16" steel with welded seams, length to be coordinated with wall thicknesses. Provide damper (face operated). Finish to be white, Titus SG-PS, Metalaire SGRP Series or equal as listed by addenda.

2.22 SECURITY GRILLES AND REGISTERS (MINIMUM SECURITY)

A. Wall mounted supply, exhaust and return security grilles and registers (minimum security) shall be of steel construction with heavy gauge steel louvers (38° deflection). Ceiling supply grilles shall have 0° deflection. Both wall and ceiling grilles to have face operated dampers. Finish to be white, Titus SG-3300 Series, Metalaire SG 2000 Series or equal as listed by addenda.
2.23 CEILING DIFFUSERS (MINIMUM SECURITY)
   A. Minimum security diffusers shall be of steel construction and have a louvered core with a
      lattice face. Provide optional rear angle frame. Finish to be white, Titus SG-TDC Series,
      Metalaire SG 5500 Series or equal as listed by addenda.

2.24 SECURITY BARRIER GRILLE
   A. Provide barrier grille with sleeve constructed with 3/4" diameter steel bars on 6"
      (maximum centers) and 2" x 1/4" steel flat bars on 8" (maximum centers) welded at each
      cross point. Units to be Titus SG-BG-SLV Series, Metalaire SG Series or equal as listed
      by addenda.

2.25 SOFFIT GRILLES
   A. Soffit grilles shall be same as specified for wall return air grilles, except shall include 1/4
      inch mesh aluminum screen installed (concealed) behind grille. Grille shall be painted to
      match soffit.

2.26 AIR EXTRACTORS
   A. Furnish and install in each rectangular duct take-off to ceiling diffusers and sidewall
      grilles, except the final outlet of each run, an adjustable air volume extractor and
      controller consisting of moving vanes on brackets. Vanes shall be capable of full closure.
      Controllers shall have operators accessible from grille or diffuser opening or from outside
      of duct. The final outlet shall have opposed blade dampers.
   B. At low pressure round duct branch take-offs, provide Flexmaster Model FLD-B03, Dace
      Model SM7 Spinin with SOLQ-CR, or equal as listed by addendum, spin collar "take-off"
      fitting, 26 gauge (minimum) galvanized steel construction with square rod axle, axle
      bushings (sleeves) and 2 inch high elevated lever (hand quadrant) regulator for
      externally insulated ductwork.
   C. Air extractors shall also occur at rectangular tee branch connections as shown in Figure
      2-16. Where tees are indicated as main double direction tees, see below.
   D. Submit all air extractors for approval.

2.27 ROOFTOP AIR INTAKES
   A. Cook VI, Greenheck FHI, Acme IV, or equal as listed by addendum, aluminum low
      silhouette gravity ventilator with aluminum birdscreen, anti-condensate coating at
      underside of top cover, and aluminum 12 inch (minimum) height factory roof curb.

2.28 ROOFTOP AIR RELIEF
   A. Same as rooftop intake, except Cook VR, Greenheck FHR, Acme FV, or equal as listed
      by addenda.
2.29 VARIABLE AIR VOLUME BOXES (DDC)

A. Variable air volume boxes shall be system pressure independent variable volume units. Boxes shall be for single duct service with or without terminal heat as indicated on Drawings. Boxes shall be designed for low or medium pressure. Boxes shall be complete with variable volume control with control points adjustable in field. Boxes shall include built-in attenuation to meet sound levels scheduled. Dampers shall have linear performance characteristics with throttling capability in all positions. Boxes shall be minimum 24 gauge hot dipped galvanized steel with 14 gauge dampers. Construct air dampers such that when subjected to 6.0 in. W.C. inlet pressure with damper closed, total leakage does not exceed 10% of specified air flow capacity. Insulation shall be 3/4 to 1 inch thick complying with U.L. 181, NFPA 255 (25/50) and NFPA 90A. Boxes shall be double wall construction with solid galvanized steel inner liner panel enclosing the insulation to prevent air flow erosion of the insulation. In lieu of double wall, insulation may be fiber-free polymer (closed cell elastomeric) foam. Control for single duct boxes shall be as specified in Section 15060. Include fully enclosed metal cover over controller and operator. Install thread locking compound on actuator shaft set screw to prevent set screw from loosening due to vibration. Damper actuators and VAV box controllers will be supplied to the box manufacturer by the Temperature Controls System Contractor (see Section 15060). Boxes shall include factory installed fused 40 VA, 120 VAC primary 24 VAC secondary transformer and primary disconnect switch for digital controls. The VAV box manufacturer shall factory mount and test the motor and controls. Boxes shall be Titus Model ESV Series, Krueger LMHS Series, Metalaire Series 500-TH, Nailor 3000 Series, Price SPV Series, Enviro-Tec SDR, or equal boxes as listed by addendum.

B. Where terminal hot water heating coils are shown, coils shall be two-row minimum and constructed of copper tubes and aluminum fins with galvanized steel casing. Coils shall be cabinet mounted or otherwise completely insulated on all sides. Control valves shall be furnished by the Temperature Controls Contractor, refer to Section 15060.

C. Provide label on each box indicating drawing identification number, CFM range, CFM factory setting and calibration curve.

PART 3 - EXECUTION

3.1 OBSTRUCTIONS

A. Make allowances for beams, pipes or other obstructions in the construction of the building and for work of other contractors whether or not these are shown on Drawings.

B. Coordinate duct layout and VAV terminal box placement with ceiling construction, light fixtures and other ceiling mounted devices for placement of equipment for ease of servicing.
C. Transform, divide or offset ducts as required, in such a manner as to maintain the same cross-sectional area of duct as indicated on Drawings. Where it is necessary to take pipes or similar obstructions into ducts, the ducts need not be enlarged if the decrease in area does not exceed 10% and such decrease is approved in writing by the Architect. If the decrease in area would exceed 10%, enlarge the duct to maintain duct area not less than 90% of that indicated on Drawings. In either case, provide a streamlined easement or collar of approved design. Contractor shall not fabricate ductwork before routing at obstructions is resolved. See "COORDINATION OF TRADES."

END OF SECTION 15020
SECTION 15021 - ROUND AND FLAT OVAL DUCT AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

A. Where shown on Drawings, provide factory fabricated round and flat oval ductwork and fittings as per this Specification.

1.2 DEFINITIONS

A. Basic Round Diameter: The diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct.

B. Critical Path or Design Leg: The duct circuit that requires maximum pressure (design pressure) to deliver the design CFM.

C. Downstream: The direction to which air is flowing.

D. Excess Pressure: The additional pressure, above what is needed, to operate a path from the fan to a terminal. Excess pressure will cause additional airflow to the path if it is not dampered.

E. Exhaust/Return Air Duct or System: An air handling system or a portion of a system that operates under negative pressure relative to atmosphere.

F. Flat Span: The flat oval duct dimension determined by subtracting the minor (smaller) axis from the major (larger) axis.

G. Gored Elbow: A segmented elbow of any bend angle where each segment (gore) is joined at an angle less than 45˚. See "Mitered Elbow."

H. Loss Coefficient: A measure of fitting performance defined as the total pressure loss of a flow path of a fitting divided by a reference velocity pressure.

I. Mitered Elbow: A two-piece 90˚ (bend angle) elbow with segments joined at a 45˚ angle relative to either end. See "Gored Elbow."

J. Pressure/Velocity Classifications: A means of designating duct systems as high, medium, and low pressure or velocity.

K. Supply Duct or System: An air handling system or a portion of a system that operates under positive pressure relative to atmosphere.

L. Upstream: The direction from which air is flowing.
1.3 REFERENCES

A. The following references are referred to in the Specification below by the appropriate number:


5. Round Industrial Duct Construction Standards, 1977, SMACNA.

1.4 QUALIFICATIONS

A. All duct and fittings shall be manufactured by a company for whom the manufacture of spiral duct and welded fittings has been a principal business for at least 10 years.

B. All duct and fittings covered by this Specification shall be manufactured by a single company.

1.5 MARKING AND STORAGE

A. Mark each section of ductwork to be delivered to the project with a unique section number, as indicated on the shop drawings. Store ductwork under roof. Ductwork stored outdoors and exposed to the weather shall be removed from the project site, cleaned or replaced with new.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified, all duct and fittings shall be a minimum G-60 galvanized sheet metal in accordance with ASTM A653, A653M, A924 and A924M Specifications.

B. All duct materials, sealants and adhesives directly exposed to airflow shall be noncombustible and conform to requirements of NFPA 90A.

C. Supply Duct:

1. Except where indicated otherwise, all primary supply duct shall be of round spiral lockseam construction except where space limitations prevent the use of round duct. In addition, low pressure round supply duct may be round spiral lockseam construction. Steel round duct shall be of standard spiral construction (without intermediate ribs) and shall be provided according to Table A.
TABLE A - ROUND SUPPLY DUCT CONSTRUCTION

<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>Standard Spiral Gauge (Supply Duct)</th>
<th>0-2 inches wg</th>
<th>2-10 inches wg</th>
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<tr>
<td>3-8</td>
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<td>52-60</td>
<td>20</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>62-84</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

D. Standard spiral gauges shown in Table A are in accordance with Reference 3 for round steel supply duct. The use of round spiral duct for the pressures listed in Table A shall be limited to systems whose maximum operating pressure never exceeds 2 inch wg for low pressure systems and 10 inch wg for high pressure systems. For purposes of gauge selection, duct and fittings downstream of VAV boxes may be considered a separate system, refer to Section 15020.

E. Where space limitations prevent the use of round duct, supply duct shall be of flat oval, standard spiral (without intermediate ribs) or longitudinal seam construction, according to the gauges given in Table B.

TABLE B - FLAT OVAL SUPPLY DUCT CONSTRUCTION

<table>
<thead>
<tr>
<th>Major Axis Dimension (inches)</th>
<th>Standard Spiral Gauge (supply duct)</th>
<th>Longitudinal Seam Gauge (supply duct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>to 24</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>24-36</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>37-48</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>49-60</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>61-70</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>71 and greater</td>
<td>18</td>
<td>16</td>
</tr>
</tbody>
</table>

F. Gauges shown in Table B are in accordance with Reference 3 for flat oval supply duct. Flat oval duct shall be reinforced based on its flat span dimension and maximum operating pressure. Reinforcement requirements shall be in accordance with Reference 3, Pages 1-16 through 1-23.

G. Exhaust Duct and Return Air Duct:

1. Except where indicated otherwise on Drawings, all duct subject to negative pressure shall be of round spiral lockseam construction, within the range of available spiral sizes, for the required gauge where space limitations prevent use of round duct, exhaust and return air duct shall be flat oval construction. Duct gauge and reinforcement requirements shall depend on diameter, maximum operating pressure, and the air being conveyed. Applicable gauge and reinforcement requirements shall be in accordance with References 1 through 4 for negative 2 inch WG pressure. Submit data confirming gauge and reinforcement required for flat oval construction at the design negative pressure and flat span dimension of the ductwork to be provided.
H. Duct Lengths:

1. Round and flat oval duct shall be provided in continuous, unjoined lengths whenever possible. Except when interrupted by fittings, round spiral duct sections shall not be less than 12 feet long. Flat oval duct not interrupted by fittings shall not be less than 12 feet long except when manufacturing limits the length to 6 feet maximum.

I. Double Wall Ducts:

1. Double-wall (insulated) duct shall be provided where specified on Drawings or Contract Documents. Unless otherwise indicated, all insulated duct diameters shown on Drawings are nominal inner liner dimensions.

2. The first 15 linear feet of flat oval supply air ductwork from the discharge of VAV air units shall be double wall ductwork; where double wall ductwork shown on Drawings exceeds 15 feet minimum length, provide length as shown. The 15 linear feet criteria shall be measured along the center line of the ductwork and shall include any section of branch ductwork within the 15 linear feet cumulative measurement.

3. Insulated duct shall be constructed of a perforated inner liner, a 1 inch layer of fiberglass insulation, and an outer pressure shell. For 1 insulation, the outer pressure shell must be 2 inches larger than the (nominal) inner liner dimension. Outer shell gauge shall always be based on actual outer shell dimensions.

4. Round and flat oval liners shall be constructed according to Table C. For flat oval products, the diameter shown in this table is the basic round diameter.

**TABLE C - INSULATED SUPPLY DUCT CONSTRUCTION**

<table>
<thead>
<tr>
<th>Inner Liner Diameter (inches)</th>
<th>Gauge</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 8</td>
<td>8</td>
<td>Standard Spiral</td>
</tr>
<tr>
<td>9 - 42</td>
<td>8</td>
<td>Single-Rib Spiral</td>
</tr>
<tr>
<td>44 - 60</td>
<td>26</td>
<td>Single-Rib Spiral</td>
</tr>
<tr>
<td>62 - 84</td>
<td>22</td>
<td>Standard Spiral</td>
</tr>
</tbody>
</table>

5. When perforated liner is indicated, the acoustical performance shall equal or exceed that shown in Reference 1.2.17. Perforations in the liner walls shall be 3/32 inch in diameter with an overall open area of 23%.

6. All insulated duct shall have a maximum thermal conductivity (k) of 0.27 Btu/hr/sq ft/°F/inch thickness at 75°F mean temperature.

7. Insulation ends shall be provided at all locations where internally insulated duct connects to single-wall duct or to any non-insulated component. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.
J. Fittings

1. Except where indicated otherwise on Drawings, primary supply system and exhaust/return air system fittings shall be round or flat oval as determined by the duct configuration. Exhaust and return air system fittings shall have a wall thickness two gauge number (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected, in accordance with that for (straight) exhaust and return air duct. Round steel supply fittings that are not elbows shall have a wall thickness in accordance with Table D.

**TABLE D - SUPPLY AIR (NOT ELLS) FITTING CONSTRUCTION**

<table>
<thead>
<tr>
<th>Fitting Body Diameter (inches)</th>
<th>Minimum Round Supply Fitting Gauge 0-2 inches wg</th>
<th>Minimum Round Supply Fitting Gauge 2-10 inches wg</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-14</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>15-26</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>27-36</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>37-50</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>52-60</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>62-84</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

2. Gauges shown in Table D are in accordance with Reference 3, Pages 3-2, 3-3 for round steel supply duct. The use of round fittings for the pressures listed in Table D shall be limited to systems where maximum operating pressure never exceeds 2 inch wg for low pressure systems and 10 inch wg for high pressure systems. For purposes of gauge selection, round supply duct and fittings downstream of VAV terminal boxes shall be considered as low pressure system and may be as specified in this Section.

3. Flat oval supply fittings shall be constructed in the same gauges as longitudinal seam flat oval duct, in accordance with Reference 3 (see also Table B). Unless otherwise specified, joints shall be solid welded. All welded joints on galvanized fittings shall be coated with a protective paint, inside and out, to prevent damage to the galvanized surface.

4. Elbows shall be of die-stamped, gored, pleated, or mitered construction. The bend radius of stamped, gored, and pleated elbows shall be 1.5 times the elbow diameter. Unless elbow construction type is specified on Drawings or Contract Documents, the following requirements will apply. All round 90˚ elbows, all round 30˚, 45˚ and 60˚ elbows, and all flat oval elbows shall be of gored construction except where space restrictions require a mitered elbow. Round elbows in diameters of 10 inches or less may be of die-stamped 20 gauge construction (45˚ and 90˚ only) or pleated 26 gauge construction (30˚, 45˚, 60˚ and 90˚ only) except where space restrictions require a mitered elbow. Mitered elbows shall be used only where space restrictions do not permit the use of 1.5 bend radius elbows. Mitered elbows shall always be supplied with single-thickness turning vanes. Flat oval mitered elbows shall be solid welded.

5. Diverging-flow (supply)/converging-flow (exhaust and return air) fittings shall be constructed with a radiused entrance to all branch taps and with no excess material projecting from the body into the branch tap entrance. **All takeoff or**
**branch entrances shall be by means of factory-fabricated fittings.** Factory-fabricated duct/saddle tap assemblies with a 2 inch minimum width duct connection flange (at tap connection to duct) may be used for single wall branch and take off fittings. Unless required otherwise due to space restrictions, take off and branch entrances shall be 45° entry, conical tee or low loss tee. Straight tee entrances may be used for return air systems at grille connections.

6. Double-wall (insulated) fittings shall be provided where specified on Drawings or Contract Documents. Insulated fittings shall be constructed of a perforated inner liner, a 1-inch layer of fiberglass insulation, and an outer pressure shell. For 1-inch insulation, the outer pressure shell will be 2 inches larger than the (nominal) inner liner dimension. For supply ducts, outer shell gauge and construction shall always be based on actual outer shell dimensions. For exhaust and return air ducts, outer shell shall be two gauge numbers (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which connected, in accordance with that for exhaust and return air ducts.

7. **All take off or branch fittings in double wall duct shall be by means of factory-fabricated fittings.**

8. Round and flat oval liners shall be constructed according to Table E. For flat oval products, the diameter shown in this table is the basic round diameter.

**TABLE E - ROUND AND FLAT OVAL INNER LINER CONSTRUCTION**

<table>
<thead>
<tr>
<th>Inner Liner Diameter (inches)</th>
<th>Gauge Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-34</td>
<td>24</td>
</tr>
<tr>
<td>35-58</td>
<td>22</td>
</tr>
<tr>
<td>60-88</td>
<td>20</td>
</tr>
</tbody>
</table>

9. All insulated fittings shall have a maximum thermal conductivity (k) of 0.27 Btu/hr/sq ft/°F/inch thickness at 75°F mean temperature.

10. When perforated liner is indicated, perforations in the liner walls shall be 3/32 inch in diameter with an overall open area of 23%. Submit performance data.

### 2.2 ACCESS DOORS

**A.** Access doors shall be provided immediately downstream of all fire and/or smoke dampers and elsewhere as indicated on Drawings. Doors shall be constructed and installed in accordance with SMACNA Standards to suit the pressure classification and the location/duct configuration to be installed.

**B.** All access doors used for resetting dampers, cleaning filters, or performing general maintenance inside duct systems shall be standard bolted construction.

**C.** In supply duct systems, a relief-type access door shall be provided immediately downstream of all smoke and fire dampers (or other dampers subject to sudden closure) when there is no branch takeoff near that location or when the branch takeoff is not sufficient to relieve the negative pressure if a damper closes suddenly. Relief-type doors
shall be fastened by spring clips that release if sudden negative pressure occurs, for example when a damper closes suddenly. The door shall be provided with a pressure-seal gasket and shall open against the positive pressure. A safety chain shall be attached to the door so that it will not travel downstream if activated by negative pressure. Ductwork with 1 inch, 2 inch, or 3 inch thick insulation shall use insulated frame and steel insulated doors.

2.3 VOLUME DAMPERS

A. All manual volume dampers shall be as applicable to match the type duct system and shall be constructed to slip-fit into or between adjoining duct sections. Flat oval volume dampers shall be constructed with steel blades, stiffened as required, and bronze or stainless steel bearing sleeves pressed into the frame for single wall ducts or the outer shell for double wall ducts to support the damper axles. The axle shall extend 6 inches from the frame body. For flat oval ducts, a center mullion shall be provided for dampers with nominal major axes exceeding 36 inches. Unless indicated otherwise, provide manual lever operator, locking quadrant with wing nut, for each damper.

B. Unless otherwise specified, all fittings shall be constructed in accordance with Reference 1 - 4.

2.4 JOINT CONSTRUCTION

A. On exhaust and return air duct systems, the requirement for flanged joints or slip coupling joints depends upon the diameter/configuration and maximum operating pressure. All round supply system sections and round exhaust/return air system sections which do not require flanged connections in diameters of less than 36 inches shall be provided with slip couplings.

1. All fitting ends shall be sized to slip inside mating duct sections. They shall provide a tight fit and have a minimum 2 inch insertion length with a stop bead. No additional coupling shall be required for duct-to-fitting joints.

2. Duct-to-duct joints shall be by means of a slip coupling that fits inside both mating duct sections (fitting size). Couplings shall provide a tight fit and have a minimum 2 inch insertion length with a stop bead.

3. Fitting-to-fitting joints shall be by means of a slip coupling that slips over both mating fitting ends (duct size). Couplings shall provide a tight fit and have a minimum 2 inch overlap length.

B. All round duct system sections with diameters greater than 36 inches shall be provided with flanged joints. (Note, exhaust/return air duct systems may require flanged joints at diameter less than 36 inches, depending on maximum operating pressure.)

1. Welded flanges shall be solid welded or tack welded and bonded with a U.L. classified cement. The finished flange assembly must be able to withstand maximum design pressure with no leakage.

2. Welded and bolted flanges on spiral duct shall include a fully welded sleeve that fits inside the end of the duct and provides a flange that will retain the angle ring on the duct. On fittings, the retaining flange may be a turn-out of the fitting body.
3. Roll formed flanges on duct and fittings shall be tack welded and include an integral mastic sealant.

C. All system sections with double-wall (insulated) duct shall be provided with both an inner liner coupling and an outer pressure shell coupling.

1. Outer shell connections shall be made with slip couplings if the outer shell diameter is less than 36 inches for round duct and if the outer shell major axis is less than 42 inches for flat oval. Outer shell connections shall be made with flanged joints if the outer shell diameter is 36 inches or greater for round duct and if the outer shell major axis 42 inches or greater for flat oval duct. Note, exhaust/return air duct systems may require flanged joints at diameters less than 36 inches, depending on maximum operating pressure.

2. When an outer shell connection is by slip coupling, a separate slip coupling shall be used to connect the inner liner at duct-to-duct joints.

3. When reinforcement is required, all sections shall be provided with flanged joints or slip channel couplings. Flanged connections shall be sized so that they will also satisfy the requirement for reinforcement at the flange connections. Slip-channel couplings shall be a combined slip joint, trapeze hanger with channel reinforcement. When properly selected for duct size and operating pressure, these couplings are acceptable for all joint applications.

4. When an outer shell connection is by flanged joint, a separate slip coupling shall be used to connect the inner liner sections at duct-to-duct joints.

5. All fitting liners shall extend 1 inch beyond the outer shell cut-off if the inner liner diameter is 7 inches or less, and 2 inches beyond the outer shell cut-off if the inner liner diameter is greater than 7 inches, to provide an inner liner coupling at duct-to-fitting joints.

6. To allow expansion of the inner liner due to changes in temperature, inner liner couplings in duct and fittings shall not be mechanically fixed or sealed.

D. All flat oval system sections shall be provided with connectors of a type determined by the need for reinforcement. Ductwork shall be reinforced as per SMACNA Standards (see "REFERENCES" No. 3) for 6 inch water gauge pressure class. Where reinforcement is not factory supplied with the flat oval ductwork, the Contractor shall provide to meet this pressure class.

1. When no reinforcement is required, all flat oval sections with a major axis dimension less than 42 inches may be joined with slip couplings, slip-channel couplings, or roll formed flanges.

2. When no reinforcement is required, all flat oval sections with a major axis dimension equal to or greater than 42 inches shall be provided with flanged joints or slip channel couplings.

3. When reinforcement is required, all flat oval sections shall be joined with flanged connections or slip-channel couplings. Flanged connections shall be sized such that they will also satisfy the requirement for reinforcement at the joint location. Slip-channel couplings shall be a combined slip joint, trapeze hanger with channel reinforcement. When properly selected for duct size and operating pressure, these couplings are acceptable for all flat oval duct joining applications.
PART 3 - EXECUTION

3.1 GENERAL

A. All round and flat oval duct and fittings shall be installed in accordance with Reference 4 and manufacturer's requirements.

B. Transverse joints and longitudinal seams shall be sealed with a duct sealant of the type specified hereinafter. Spiral lockseams are not longitudinal seams and do not require duct sealant.

C. Assembly joints to be installed indoors shall be sealed with a water-based duct sealant that is formulated to withstand temperatures from -20 to +150°F. Sealant shall be formulated such that surface preparation is not necessary. Sealant shall be U.L. Classification. Sealant shall be United McGill Uni-Grip, Hardcast Iron Grip or approved equal.

D. Flanged joints in indoor applications shall be sealed with a duct sealant that has a synthetic elastomer base and is formulated to withstand temperatures from -20 to +150°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a U.L. Classification marking with a flame spread of 5 and smoke developed of 5 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 80 square feet per gallon. Sealant shall exceed 500 hours without becoming brittle under ASTM D572 test conditions (oxygen bomb).

E. Where duct liner adhesive is used to secure insulation to metal surfaces, it shall have a U.L. Classification marking with a flame spread of 0 and smoke developed of 0 when applied to 18-gauge galvanized steel.

F. Duct hangers shall be provided in accordance with References 3 and 4.

3.2 DUCT SYSTEM PERFORMANCE

A. Duct system shall be constructed and installed to maintain minimum friction loss throughout. The fewest possible number of duct joints shall be used. Couplings shall be tight to the duct wall surface, and projections into the duct at connections shall be minimized. The inside surface of all duct (area exposed to airflow) shall always be constructed of sheet metal.

B. The system shall be designed for optimum performance. Any subsequent alterations to the design must be accompanied by a computer analysis or calculations showing that the proposed alterations will still provide the original design volume without increasing the system total pressure.

C. Any unavoidable field changes to the original design (offsets, etc.) must be reported to the Architect so that accurate "as built" operating parameters may be established.

END OF SECTION 15021
SECTION 15025 - MEDICAL GAS SYSTEMS

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Division-16 Basic Electrical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of medical gas systems work is indicated on drawings and schedules, and by requirements of this section.

B. Types of medical gases required for project include the following:

1. Oxygen. (O2)
2. Medical Air. (A)
3. Vacuum. (V)

C. The Contractor shall furnish all labor, materials, equipment and services necessary to install the above listed medical gas systems and to perform all required "progress" and final tests.

D. The layout on the drawings is diagrammatic, and the contractor shall cooperate with other trades in fitting piping to job conditions. The systems shall conform with National Fire Protection Association regulations as contained in NFPA 99, 1996, "Health Care Facilities".

E. Refer to Division-16 for the following work: not work of this section.

F. Power supply wiring from power source to power connection on medical gas equipment. This includes starters, disconnects, alarms, manifolds, and other required electrical devices.

G. Provide the following electrical work as work of this section, complying with requirements of Division-16.

H. Control wiring between electrically operated medical gas equipment units; and between equipment and field-installed control devices, indicating devices and unit control panels.

I. Interlock wiring specified as factory-installed is work of this section. All low voltage wiring for medical gas alarms and equipment shall be installed by the medical gas equipment supplier. Final terminations of low voltage wiring, alarm calibrations and final equipment check out and start up shall be by the medical gas equipment supplier.

1.3 CODE COMPLIANCE

A. Contract requirements and general requirements shall apply to all work included in this section as per the National Fire Protection Association (NFPA) - 99, 1996 and the
Compressed Gas Association (CGA) Handbook. Comply with all local, state, or federal codes applicable in this jurisdiction.

B. Codes and Standards:

1. **NFPA Compliance:** Install and test medical gas systems in accordance with the following standard: NFPA 99, 1996, "Health Care Facilities"

2. **ASME Compliance:** Provide medical gas pressure vessels and relief valves in accordance with ASME "Boiler and Pressure Vessel Code"; provide ASME Code Symbol Stamp.

3. **CGA Compliance:** Fabricate and install medical gas systems in accordance with CGA Standards (Compressed Gas Association).

4. **UL Compliance:** Provide electrical components which are UL-listed and have UL label affixed.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of medical gas systems equipment and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. References may be required

B. Installer Qualifications: Firm with at least 3 years of successful installation experience on projects with medical gas systems work similar to that required for project. Brazers must present written documentation (less than 1 year old) from a recognized agency trained in administering and testing brazing techniques as per AWS B2.2 or ASME Section IX. Certification stating that they have been thoroughly trained and tested in the complete installation of medical gas systems shall be required.

C. Testing Agency Qualifications: Firm regularly engaged in the testing and certification of similar facilities with a minimum of 5 years of experience. Quality control standards of testing agency shall be in strict accordance with American National Standards Institute (ANSI) Q-91. Copy of agency's written Q-91 standards may be required.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for medical gas systems materials and products.

B. Material Mill Sheets: Stating name and address of the tubing manufacturer and of company claiming responsibility for "Cleaning and Capping Tubing for Oxygen Service."

C. Brazing Filler: As per AWS A5.8, minimum 1000°F melting point (cadmium free). Approved submittal sheets shall become part of the facilities permanent documentation.

D. Shop Drawings: Submit scaled layout drawings of medical gas systems pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, equipment connections, and gas outlets. Indicate interface and spatial relationship between piping and proximate equipment.
E. Record Drawings: At project close-out, submit record drawings of installed piping, and medical gas systems products; in accordance with requirements of Division-1. Drawings shall show "as built" layout of medical gas piping system indicating location and designation of all valves. Valve designation, location, and area served shall be incorporated into a schedule on the drawings.

F. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Submit complete wiring diagrams of all low voltage interconnecting wiring for medical gas alarm systems.

G. Maintenance Data: Submit maintenance data and parts lists for medical gas systems materials and products. Include this data, product data, shop drawings, record drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Major medical gas equipment such as medical air compressors, medical air vacuum pumps, manifolds, surgical columns, surgical booms, etc. shall be received and field assembled in place by the medical gas supplier. Medical gas supplier shall be responsible for proper assembly and operation of equipment.

B. Deliver medical gas pipeline equipment, including alarms, valves, outlets and miscellaneous accessories packaged in factory-fabricated containers. Medical gas pipe shall be delivered to site with plastic end-cap protectors to prevent pipe-end damage and to eliminate dirt and moisture from entering interior of pipe. Medical gas fittings shall be delivered to site sealed and bagged to avoid contamination.

C. Handle medical gas piping and equipment carefully to avoid damage to components, enclosures and finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer. Store medical gas piping and equipment indoors and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT IDENTIFICATION

A. Provide identification complying with NFPA 99, 1996 and CGA color coding requirements for medical gas systems and as described below:

1. Medical Gas Piping Above Ground: Plastic pipe markers with direction of flow arrows and pressure of gas contained.


3. In-Line Shutoff Valves: Brass valve tags indicating valve number (corresponding to valve legend), gas controlled and area controlled. This includes concealed valves, valves located at oxygen bulk yard, exposed valves, etc.

5. Area Alarms: Plastic laminate sign indicating area monitored.

6. Pressure Gauges: Plastic laminate sign indicating gas served and warning to use no oil.

2.2 PIPE AND FITTINGS

A. Copper tubing conforming to American Society for Testing and Materials (ASTM) B819, specially cleaned for oxygen service shall be Type L hard drawn for above ground, and Type K for underground and nitrogen service and bear one of the following markings: OXY, MED, OXY/MED, ACR/OXY, or ACR/MED. Mains and branches in piping systems shall be not less than 1/2 in. nominal size. Runouts to area alarm panels shall be permitted to be 1/4 in. nominal size. Mill sheets shall be required.

B. Copper fittings to be wrought copper only, no cast brass fittings are to be used. All fittings shall be specially cleaned for oxygen service and comply with ANSI B16.22. Mill sheets shall be required.

C. Brazing filler material shall be selected on the basis of American Welding Society (AWS) 5.8 requirements. Brazing filler metal to be copper-phosphorus (BCuP Series) or a Silver BAg, cadmium free that has a melting temperature in excess of 1,000°F.

D. Copper tubing for vacuum may be cleaned for oxygen service type or may be Type L labeled for vacuum service before being installed in hangers.

2.3 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Division-15 Basic Mechanical Materials and Methods section "Piping Specialties," in accordance with the following listing:

1. Pipe escutcheons.
2. Pipe sleeves.
3. Sleeve seals.

2.4 BASIC SUPPORTS AND ANCHORS

A. Provide supports and anchors, complying with Division-15 Basic Mechanical Materials and Methods section "Supports and Anchors," in accordance with the following listing:

1. Extension split pipe clamp, copper plated, hinged or 2-bolt for pipe support from any substrate.

PART 3 - EQUIPMENT

3.1 PIPELINE EQUIPMENT

A. Shut-Off Valves:

1. All in-line shut-off and main line isolation valves shall be 3 piece ball-type design with a bronze body. Seats shall be Teflon (TFE), seals buna and the ball plated. A blow-out proof stem shall be used and the valve shall have a minimum pressure
rating of 300 psi WOG. Valve shall be operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation. On outlet pipe stub provide 1/8" FPT tap with plug to accept gauge on nitrogen purge connection. Valve tags showing the appropriate gas services, pressure rating, etc. shall be attached to each valve. All in-line shut-off valves shall be provided with locking kit. Each valve assembly shall be provided washed and degreased for medical gas service and pipe stub extensions shall be capped at both ends. The valve shall be supplied in a sealed plastic bag to prevent contamination prior to installation.

2. Shut-off and main line isolation valves shall be as manufactured by: AAT/AMICO.

B. Zone Valve Box Assembly:

1. Each recessed zone valve box shall consist of the following components: A steel valve box which can house one or more shut-off ball valves with tube extensions, an aluminum frame, and a pull-out removable window. The valve box shall be constructed of 18 gauge steel complete with a baked gray enamel finish. Affixed to the opposing sides of the box will be two adjustable steel brackets for the purpose of mounting the box to the structural support. The steel brackets shall accommodate various finished wall thickness of between 1/4" and 1/2" and shall be field adjustable. The door frame assembly shall be constructed of anodized aluminum and shall be mounted to the back box assembly by standard number 6-32 screws as provided. The removable front shall be a clear Lexan window with a pull-out ring pre-mounted to the center of the window. Access to the zone shut-off valve shall be by merely pulling the ring assembly to remove the window from the door frame. The window can be reinstalled without the use of tools only after the valve handle has been returned to the open position. The window shall be marked to prohibit unauthorized persons from tampering with the valve with the following silk-screen caution:

CAUTION - (name of medical gas) VALVE
DO NOT CLOSE EXCEPT IN EMERGENCY
THIS VALVE CONTROLS SUPPLY TO . . .

2. Valve shall be 3 piece ball-type design with a bronze body. Seats shall be Teflon (TFE), seals buna and the ball plated. A blow-out proof stem shall be used and the valve shall have a minimum pressure rating of 300 psi WOG. Valve shall be operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position. The valve shall be equipped with Type "K" washed and degreased copper pipe stub extensions of sufficient length to protrude beyond the sides of the box. All pipe stub extensions shall be supplied with suitable plugs or caps to prevent contamination of the assembly prior to installation. Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved medical gas identification label. A package of labels shall be supplied with each valve box assembly for application by the installer. Valve shall be provided with a line pressure monitoring gauge. Gauge shall be 1-1/2" diameter, with metal case and ring, and a 1/8" NPT brass stud at the back of the gauge for the purpose of mounting onto pipe stub extensions. The pipe stub extension shall be complete with a gauge port soldered onto the pipe stub extension. The gauge port shall be sealed with a brass plug to prevent contamination prior to mounting of the gauge. The gauge port shall be on the downstream side of valve and shall be within the zone valve box. Pressure gauges shall read 0-100 psi for all gas services except nitrogen which shall read 0-300 psi; and vacuum which shall read 0-30 inches of Hg. The installer of the zone valve box assembly shall exercise care and caution during the installation procedures to prevent physical damage to
the "O" ring and seat assemblies due to heat transfer during brazing and shall ensure nitrogen is purged through the assembly during the installation to prevent oxidation in accordance with applicable standards. Zone valve boxes shall meet requirements of NFPA 99, 1996 UL and CSA Standards.

3. Zone valve box assemblies shall be as manufactured by: AAT/AMICO.

C. Medical Gas Check Valves:

1. The check valve body shall be made of bronze. It shall have a positive shut-off with a self-aligning spring loaded plunger which shall mate with a soft seat. The valve shall have a straight through design, for minimum pressure drop. It shall be vibration free and fast acting for silent operation. Each Check valve shall be 100% leak tested and cleaned for oxygen service.

2. All check valves shall be as manufactured by: AAT/AMICO.

D. Area Alarms:

1. The digital Area Alarm shall be microprocessor based with individual microprocessors on each display and sensor board. The sensors shall be capable of local (in-box) or remote monitoring. Each sensor and display unit shall be gas specific, with an error message display for the incorrect connection.

2. The area alarms shall be of modular construction and shall be field expandable with the addition of extra modules. Standard box shall accommodate up to six services.

3. Each specific service shall be provided with a individual LED digital readout comprising of 0-300 psi for pressure and 0-30" Hg for Vacuum. The digital readout shall provide a constant indication of each service being measured. In addition, the digital readings shall be lit up so that they can be read when surrounding lights around the alarm are turned down. A bar graph trend indicator shall be provided for each service indicating a green "NORMAL" condition, yellow "CAUTION", red "HIGH" or "LOW" alarm condition. Under normal operation the bar graph display shall move up and down in the "GREEN" range depending on service usage. If an alarm occurs, the "RED" alarm light shall flash and the audible alarm will sound. Pushing the "ALARM SILENCE" button will cancel the audible alarm, but the unit will remain in the alarm condition until the problem is rectified.

4. The default setpoints shall be +20% variation from normal condition. In the calibration mode, the following parameters shall be field adjustable: High/low set-points, Imperial/metric units,. Repeat alarm enable/disable. Set points shall be adjustable by two on board push buttons. In addition, "PUSH TO TEST" and "ALARM SILENCE" buttons shall be easily accessible to operate and test the unit.

5. The box shall be fabricated from 18 gauge steel with 1/4" I.D. type "K" copper pipe for connection to the service lines. The box mounting brackets shall be adjustable by up to 1/2" to accommodate for the different wall thickness. The front panel shall consist of a Plexiglas cover for ease of cleaning.

6. All final low voltage wire terminations and final adjustments for area alarms shall be performed by the area alarm supplier prior to activation of electrical service.

7. The area alarm shall also be capable of interfacing with the optional hospital Alarm Interface Management System (AIMS), as provided by the manufacturer.
8. Area Alarms shall be as manufactured by: AAT/AMICO.

E. Master Alarms:

1. Each master alarm module shall be microprocessor based and able to be field adjustable. A maintenance mode shall, when enabled, latch the alarms, requiring a reset after the alarm condition has been rectified. This is to assist in tracking down wiring problems or faulty field devices. The master alarm shall identify the last alarm condition, with a faster flashing rate than alarms already acknowledged. Previously acknowledged alarms shall flash at the normal rate. A repeat alarm function shall, when enabled, be capable of turning the buzzer on again, after a preset time, if the fault has not been rectified.

2. Each module shall handle 10 functions and up to 6 modules can be accommodated per standard box for a total of 60 functions. Master alarms shall be modular in construction and shall be field expandable with the addition of extra modules. If an alarm occurs, a “RED” alarm LED shall illuminate and the audible alarm shall sound. Pushing the alarm silence button will silence the audible alarm, but the unit will remain in alarm condition until the problem is rectified.

3. The master alarm shall be a closed circuit self monitoring type. A green "power" light shall provide indication that the unit is energized. In addition, a "Push to Test" and "Alarm Silence" buttons shall operate and test the unit.

4. For combination alarms, the digital display modules shall be microprocessor based with individual microprocessors on each display and sensor board. The sensors shall be capable of local (in-box) or remote monitoring. Each sensor and display unit shall be gas specific, with an error message display for the incorrect connection.

5. Each specific service shall be provided with a individual LED digital readout comprising of 0-300 psi for pressure and 0-30" Hg for Vacuum. The digital readout shall provide a constant indication of each service being measured. In addition, the digital readings shall be lit up so that they can be read when surrounding lights around the alarm are turned down. A bar graph trend indicator shall be provided for each service indicating a green "NORMAL" condition, yellow "CAUTION", red "HIGH" or "LOW" alarm condition. Under normal operation the bar graph display shall move up and down in the "GREEN" range depending on service usage. If an alarm occurs, the "RED" alarm light shall flash and the audible alarm will sound. Pushing the "ALARM SILENCE" button will cancel the audible alarm, but the unit will remain in the alarm condition until the problem is rectified.

6. The default setpoints shall be + 20% variation from normal condition. In the calibration mode, the following parameters shall be field adjustable: High/low set-points, Imperial/metric units, Repeat alarm enable/disable. Set points shall be adjustable by two on board push buttons. In addition, "PUSH TO TEST" and "ALARM SILENCE" buttons shall be easily accessible to operate and test the unit.

7. The box shall be fabricated from 18 gauge steel with 1/4" I.D. type "K" copper pipe for connection to the service lines. The box mounting brackets shall be adjustable by up to 1/2" to accommodate for the different wall thickness. The front panel shall consist of a hinged Plexiglas cover for ease of cleaning.

8. The master alarm supplier shall be responsible for furnishing and installing all low voltage wiring, including conduits, junction boxes, etc. and for making all final terminations at sources and at the master alarm. Exact field location of equipment
as well as actual running of conduit shall be the responsibility of the master alarm supplier.

9. Every master module shall be field upgradable to allow for interfacing to a building management system with the addition of add-on, piggyback circuit board. The master alarm shall also be capable of interfacing with the optional hospital Alarm Interface Management System (AIMS), as provided by the manufacturer.

10. Master Alarms shall be as manufactured by: AAT/AMICO.

F. Quick Connect Wall Outlet:

1. The latch/valve assembly shall be Ohmeda DiamondTM Quick Connect compatible and accept only corresponding Ohmeda type gas specific adapters.

OR

2. The latch/valve assembly shall be Chemetron Quick Connect compatible and accept only corresponding Chemetron type gas specific adapters.

AND/OR

3. The latch/valve assembly shall be DISS (Diameter Index Safety System) compatible and accept only corresponding DISS type gas specific adapters.

4. Outlets shall be manufactured with a 6-1/2" length type "K" 1/4" inside diameter copper inlet pipe stub, which is silver brazed to the outlet body. Body shall be 1-1/4" diameter one piece brass construction. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valve and the secondary check valve shall be rated at a minimum 200 psi in the event the primary check valve is removed for maintenance. Outlet bodies shall be gas specific by indexing each gas service to a gas specific pin indexing arrangement on the respective identification module. A large color coded front plate shall be used for ease of gas identification and aesthetic appeal. A one piece high density plastic with chromed finish fascia plate shall cover the outlet. With the backbox mounted, the outlet shall adjust from 3/8" to 1-1/4" variation in wall thickness. The outlets shall be of modular design and include a gas specific 16 gauge steel mounting plate designed to permit on-site ganging of multiple outlets, in any order, on 5" spacing. All outlets shall be cleaned and degreased for medical gas service, factory assemble and tested.

5. All outlets shall be as manufactured by: AAT/AMICO.

G. Low Pressure Emergency Oxygen Inlet Station:

1. The Emergency Gaseous Oxygen Inlet shall be housed in a weathertight enclosure. A 1" ball valve and a supply pressure gauge shall be used to introduce the oxygen into the oxygen pipeline. The enclosure door shall be labeled "Emergency Gaseous Oxygen Inlet" and shall be equipped with a staple for padlocking to allow entry only by authorized personnel. A print pocket shall be included on the door interior for storage of instructions. A mounting frame shall extend completely around the enclosure to trim recessed mounting on an exterior wall. The interior of the enclosure shall be clearly labeled with instructions for connection and operation of the emergency oxygen inlet. Bronze body check valves with female pipe threads on each end shall be provided for installation in the main and emergency supply pipeline in accordance with NFPA-99. A brass body relief valve with the relief pressure set @ 75 PSI shall be provided for installation in the emergency supply line. The relief
valve shall be supplied factory cleaned for oxygen service and shall automatically
reset after discharging to provide a positive seal.

2. Emergency Oxygen Inlet Station shall be as manufactured by: AAT/AMICO.

3.2 MEDICAL AIR COMPRESSOR (M.A.C.)

A. GENERAL: Provide a complete duplex oil-less medical air supply package, consisting of two
base mounted compressors, plus a second base containing a PLC based control panel, one
desiccant and one refrigerated dryer, an ASME rated air receiver, and other specified
components, all factory mounted, wired, plumbed, tested, and meeting NFPA 99, 1996
requirements. Package shall be designed whereby one compressor operate to provide no
less than 7.25 CFM @ 55 PSIG, while the last compressor is for back-up reserve in the event
of failure or service down time. Each dryer shall be capable of handling the capacity of all
compressors (but one) in operation, with the second dryer for reserve back-up.

B. COMPRESSORS: Compressors shall be single stage of the totally oil-less design, using no
liquid lubrication of any type, with totally sealed rod bearings and crankshaft bearings. Rings
shall be of graphite-filled Teflon, crankcase and cylinders shall be of all cast iron, cylinders
shall be nickel plated, pistons shall be of aluminum alloy, complete with Teflon heat shield on
top to keep heat of compression away from bearings, connecting rods shall be of aluminum
alloy, two piece design, and compressors shall not require water of any type, for cooling or
sealing. Compressors shall be designed for 100% duty cycle, for continuous operation at
rated output and pressure. Compressors shall incorporate the following features:

C. AFTERCOOLERS: Each compressor pump shall be equipped with a factory installed air
cooled aftercooler, complete with automatic condensate trap and drain, not relying on the
receiver drain to remove aftercooler condensate.

D. MOTORS: Compressor drive motors shall be no more than 2 Hp nameplate rating, open,
drip-proof design, NEMA rated, and designed to operate on an available power supply of 480
Volts, 60 Hz, 3 Phase.

E. AIR INTAKE FILTERS shall be of pleated paper design, rated at no less than 3 micron, and
contained in metal enclosure, with facilities for attaching piping from remote intake location in
compliance with NFPA - 99. When multiple intake filters are used, they shall be manifolded
together with all copper piping, to accommodate one single air inlet connection, including flex
connectors and isolation valves.

F. AIR DRYERS: The Medical Air Dryers are to be duplexed, consisting of (1) Twin Tower
Desiccant Dryer and (1) Refrigerated Dryer.

G. Primary Air Dryer shall be a pressure-swing (heatless) type regenerative desiccant dryer.
Dryer is to be complete with (2) pressure vessels (towers) each containing a desiccant bed
fully charged with activated alumina, controller and control valves to direct inlet and purge air
flows from tower to tower, and a means of regulating purge air usage. All components are to
be mounted on a structural steel frame with floor stand and lifting lug. Dryer is to be ready to
start up after utility connections are made. Dryer is to operate automatically and
continuously. Inlet conditions to be 100 psig, 7 brag, and 100°F (saturated) and 7.25 scfm.
Outlet pressure dew point to be -40°F at above conditions when dryer is operating on a 10
minute purge cycle. Pressure drop across dryer shall not exceed 3 psig. Maximum working
pressure of dryer to be 150 psig.

H. Secondary Air Dryer shall be of the non-cycling, air cooled, refrigerated type and shall comply
with the latest edition of NFPA 99. Dryer is to be operate automatically and continuously.
Inlet conditions to be 100 psig and 100°F (saturated) and 7.25 scfm. Outlet pressure dew point to be 35°F at above conditions when dryer is operating. Pressure drop across dryer shall not exceed 5 psig. Maximum working pressure of dryer to be 175 psig. Instrumentation shall include a suction pressure gauge, high air temperature lamp, power on lamp. A power on/off switch shall be located on the front cover.

I. Each dryer shall be installed with a 3-valve by-pass piping system, in compliance with the latest edition of NFPA 99, so as to allow service to each dryer without interrupting medical air service, and dryers shall be compactly installed on control module base, and be completely factory plumbed and tested. Dryers shall be designed to operate on field provided 120 volt emergency power.

J. RECEIVER: Receiver shall be of no less than 80 gallon capacity, horizontal type, and shall comply with Section VIII of the ASME Code, be corrosion resistant and factory installed, plumbed, and tested on the control module base, and shall incorporate the following features/components:

1. ASME safety pressure relief valve.
2. Air pressure gauge.
4. Automatic electric timed drain, adjustable span and duration.
5. 3-valved by-pass, plumbing for isolation of receiver.
6. Condensate level sight glass.

K. CONTROLS: Compressors shall be designed for start/stop operation, with motors controlled via a pressure sensor reading tank pressure. System dewpoint, carbon monoxide, and discharge air temperatures shall also be monitored by the panel.

L. The control panel shall be of Programmable Logic Controller (PLC) design, housed in a NEMA 12 rated enclosure, mounted on the control module base, and factory wired and tested. Panel shall contain a 80 character (40x2) backlit Liquid Crystal Display (LCD) Operator's Access Panel (OAP). All operations are achieved by pressing the function keys in response to the display prompts. This panel shall display the following default information:

1. Compressor running status (on/off)
2. System Pressure (psi)
3. System Dewpoint (°F)
4. System Carbon Monoxide Levels (ppm)
5. Alarm status

M. Menus accessible via the function keys on the access panel, shall display the following information:

1. Compressor discharge air temperature.
2. Elapsed running hours for each compressor.
3. Hours to next preventative maintenance for each compressor.
4. Compressor alternator selection (manual for each compressor or automatic).
5. Alarm status screens.

N. Setpoints necessary to operate the system, via the access panel, shall include:

1. Lead compressor(s) start/stop
2. Lag compressor start/stop
3. Alternator position
4. Discharge air temperature high limit (password protected)
5. CO level high position (password protected)
6. Dewpoint high level (password protected)
7. PM due hours (password protected)

O. External features of the control panel shall include:

1. Hand-Off-Automatic selector switch for each compressor
2. Motor disconnect and reset handle for each compressor
3. Red common alarm lamp (push to test type)
4. Alarm horn
5. Silence button for alarm
6. Reset button for alarm
7. Amber preventative maintenance due lamp (push to test type)

P. Internal features of the control panel shall include:

1. Separate disconnect, starter and overload for each compressor.
2. Dual control transformers (120vac) with fused primary and secondary.
3. 120 volt fused computer access receptacle.
4. Terminal strip for installation of remote master alarms/signals. (normally closed, dry contacts)

Q. Control panel shall be designed to allow for fully automatic alternation by independently selecting the lead compressor, or manual selection, by the operator, of any one compressor, with the second compressor acted as back-up reserve. Whether selection of running units is automatic, or manual, the lag unit shall always remain on automatic stand-by in the event system pressure drops below design capacity. If this unit is called into operation for any reason, the lag alarm will be triggered.

R. Temperature sensors, connected to visual indicators on the control panel, will alarm and shut down the affected unit and sound the alarm in the event of temperatures above design limits.

S. PARTICULATE FILTERS: A duplex bank of filters shall be provided, in compliance with NFPA 99, latest edition, installed, plumbed, and piped on the control module base, each side of the duplex bank shall include the following:

1. Particulate filter, sized to the design of the piping of the system, with automatic drain, minimum 98% efficiency and rated at one micron.

T. REGULATORS: A duplex bank of regulators shall be provided, in compliance with NFPA 99, latest edition, installed, plumbed, and piped on the control module base, each one of the regulators shall include the following:

1. Air regulator, with gauge, sized to the design of the piping of the system, capable of regulating system air pressure to desired pressure.
2. Isolation valves, properly placed and sized, to allow the isolation of either side of the duplex filter/regulator system while the other is operational.

U. PRESSURE RELIEF: Immediately downstream of the duplex filter/regulator system described above, and before the equipment source valve, the piping shall consist of a pressure relief valve, set at 50% over normal line pressure to insure that downstream pressure does not exceed design limits. (75 psi for 50 psi line pressure systems)

V. FLEXIBLE CONNECTORS: Sized for system design, shall be provided, four (4) in number, one each at connection of both aftercoolers to compressor, and two (2) provided for installed connection to remote air intake piping.
W. SPECIAL PACKAGE DESIGN: Each base module of package shall allow passage through normal (36") doorways for ease of placement and installation. Compressors, motors, and other components shall be mounted on integrally nested and spring isolated bases, requiring no special foundations for installation. The equipment supplier shall be responsible for field re-assembly and preparation for final tie-ins.

X. INTERNAL PUMP COMPONENT WARRANTY shall be supplied by manufacturer, and shall be no less than the following:

1. Valve Assemblies 5,000 Hours or 1 Year
2. Piston/Guide Rings 10,000 Hours or 3 Years
3. Con Rod Bearings 10,000 Hours or 3 Years
4. Main Bearings 20,000 Hours or 3 Years

Y. WARRANTY: Complete package shall be warranted by manufacturer for a period of not less than twelve months from date of start-up, or eighteen months from date of shipment, whichever occurs first, with the exception of internal pump components, which shall be warranted as outlined in previous section. Warranty shall include 100% of both parts and labor.

Z. SERVICE/PARTS: Factory trained and authorized service personnel, as well as an adequate stock of repair parts shall be maintained within a reasonable distance of the installation location to insure prompt repair and service both in and out of the warranty period.

AA. DELIVERY/START-UP: Complete package shall be delivered with transportation charges prepaid. Medical air compressor unit shall be received and field assembled in place by the air compressor supplier. The air compressor supplier shall be responsible for proper re-assembly and alignment for preparation for final tie-ins. Mechanical contractor shall install piping tie-ins. Electrical contractor shall install high voltage connections (See Division 16).

BB. The medical gas installer shall be responsible for providing all master alarm circuits required by NFPA-99, latest edition. These circuits shall include all necessary signals from the medical air compressor system as well as the oxygen, nitrous oxide and nitrogen supplies. Exact field locations, all equipment, low voltage wiring, conduits and terminations necessary for these circuits shall be the responsibility of the medical gas installer.

CC. One eight hour job site visit shall be provided by factory trained representative to supervise the start-up and operation of the system.

DD. CERTIFICATION: Complete qualitative and quantitative air analysis shall be performed after start-up. Contaminants shall be within CGA commodity specifications for grade D air or better, as well as the latest edition of NFPA 99 air standards. Written reports shall be forwarded to the engineer and owner.

EE. PRE-APPROVED: The Medical Air Compressor System shall be Ohmeda OL 2.0, Puritan-Bennet LTM-2D-D8D, or equal as listed by addenda.

3.3 MEDICAL VACUUM PUMPS (M.V.P.)

A. General: Provide a factory packaged continuous on demand dry running rotary vane duplex medical vacuum system, consisting of two electric motor driven pumps, a horizontal ASME receiver, and a PLC based duplex electrical control system mounted in a NEMA 12 dustproof enclosure. The components shall be assembled on a heavy duty skid base with interconnecting piping and wiring to provide a functional operating package with single point
electrical and plumbing connections. The packaged unit shall be factory tested prior to shipment.

B. Receiver: The 80 gal. horizontal receiver shall be constructed to ASME standards and include valved by-pass, manual drain valve, vacuum gauge, sight glass and the National Board label. Tank shall be rated for full vacuum service.

C. Pumps: The pump assembly shall be direct drive, rotary, four carbon graphite vanes, dry running, air cooled, each with a capacity of 6.25 SCFM at 19” Hg and capable of producing a maximum vacuum of 25.49” Hg. Each pump shall have an inlet air filters, inlet check valve, inlet isolation valve, discharge isolation valve and unions to facilitate pump removal.

D. Motors: The drive motors shall be 2 Hp, drip-proof, rigid base continuous duty, 40°C, ball bearing, NEMA design B, class B insulation, for operation on 480 Volts, 60 Hz, 3 phase.

E. Controls: The automatic duplex electrical control shall be mounted in a NEMA 12 dustproof cabinet. The controls include non-fusible disconnect switches, magnetic motor starters with three phase thermal overload protection, dual 120 volt control circuit transformer with fused primary and secondary, dual vacuum control switches, dry contacts with reset button for lag alarm (Master Alarm), an automatic alternator to switch the operating sequence of the pumps. The cabinet door shall have hand-off-automatic selector switches, an audible and visual lag alarm with reset button, hours meters, pump running lights and safety disconnect operating handles.

F. Accessories: The following accessories shall be included for job site installation:

   1. inlet and discharge flexible connectors
   2. system isolation valve (source valve)
   3. vibration mounting pads

G. Delivery/Start-Up: Complete package shall be delivered and transportation charges prepaid. Vacuum pump unit shall be received and field assembled in place by the vacuum pump supplier. Vacuum pump supplier shall be responsible for proper assembly, alignment, etc. One day/eight hour start up supervision shall be provided by factory trained representative.

H. The system shall meet all the requirements of NFPA 99, 1996 edition.

I. The medical vacuum pump system shall be as manufactured by Ohmeda CD1.5, Puritan-Bennet LTV-2D-N80, or equal as listed by addenda.

PART 4 - EXECUTION

4.1 INSTALLATION

A. The Contractor shall employ for this work only labor that has been qualified by training and testing to the industry standards (UPC Section 309, NFPA 99, 1996, 4-4.1.4.2). Installation shall be made by certified competent technicians trained and tested in making medical gas installations.

B. Brazing shall be performed in strict accordance with AWS B2.2-91. All brazing operators shall be qualified by training and certification according to AWS standards for brazing procedures and performance qualifications. (AWS B2.2-85 or ASME Section IX)
C. Threaded Joints: Use these only at valves and equipment designed for threaded pipe connections. Use Teflon tape starting on the third thread of the male thread only.

D. Other Joints: Except as otherwise specified above, silver braze these with BCuP series or Silver BAg having at least a 1,000°F melting point.

E. Junctions and Turns: Use standard "tees" at all branch connections and standard reducers, adapters, caps, and other standard fittings of wrought copper only. Use standard elbows at turns, or tubing for turns. Bent turns shall be uniform long radius type, made only with suitable mechanical tube benders of proper size, without flattening, weakening, kinking or otherwise damaging tubing. Tube benders may be used for 3/8" tubing and below only. Install piping with ample flexibility to permit free expansion and contraction of pipework without putting on pipework, supports, fixtures, and equipment any stress which could cause damage or breakage. Branch connections to mains, risers, and laterals shall be swing type, except where length and arrangement of branch will provide sufficient flexibility.

F. Shutoff Valves: Shall be of a quarter-turn ball-type shutoff valve, constructed of materials that are suitable for medical gas service, and must be able to withstand pressure up to 400 PSIG. The location of valves shall be as per the latest edition of NFPA 99 and where shown on drawings. Provide shutoff valves where indicated, and in accordance with NFPA 99 latest edition. All in-line shut off valves in non-secured areas shall be chain locked in open position.

G. Purging: The system shall be continuously purged prior to and during all assembly, fitting, and brazing operations with dry nitrogen to prevent the formation of scale or the intrusion of ambient air within the tubing. The flow rate shall be 15 - 25 LPM during brazing. Prior to brazing, check the open end of the purged tube with an Oxygen Analyzer to verify the absence of oxygen in the purge gas. Braze the joint nearest the supply end of the purge, working toward the exit end of the purge. Use vinyl tape (electricians tape) to temporarily seal off joints that have not been brazed. Purge gas is to continue until all brazed joints and piping has reached ambient temperature. Whenever assembly or brazing is stopped, installer shall re-cap and/or tape all openings in the system leaving nitrogen present to prevent ambient contamination.

H. Piping: Pipe shall be cut square and true to size with copper tubing cutter with a sharp wheel. Hack saws or similar type cutting tools are not allowed. All cut ends shall be reamed, cleaned and restored to original pipe dimension. Copper or brass shavings in system shall be cause for rejection of piped system.

I. Supports: Gas piping shall be supported directly from the building structure with pipe hooks, metal pipe straps, bands, or hangers suitable for the size of the pipe and of proper strength and quality at proper intervals, so that piping cannot be moved accidentally from the installed position as follows:

<table>
<thead>
<tr>
<th>Pipe or Tubing Size</th>
<th>Maximum Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>6 feet</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>7 feet</td>
</tr>
<tr>
<td>1&quot;</td>
<td>8 feet</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>9 feet</td>
</tr>
<tr>
<td>1-1/2&quot; and larger</td>
<td>10 feet</td>
</tr>
<tr>
<td>Vertical Risers</td>
<td>every floor level</td>
</tr>
</tbody>
</table>

J. Buried piping outside shall be buried below the local level of frost penetration. Buried piping that is subject to surface loads shall be buried at a sufficient depth to protect the piping from excessive stress. The minimum backfilled cover above the top of the buried pipe shall be 36", except the minimum cover shall be reduced to 18" where physical damage is not likely to
occur. Trenches shall be excavated so that the pipe has a firm, substantially continuous bearing on the bottom of the trench.

K. Underground piping shall be installed in a continuous split enclosure to protect the pipe while backfilling. Backfill shall be clean and compacted so as to protect and support the pipe. A continuous tape or marker immediately above the enclosure shall clearly identify the pipeline by specific name. In addition, a continuous warning means shall be provided above the pipeline at approximately one half the depth of the bury. Where underground piping is installed through a wall sleeve, the ends of the sleeve shall be sealed to prevent the entrance of ground water.

L. Air Compressor Intakes: Install air compressor intakes minimum 20 feet above ground and above roof level, turned down and screened. Install a minimum 10 feet from any door, window, other entrance or opening in the building.

M. Support: Install equipment on 4” high reinforced concrete pads, 4” larger on each side than equipment base. Cast anchor bolt inserts into pad.

4.2 TESTING REQUIREMENTS

A. It shall be the responsibility of the Medical Gas Testing Agency to make the required periodic job site visits to assure all requirements of this specification and NFPA 99 are strictly adhered to.

B. All written results shall be copied and issued to the hospital authority, plumbing contractor, and State Fire Marshall upon completion of the project and prior to patient use.

C. Certification shall clearly state that the system is approved for patient use and meets all requirements of NFPA-99, 1996 inclusive of all referenced and/or related documents. Any exceptions or limitations shall be clearly stated on the same certification document.

D. The following tests shall be conducted by the medical gas installer prior to any testing by the Testing Agency:

1. Before installation of any system components, each section of the piping system shall be tested at a pressure 1.5 times the working pressure (minimum 150 psig) with oil-free, dry nitrogen. The test pressure shall be maintained until each joint is tested for leakage. All leaks, if any, shall be repaired and re-tested.

2. All pipelines shall be blown clear by means of oil-free, dry nitrogen.

3. After installation of all system components, all pipelines shall be subjected to a 24 hour standing pressure test with oil-free, dry nitrogen at 20 percent above the normal operating line pressure (for Vacuum, not less than 60 psig). All leaks, if any, shall be repaired and re-tested.

4. A high flow purge of each outlet shall be performed until the purge produces no discoloration in a white cloth.

5. Before the wall are closed it shall be determined that no cross-connection of piping systems exists.

6. The presence and correctness of labeling for all components shall be verified.
E. The following tests shall be completed by the Testing Agency prior to the connection of any work or any extension or addition to an existing piping system:

1. It shall be determined that no cross-connection of piping systems exists.

2. The presence and correctness of labeling of all components shall be verified.

3. Valves installed in each medical gas piping system shall be tested to verify proper operation and rooms or areas of control. A chart with these depictions shall be completed to assist in the proper labeling of the valves.

4. All outlets shall be tested for flow. Applicable Oxygen, and Air outlets shall be verified to deliver 3.5 scfm with a pressure drop of no more than 5 psig, and a static pressure of 50 psig. Vacuum outlets shall be verified to evacuated 3 scfm at one station inlet without reducing vacuum below 12 in. Hg at an adjacent inlet.

5. All warning systems for each medical gas piping system shall be tested to ensure that all components function properly.

6. A heavy, intermittent purge of each positive pressure gas system shall be performed. Cleanliness of each zone of each system at the outlet most remote from the source shall be verified following procedure stated in NFPA 99, 1996 Section 4-5.1.3.5.

7. Each zone of each system at the outlet most remote from the source was tested for dew point, total hydrocarbons (as methane), and halogenated hydrocarbons and compared to the source gas. Tests shall not exceed variation as specified in the Maximum Allowable Variation Table of NFPA 99, 1996, Section 4-5.1.3.6.

F. The following tests shall be completed after connection to the existing system and before use of the addition for patient care:

1. The final connection between the addition and existing system shall be leak tested with the gas of system designation at the normal operating pressure.

2. Applicable Oxygen, and Air outlets shall be verified to deliver 3.5 scfm with a pressure drop of no more than 5 psig, and a static pressure of 50 psig. Vacuum outlets shall be verified to evacuated 3 scfm at one station inlet without reducing vacuum below 12 in. Hg at an adjacent inlet.

3. Each pressure gas shall be analyzed for concentration of gas, by volume and found to be within the parameters specified by NFPA 99, 1996 Section 4-5.1.3.9 (c).

END OF SECTION 15025
SECTION 15030 - PIPING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install in a neat, workmanlike manner all piping shown on Drawing or that is specified or required to provide a complete, properly operating installation.

B. Where pipe or equipment is to be insulated, extend all grease and oiling fittings from equipment to locations outside of insulation and provide rigid supports.

C. The Contractor shall provide small ready fire extinguisher at all welding and cutting operations indoors.

1.2 SERVICE CONNECTIONS

A. All connections to services shall be verified by the Contractor. Where costs for service connections are incurred, the Contractor shall include these costs in his bid.

1.3 TESTING

A. Test all piping and prove tight to the satisfaction of the Architect before covering is applied, trenches backfilled or fixtures connected.

B. Test all water and compressed air piping at 125 psig water pressure including hydrostatic head for a period of 8 hours.

C. After all soil, waste and vent lines have been set, all the outlets shall be temporarily plugged up. The pipes shall be filled with water, full to the top and all allowed to remain so for 24 hours. A minimum head of ten feet shall be used for this test.

D. Notice shall be given to the Architect and to the plumbing inspector before the tests are made, and the test is not to be drawn off the pipes and pipes are not to be covered or insulated until the filled pipes have been examined and the testing approved by the Architect and inspectors.

E. Test all gas piping with 30 psig air pressure for a period of eight hours. Apply soap suds to all joints during pressurized period.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials necessary to accomplish the installation of the piping systems.
PART 3 - EXECUTION

3.1 PIPE JOINTS

A. Threaded joints shall be American Standard taper pipe threads made up metal-to-metal with a thread lubricant. No hard setting pipe thread cement or caulking will be allowed. Cut threads so that maximum of three threads remain exposed after the fitting is made up. Ream all pipe ends after cutting and clean before erection.

B. Make welded joints by the electric arc method, using direct current in accordance with standards of the American Welding Society. Welding electrodes shall have coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

C. Make up copper piping joints with soldered joints using sweat type fittings. Cut pipe square and remove all burrs before assembly. Carefully clean and solder pipe and fittings with solder containing 95% tin and 5% antimony using non-corrosive flux. Solder or fluxes used shall not contain lead or lead compounds. The Contractor may, at his option, braze joints in copper piping using silver solder, phos-copper, silphos, or other high temperature brazing alloy approved by the Architect. Solder used for potable water systems shall be lead free.

D. Make plastic pipe and pipe fitting joints as per the recommendations of the manufacturer using joining methods and materials in strict accordance with all applicable standards. Generally, make joints using proper materials, properly prepared and complying with all recommended procedures and techniques regarding cleanliness, dryness, temperature, physical alignment and all other pertinent precautions. Gasketed joints shall have beveling at spigot ends and shall be cleaned then lubricated (as per manufacturer's instructions) prior to inserting ends.

E. In addition, follow all recommended procedures for solvent welded joints including but not limited to the following.

1. Cut the pipe square and properly deburr and bevel.
2. Follow all manufacturer's recommendations providing the separate steps of cleaning, priming and cementing.
3. Use purple primer so that use can be clearly observed.
4. Use an appropriate number of workers for recommended procedures and timing.

F. For above slab domestic water copper piping, tee connections may be mechanically formed branch collars as listed by the National Standard Plumbing Code, Standard Building Code Congress (S.B.C.C.) and U.L., and complying with ASME Code for pressure piping ANSI B315c. The lap joint collar shall be mechanically formed by drawing out the tube surface to form a raised collar to accept the branch tube. The branch tube shall be notched to insure proper penetration of the branch tube into the collar. Mechanically formed joints shall be brazed in accordance with manufacturer's approved methods using BCuP Series filler metal, no soft solder joints.
3.2 SLEEVES AND PLATES

A. Wherever pipes pass through concrete or masonry walls or structural slabs, furnish and install sleeves, properly located for the work. Where pipes pass through monolithic concrete floors, omit sleeves and use double wrap of 15 pound tarred felt.

B. Sleeves shall be of sufficient size to allow the specified pipe covering to pass through the sleeves. Finish flush with floors where exposed to view in finished areas of the building, 2 inches above floors where in equipment rooms and furred spaces and 6 inches above roofs. Seal all spaces between sleeves and pipes or pipe coverings. Use method as described under "OPENINGS, CUTTING AND PATCHING" or ceramic fiber packing or a mechanical device for fire rating to match wall or floor.

3.3 GAS PIPING SLEEVES

A. Special care shall be taken to provide sleeves at all gas piping penetrations through wall, floors and ceilings. The sleeves shall pass full length completely through any concealed spaces and shall have ventilated escutcheons at each end. Sleeves shall be Schedule 40 steel pipe with 2 inch air space. Seal space between sleeve and pipe at rated walls or floors with single application packing as above with rating to match wall or floor.

B. Underground gas piping rising through slabs/pavement shall have protective sleeves.

3.4 ESCUTCHEONS

A. Where pipes passing through walls, floors and ceilings are exposed to view in finished areas of the building, provide nickel plated pressed steel split floor and ceiling plates which shall cover the opening and fit snugly to the pipe or covering.

3.5 ACCESS DOORS

A. Provide access doors in ceilings and walls where required for access to valves and other devices. Doors shall be as specified under "BASIC MATERIALS AND METHODS." Where lay-in ceilings exist, no access doors are required.

3.6 PIPE SUPPORTS

A. Support pipe carrying cold fluids in hangers which allow the pipe covering to pass full thickness through the hanger. Install metal saddles as specified under "INSULATION" to protect the covering.

B. In general, suspend horizontal runs of pipe from the overhead construction using steel clevis type, band type or split ring malleable iron hangers, suitable for the pipe size and weight. Anchor hanger rods to building construction using beam clamps, inserts, weld clips, drilled bolts and nuts, etc. Any straight up nails, wood bolts or concrete expansion shields will not be allowed. Verify final exact hanging arrangement with the Architect. See Drawings for additional support information. Size rods as follows:

<table>
<thead>
<tr>
<th>Pipe Size, Inches</th>
<th>Rod Diameter, Inches</th>
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<tbody>
<tr>
<td>2 and Smaller</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2 and 3</td>
<td>1/2</td>
</tr>
<tr>
<td>4</td>
<td>5/8</td>
</tr>
</tbody>
</table>
C. Where two or more pipes run parallel and at the same location, they may be supported on channel or angle iron trapeze hangers, suspended from the overhead construction by rods same as specified for single hung pipe, except that the hanger rods shall be increased in size to support the additional weight. Thread lower ends of hanger rods 2 inches for adjustment and provide with nuts at top and bottom of channels. Upon completion of work, cut the rods off to present a neat appearance.

D. When steel hangers are used to support bare (unprotected) copper piping, provide two wraps of 2 inch wide plastic tape around piping to isolate piping from hanger; otherwise, provide solid copper or plastic coated hangers for copper piping.

E. Unless otherwise specified herein or on Drawings, space hangers for steel pipe at not more than 5 feet for pipe 1 inch and smaller and at not more than 10 feet for pipe 1-1/4 inches and larger. Support copper tubing at intervals not exceeding 8 feet. Support plastic pipe at intervals one third closer than for steel pipe. Support cast iron pipe at intervals not exceeding 10 feet with at least one hanger for each pipe section; hangers should be located adjacent to joints, changes in direction and branch connections.

F. Support cast iron, steel or copper piping at each floor penetration.

G. Plumbing piping shall be supported in accordance with local code requirements.

H. Drain risers shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents, but in no case less than at every floor level.

I. Provide supports and anchors for all pipe in horizontal or vertical position as required for installation satisfactory to Architect.

3.7 PIPE FLASHINGS

A. Where pipes extend through roof or outside walls, use flashings as required for weatherproofing. Roof flashings shall be lead with minimum 10 inch turnout and rolled into top of pipe. Wall flashings may consist of suitable caulking.

B. For metal panel roofing systems, flashings shall be T.W. Buildex Dek Tite, The Pate Co. Pipe Flashing Device, or equal, conical shaped, long life E.P.D.M. rubber stepped boot assembly with flexible aluminum base ring. For conforming to contour of metal roofing panel, provide required sealant caulking, self-sealing fasteners and accessories necessary for installation in accordance with manufacturer's requirement to insure a weather-tight/rain-tight installation.

3.8 PIPING INSTALLATION

A. Run piping parallel with lines of the building, unless specified or noted otherwise. All pipe shall have minimum one-half inch clearance from other work, including coverings.

B. Install piping so as to eliminate air pockets and permit complete drainage, providing air vents at all high points and drains at all low points. Install piping so that it can expand or contract freely. Pipe all air vents to drain.

C. Install drains at low points in mains and risers consisting of tee fitting, 3/4 inch ball valve and short 3/4 inch threaded nipple and cap.
D. Slope horizontal soil and waste pipes 1/4 inch per foot for pipes 2 and 3 inches in size and with a minimum fall of 1/8 inch per foot for pipes 4 inches and larger. Where an end or circuit vent pipe from any fixture or line of fixtures is connected to a vent line serving other fixtures, make the connection at least four feet above the floor on which the fixtures are located.

E. Grade horizontal drain piping downward in the direction of flow at least 1/4 inch per foot wherever possible but in no case less than 1/8 inch per foot.

F. Make all changes in pipe size on soil, waste and drain lines with reducing fittings, recessed reducers or flush bushings.

G. Make all changes in direction by the appropriate use of long radius fittings, except that sanitary tees may be used on vertical stacks and short quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from horizontal to vertical. Where it becomes necessary because of space conditions to use short radius fittings in any other location, obtain the consent of the Architect before they are installed.

3.9 UNDERGROUND PIPING WARNING TAPE

A. For underground chilled water, condenser water, heating water, fire water and domestic water piping, provide warning tape installed directly above underground piping (beyond building slab). Tape shall be placed at 12 to 18 inches below finished grade. Warning tape shall be metallic detectable type consisting of 0.35 mils thick solid foil core encased in a protective plastic jacket that is resistant to alkalis, acids and other destructive elements found in the soil. The lamination bond shall be strong enough that the layers cannot be separated by hand. Total composite thickness to be 5.0 mils. Foil core to be visible from unprinted side to ensure continuity. Warning tape for metallic piping may be 0.4 mils polyethylene film without metallic laminate.

B. A continuous warning message repeated every 16 to 36 inches shall be imprinted on the tape surface. The tape shall contain an opaque color concentrate designating the color code appropriate to the line being buried. Tape shall be minimum of 3 inches wide.

END OF SECTION 15030
SECTION 15040 - PIPING MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Piping within air ducts, plenums or other similar compartments used as part of an air distribution system shall be non-combustible or have a flame spread of not over 25, and shall have a smoke developed rating no higher than 50; no plastic piping is allowed in such spaces unless specifically rated for such service.

B. All steel pipe shall be in accordance with the "American Standards for Wrought Steel Pipe." Piping materials shall be in accordance with the following:

PART 2 - PRODUCTS

2.1 PREINSULATED STEEL PIPING SYSTEM

A. GENERAL:

1. Furnish a complete system of factory preinsulated steel piping for underground chilled water, condenser water and hot water heating service. All preinsulated pipe, fittings, insulating materials and technical support shall be provided by the preinsulated piping system manufacturer.

2. The system shall be Thermafab FERRO-THERM manufactured by Thermacor Process, Steelguard manufactured by Perma-Pipe, Inc., or equal as listed by addendum.

3. Certain fittings and joints may require tying into existing preinsulated piping system. The Contractor shall use correct style and material fittings (tees and ells) to tie into the existing system. All joints between the existing carrier pipe system and this steel system shall be via gasketed full face stainless steel bolted flanges.

B. CARRIER PIPE

1. Carrier pipe shall be Schedule 40 steel or seamless (Type S), standard weight. Seamless pipe smaller than 2” shall be ASTM A-106, or A53, Grade B. When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory insulated pipe shall have 6” of exposed pipe at each end for field joint fabrication.

C. POLYURETHANE FOAM INSULATION

1. Polyurethane foam insulation shall be injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of 1 inch for condenser water piping, 1-1/2 inch for chilled water piping and 2 inch for hot water piping. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0-to-3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.14, and shall conform to ASTM C-591. Maximum operating temperature shall not exceed 250°F.
D. JACKETING MATERIAL
1. Jacketing material shall be high density polyethylene (HDPE), conforming to ASTM D-1248. Wall thickness for HDPE jacketing shall be a minimum of 150 mils. Jacketing for above ground, outdoors installations shall contain ultraviolet inhibitors for protection from sunlight. No FRP jacket allowed.

E. MOISTURE BARRIER END SEALS
1. Moisture barrier end seals shall be factory applied, sealed to the jacket and carrier pipe. End seals shall be certified as having passed a 20-foot head pressure test. End seals shall be mastic, completely sealing the exposed end of the insulation. Field applied end seals shall be installed at each field cut to the piping before continuing with the installation.

F. STRAIGHT RUN JOINTS
1. Straight run joints are insulated using urethane foam to the thickness specified, jacketed with PVC sleeves and sealed with a pressure sensitive polyethylene backed, rubberized bitumen adhesive tape, 30 mils thick. Above ground installations shall use white, pressure sensitive PVC tape.

G. FITTINGS
1. Fittings are factory prefabricated and preinsulated with urethane to the thickness specified, jacketed with a PVC fitting cover and then wrapped with polyethylene backed, pressure sensitive rubberized bitumen adhesive tape, 30 mils thick. Carrier pipe fittings shall be butt-welded, except sizes smaller than 2" shall be socket welded. Fittings include expansion loops, elbows, tees, reducers and anchors. Fittings may be field insulated with liquid urethane foam insulation, jacketed with a PVC fitting cover and then wrapped with polyethylene backed, pressure sensitive rubberized bitumen adhesive tape, 30 mils thick. Above ground installations shall use white, pressure sensitive PVC tape.

H. EXPANSION/CONTRACTION COMPENSATION
1. Expansion/contraction compensation will be accomplished utilizing factory prefabricated and preinsulated expansion elbows, Z-bends, expansion loops and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion bolsters minimum 1" thick, extending on either side, both inside and outside the radius of the fittings is used, with all fittings having expansion in excess of 1/2". Submit drawings and calculations indicating proposed expansion/contraction compensation system for approval.

I. PRE-ENGINEERED SYSTEMS
1. Pre-Engineered systems shall be provided with all straight pipe and fittings factory preinsulated and prefabricated to job dimensions. Prefabricated systems shall be provided with factory insulated straight pipe sections and field fabricated fittings insulated with kits provided by the system manufacturer.
J. HYDROSTATIC PRESSURE TEST

1. A hydrostatic pressure test, as required by project specifications, shall be performed at one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

2.2 CHILLED WATER, CONDENSER WATER AND HEATING HOT WATER PIPING (ABOVE GROUND)

A. Schedule 40 black steel pipe with forged steel welding fittings for pipe 2-1/2 inches and larger and with malleable iron screwed pattern fittings for pipe 2 inches and smaller.

B. Contractor may, in lieu of welding pipe, use grooved type couplings and fittings. Grooves in the pipe must be in accordance with manufacturer's specifications. Couplings and fittings must be of American manufacture.

2.3 DOMESTIC COLD WATER PIPING

A. Piping inside building shall be Type "L" hard drawn copper with wrought copper sweat fittings. Piping 1-1/4 inches and smaller may be run under building slab using Type "L" soft drawn copper, without joints. Underground piping 4 inches and larger within 5 feet of building shall be cast iron or ductile iron water pipe with mechanical joints. Underground piping smaller than 4 inches diameter within 5 feet of building shall be Type "L" hard drawn copper.

2.4 DOMESTIC HOT WATER AND HOT WATER RETURN PIPING

A. Pipe shall be Type "L" copper.

2.5 SOIL, WASTE AND VENT PIPING

A. Coated Service Weight, bell and spigot cast iron with neoprene gasket joints in accordance with manufacturer's recommendations. Piping above grade may have no-hub joints. Cast iron piping (including fittings and couplings/gaskets) shall conform with ASTM standards A-888, A-74 and C-564 (as applicable) and Cast Iron Soil Pipe Institute Standard Specifications (CISPI) 301 and 310 (as applicable). Each length of pipe and each fitting shall be plainly marked with country of origin and the manufacturer's name or registered trademark.

B. Joints for no hub pipe and fittings shall conform to the manufacturer's installation instructions and local Code requirements. No hub couplings shall be composed of a stainless steel shield, clamp assembly and an elastomeric sealing sleeve conforming to CISPI 310.

C. Where space limitations restrict the use of cast iron piping, waste piping may be DWV type copper tube ASTM B306 with cast bronze drainage pattern fittings with soldered joints. (Not applicable for waste from urinals or water closets.)

D. Above ground piping 3 inches in diameter and smaller in enclosed spaces may be Schedule 40 PVC plastic drainage pipe and solvent welded fittings. Plastic pipe or pipe with plastic connectors is not allowed in plenum spaces used for air return; see "SCOPE" in "PART 1" of this Section.
2.6 EQUIPMENT DRAIN PIPING

A. Condensate drains from evaporators shall be Type "L" hard copper with wrought copper fittings. Drains shall be 1-1/2 inch minimum size. Where drains are not in air plenums, material may be Schedule 40 PVC plastic pipe and fittings; see "SCOPE" in "PART 1" of this Section. Drains from other equipment and piping system points shall be Schedule 40 galvanized steel.

2.7 GAS PIPING

A. Schedule 40 black steel pipe. Low pressure (not exceeding 5 psig) gas piping shall have thread joints with malleable iron banded fittings, except piping 2-1/2 inches diameter and larger may have welded joints with forged steel welded fittings. High pressure (5 psig or greater) gas piping shall have welded joints with forged steel welded fittings. All gas piping installed concealed above ceilings shall have welded joints with forged steel welded fittings.

B. Piping exposed to outdoor conditions shall be painted, see "SCOPE" in Section 15000.

2.8 FITTINGS

A. Screwed fittings shall be fine grain full weight malleable cast iron as specified, with smooth cut tapered threads. Welding fittings shall be seamless steel full standard weight. Mitered ells or notched tees will not be allowed. Where pipe 2 inches and smaller tees into pipe 2-1/2 inches and larger, "Thread-O-Lets" may be used. "Weld-O-Lets" may be used for tees where the branch size is not more than one-half the main size.

B. Companion Flanges 2-1/2 inches and larger shall be 150 pound forged steel slip-on or welding neck type with raised face. Companion flanges 2 inches and smaller shall be standard 125 pound cast iron, screwed pattern. Flange bolts and nuts shall conform with ASTM A307, Grade B. Gaskets shall be suitable for the service intended.

C. PVC pipe threaded connections larger than 1 inch shall be male threaded fittings; not female thread. When connecting PVC piping to metallic piping or fittings, Contractor shall use plastic male thread into a metallic female thread.

D. Copper pipe fittings shall be sweat type made up as described under "PIPE JOINTS" in Section 15030.

E. Plastic fittings shall be made as described under "PIPE JOINTS" in Section 15030.

F. Gasket/mechanical joint fittings shall be cast or ductile iron Class 250 (minimum) produced in accordance with AWWA C-111.

2.9 VALVES, GENERALLY

A. All valves shall have manufacturer's name and working pressure clearly cast on valve bodies. Where underground piping system with gasket/mechanical joint fittings are allowed in this Specification, valves may have mechanical joint connections (complying with AWWA C111). Valves shall have pressure and temperature ratings equal to or greater than the service intended.
B. Valves 2 inches and smaller shall be 125 psi SWP/200 psi WOG, bronze body (conforming to MSS SP-80), threaded or sweat pattern (use threaded ends for piping joined by brazing methods), as indicated below:

1. Gate Valves (RS): Nibco T/S-111; Milwaukee 148/149; Stockham B-100/108
2. Gate Valves (NRS): Nibco T/S-113; Milwaukee 105/115; Stockham B-103/104
3. Check Valves: Nibco T/S-413; Milwaukee 509/1509; Stockham B-319/309

C. Valves, 2-1/2 inches and larger shall be Class 125, iron body (conforming to MSS SP-70), bronze trimmed, flanged faced and drilled in as indicated below:

1. Gate Valves (OS&Y): Nibco F-617; Milwaukee F2885; Stockham G-623
2. Gate Valves (NRS): Nibco F-619; Milwaukee F2882; Stockham G-612
3. Check Valves: Nibco F-918; Milwaukee F2974; Stockham G-931

D. Contractor may, as an option, use grooved end valves and strainers with a 300 PSI pressure rating. All components must be of American manufacture.

E. Ball valves 2 inches and smaller shall be Grinnell 3810 Series, Nibco 595-Y Series or Watts B-6800 Series, rated for 150 PSI saturated steam pressure, 400 psig WOG pressure, 3-piece construction, with bronze body conforming to ASTM B 62, conventional port (or full port), chrome-plated brass or stainless steel ball, replaceable “Teflon” or “TFE” seats and seals, blow out proof stem and vinyl-covered steel lever handle, 4 inch minimum length. Ball valves one inch and smaller may be two-piece construction with standard or regular port, Nibco T/S-585-70, Watts B-6080 Series or Stockham S-216-BR-R Series. For chilled water systems, provide ball valves with extended stems arranged to receive insulation.

F. Butterfly valves (2-1/2 inch and larger) shall be Stockham LG-712/722 Series, Nibco LD-3010 Series or Watts BF-03-121 Series, with cast iron body conforming to ASTM A 126, Class B with ANSI 150 rating, EPDM seats rated for 225°F continuous service and suitable for 150 PSI shut-off pressure, nickel plated, ductile iron disc, stainless steel stem and lugged body drilled and tapped. Provide 10 position locking type lever operator for sizes 2-1/2 through 6 inches and gear drive operator with position indicator for sizes 8 inch and larger.

G. For chilled water and hot water service, butterfly valves may be substituted for gate valves for sizes 2-1/2 inches and larger.

H. Plug cocks in HVAC system water piping shall be iron body bronze trim, 125 psig steam rated, lubricated plug cocks flanged, faced and drilled to ANSI Class 125/150, and shall include lubricant rated for 220°F minimum service. Plug cocks may be Dezurik Fig. 118 or Milliken 601 Series non-lubricated eccentric plug valve with resilient faced plug rated for 225°F continuous service, flanged iron body, faced and drilled to ANSI Class 125/150, and stem seal packing repackable under pressure. Plug cocks shall have manual lever actuators and adjustable, open position memory stop.

I. Except where indicated otherwise, check valves at discharge of base-mounted HVAC pumps shall be spring loaded wafer type, non-slam design, with cast iron (ASTM A-126-B) body, Buna-N or bronze seat, lapped and balanced twin bronze flappers, and stainless steel trim and torsion spring. Valves shall be rated for 200 PSI pressure at 150°F and shall be designed to fit 125# ANSI bolt flange. Valves shall open/close at approximately one foot differential pressure. Valves shall be Nibco KW-900-W Series, Grinnell Fig. 300 Series or Watts 1CV-125 Series.
J. Gas valves shall generally be U.L. listed lubricated plug cocks, Homestead Series 600, Milliken 170 Series, or equal as listed by addendum. Valves 2-1/2 inches and larger shall have 100% (full port) area. Low pressure valves at terminal appliances, 1-1/2 inches and smaller may be quarter-turn plug valves with removable wrench handle and suitable for gas service.

2.10 FLEXIBLE PIPE CONNECTIONS

A. Provide flexible pipe connectors where shown on Drawings. Unless otherwise approved by Architect, connectors shall be flanged, 125 psig WOG and fabricated with stainless steel bellows and braided cover, length three times the pipe diameter.

2.11 DIELECTRIC FITTINGS

A. Provide dielectric fittings with appropriate end connections for pipe materials in which to effectively isolate dissimilar metals (including copper to steel connections), to prevent galvanic action and stop corrosion. For water (liquid) piping systems 4 inch diameter or less, dielectric fittings shall be Victaulic Clearflow Style 47, Precision Plumbing Products Inc. (PPP) Clearflow, or equal as listed by addendum, dielectric piping "nipples" with inert thermoplastic lining. For water (liquid) piping systems larger than 4 inch diameter, dielectric fittings shall be same as specified below for air/gas piping systems (larger than 2 inch diameter). For air/gas piping systems 2 inch diameter and smaller, dielectric fittings shall be dielectric unions with isolating gasketing/seals, Watts 3000 Series, Legend T-57 Series, Central (Plastics) Insulating Unions or equal as listed by addendum. For air/gas piping systems larger than 2 inch diameter, dielectric fittings shall be piping flanges with flange isolation kits (including isolating/sealing gasket, bolt isolating sleeves and isolating washers).

2.12 UNIONS

A. Install union connections at all pieces of equipment such as coils, pumps, tanks, etc., and all control valves. Where there is a valve at a piece of equipment, locate the union connection on the equipment side of the valve. No union shall be concealed in construction.

B. Unions installed in sweatend copper pipe shall be Crane No. 633, Nibco No. 633 or Grinnell Figure 9730. Unions 2-1/2 inches and larger shall be Grinnell Figure 463, Stockham Figure 698 or Nibco No. 733, standard malleable iron flange union with gasket.

2.13 PIPING ACCESSORIES AND SPECIALTIES

A. Piping accessories and specialties shown on Drawings or called for in these Specifications shall be in accordance with or similar in style and quality to the following specified equipment. Manufacturer's name and model numbers are mentioned only to establish the style and quality desired.

B. Provide valved manual air relief points at all locations required to remove air from circulating water systems.

C. Strainers shall be Y-type with removable bronze screens having 1/8 inch perforations. Provide 3/4 inch blow-down connection with valve.
D. Expansion tanks shall be bladder type (separate air charge from system water by means of a flexible diaphragm sealed into tank) with steel tank for 125 psig working pressure, built in accordance with ASME Code for Unfired Pressure Vessels, of the size shown on the Drawings, complete with all tappings and drain. Provide steel saddles for horizontal suspended applications or base ring support for vertical mounted applications.

E. Air separator shall be welded black steel, built and labeled in accordance with ASME pressure vessel code for 125 psig water working pressure with perforated stainless steel air collector tube designed to direct released air to high capacity, cast iron construction automatic air vent (pipe to drain) and with tangential inlet/outlet connections.

F. Chemical feed pot shall be bypass type chemical feeder of 5 gallon capacity, welded steel construction and 125 psig working pressure. Feeder shall be complete with fill funnel and inlet, outlet and drain valves. Provide chemical feeder for heating hot water and/or cooling chilled water system as indicated on Drawings.

G. Pressure regulating valves for cold water make-up lines shall be Bell & Gossett B12, Watts N250, or equal as listed by addendum, adjustable regulators factory set for 12 psig.

2.14 TRIPLE DUTY VALVES

A. Valves to be installed on the discharge piping of chilled water and heating hot water pumps shall be full line size triple duty valves. Valve shall be a non-slam check valve with spring-loaded disc, and a calibrated adjustment feature permitting regulation of pump discharge flow and shut off. The unit shall be of cast iron or ductile iron body construction suitable for maximum working pressure of 175 pig at maximum operating temperature of 300°F. The valve shall be fitted with a replaceable disk/clapper with resilient tight shut off seal, stainless steel spring and stainless steel stem. Valves shall be ITT Bell & Gossett 3D Series, Taco MPV Series, or approved equal.

2.15 SUCTION DIFFUSERS

A. Suction diffusers shall be an angle pattern flow straightening fitting equipped with combination diffuser-strainer-orifice cylinder, flow straightening vanes and start-up strainer. The suction diffuser shall be of cast iron construction with stainless steel or cast integral straightening vanes. A start up screen of 16 to 20 mesh, 304 stainless steel or bronze shall be included. The primary strainer will be of 304 stainless steel and have 5/32 inch to 3/16 inch diameter perforations. The cover shall be O-ring or gasketed sealed and the diffuser body shall be equipped with a cast boss for a pipe support. Each diffuser shall have ANSI 125 lb. flanges suitable for working pressure of 175 pig and 300°F temperature. Diffuser shall match pump suction size and have minimum size variation from piping serving pump. Diffuser shall have tappings (with plugs) for pressure gauge and drain openings; drain plug shall be magnetic. Diffusers shall be Bell & Gossett Bulletin B-820B, Aurora SD Series, or equal as listed by addendum.

2.16 BALANCING DEVICES

A. Circuit balancing valves for heating and chilled water service or domestic hot water shall be globe style valves for precise regulation and control, and rated 175 psi for iron and 240 psi for bronze at 250°F. Valves 2 inch to 2 inches shall be constructed of dezincification resistant brass (DZR) or bronze alloy. Valves 2-1/2 inches to 12 inches shall be constructed of iron with ANSI Class 125/150 flanged or grooved ends. Each valve shall have two metering/test
ports with internal check valves and protective caps. All valves must be equipped with visual position readout and concealed memory stops for repeatable regulation and control.

1. Valves 2 Inch to 2 Inches: Nibco T or S1710; Tour & Anderson STAD/STAS; Armstrong ABV-G

2. Valves 2-1/2 Inches to 12 Inches: Nibco F or G737; Tour & Anderson STAF/STAG; Armstrong ABV-G

2.17 GAUGE PLUGS
A. Provide a T.A.P. #4520 plug kit or Watts Series TP test kit for temperature and pressure readings in and out of all apparatus. Plugs shall be 2 inch IPS brass constructed plugs. Fitting caps shall be installed to extend above insulation. Provide one temperature/pressure test kit with one 2-1/2 inch test pressure gauge, two gauge adapters and one 1 inch dial test probe thermometer, all contained in carrying case. Ranges for gauges and thermometers shall be as described below.

2.18 PRESSURE GAUGES
A. Pressure gauges shall be Weiss 4CTS-1, Davis Model 1009 (4"), Weksler EA-14 or equal as listed by addendum, and shall have 4-1/2 inch glass dial face, corrosion resistant stainless steel case and ring, balanced adjustable black pointer guaranteed accurate to 1% of range, easy read dial - white background with bold black numerals and graduations, 270 degree arc, 1/4 inch N.P.T. bottom connection. Provide shut-off cock in stem.

2.19 THERMOMETERS
A. Thermometers shall be Weiss 5VBM, Davis PZ156, Weksler 5AA or equal as listed by addendum, round bi-metallic type with 5 inch dial, stainless steel case, bold black numerals, bold scale graduations and a heavy glass face. Graduations for chilled water, 20 degrees to 120 degrees. Graduations for hot water, 30 degrees to 240 degrees.

2.20 VALVE BOXES
A. Unless indicated otherwise on Drawings, all valves underground shall be installed in cast iron valve boxes, two piece, roadway box. Provide extension wrench tool for operation of valve from above grade.

PART 3 - EXECUTION

3.1 GENERAL
1. Install all equipment, piping and accessories as per manufacturer's recommendation.

2. For domestic water supply piping 4 inches in diameter and larger, provide thrust blocking at each change in direction of the piping and at all tees, plugs, caps and bends in accordance with requirements of NFPA 24. Where thrust blocking is impractical, fittings with an approved mechanical joint retainer gland may be used in lieu of thrust blocking.
3. Gas piping shall be installed in accordance with NFPA 54 and piping manufacturer's installation requirements.

4. Where allowed by the preceding Specifications, plastic piping below slabs, drives or other paved surfaces must be installed at minimum depth of 3'-0 inches below finished pavement.

5. Provide complete flushing of all new underground and above ground piping system (chilled water, condenser water and heating hot water) before placing into service. Flushing shall include pumping of system water (and chemicals) through piping system to thoroughly flush piping of all oils, slag, etc. Remove, clean and replace all strainers upon completion of this process.

END OF SECTION 15040
SECTION 15050 - EQUIPMENT AND SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install all equipment as indicated on the Drawings, and specified hereinafter including requirements of Section 15000 - "MECHANICAL SYSTEMS."

B. Heating and air conditioning equipment shall meet or exceed applicable minimum efficiency requirements of the National Energy Code as adopted by the State of Louisiana.

PART 2 - PRODUCTS

2.1 ROTARY SCREW LIQUID CHILLERS

A. The Contractor shall furnish and install Rotary screw Liquid Chillers where shown on Drawings. The capacity scheduled shall be based on the fouling factor as per ARI Standard 550/590-1998 for the condenser and evaporator. Provide first year parts, labor and refrigerant warranty on the entire chiller. Provide an additional four-year warranty covering parts, labor and refrigerant for the compressor sections, including the motor.

B. Each unit shall be completely factory packaged including evaporator, condenser, subcooler, oil separator, compressor, motor, lubrication system, Microprocessor control panel, Solid State Starter and refrigerant isolation valves. All units shall ship with a full charge of refrigerant (HCFC-22 or HFC-134a) and oil.

C. The compressor(s) shall be an open-drive, hermetic or semi-hermetic, screw type.

D. Automatic capacity control shall provide fully modulating control from 100% to 10% of full load. The unit shall be capable of operating with lower temperature cooling tower water during part-load operation in accordance with ARI Standard 550.

E. The motor shall be 2-pole, continuous duty, squirrel cage induction type, and shall have an open drip-proof enclosure. Motor full-load amperes at design conditions shall not exceed motor nameplate (FLA). Motor shall be designed for use with the type starter specified. Motor shall be factory-mounted and directly connected to the compressor to provide compressor/motor alignment.

F. An adequate supply of oil shall be available to the compressor at all times.

G. Evaporator shall be of the shell-and-tube, flooded type designed for 300 psig working pressure on the refrigerant side, and be tested at 450 psig. Shell shall be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports. The refrigerant side shall be designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section V III - Division 1. Tubes shall be high-efficiency, type. Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable.
H. Condenser shall be of the shell-and-tube type, designed for 300 psig working pressure on the refrigerant side, and be tested at 450 psig. Shell shall be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports. The refrigerant side shall be designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII - Division 1. Tubes shall be high-efficiency type. Each tube shall be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable.

I. The control panel shall contain the following digitally displayed diagnostics:

1. Chilled Water Temperatures, Supply and Return
2. High Refrigerant Pressure
3. Low Oil Flow Protection
4. Loss of Chilled Water Flow
5. Contact for Remote Emergency Shut-Down
6. Contact for Remote Alarm
7. Motor Current Overload
8. Phase Reversal/Unbalance/Single Phasing
9. Over/Under Voltage
10. Failure of Water Temperature Sensor Used by Controller
11. Compressor Status (On or Off)

J. The control panel shall provide an adjustable time limit start-to-start solid state anti-recycle timer to prevent compressor from short cycling.

K. Control Center shall be able to interface with the building automation system to provide remote chiller start/stop; reset of chilled water temperature; reset of current limit; and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down on a recycling safety.

L. Provide a load limit microprocessor logic to limit compressor loading on high return temperature to prevent nuisance trip-outs.

M. This panel shall contain controls permitting manual or automatic operation of the oil pump and the purge pump.

N. The panel shall also contain an evaporator low temperature cutout, condenser high pressure cutout, motor high temperature cutout and differential oil pressure controller to indicate adequate oil pressure to the bearings. These controls shall be so interlocked that if any one of the controls indicates abnormal conditions, the compressor will not be allowed to operate. The high pressure cutout, evaporator low temperature cutout and motor temperature cutout shall be arranged in a lockout circuit provided with a reset. The panel shall also contain a demand limiter with variable settings up to 100%, and a load limit mechanism to limit the load on the compressor motor to a safe maximum.
O. Supplementing the instrument and control panel for low pressure chillers shall be a low loss high efficiency purge system consisting of a motor driven purge compressor provided with an electrically heated oil separator, a sectionalized separator drum permitting a separation of the non-combustible gases and water from the discharge of the purge compressor. Means shall be provided for returning refrigerant to the evaporator. The purge system shall contain solenoid valves that will automatically isolate the purge system from the machine when the purge compressor is not in operation. The purge pump motor shall be 3 horsepower and suitable for operation on 120 volt, 60 cycle, single phase power. It shall draw its power through the control panel and shall have unit mounted contactors.

P. The Contractor shall furnish and install all necessary auxiliary water piping for the oil cooler, motor jacket and purge condenser in accordance with the manufacturer's recommendations. The Contractor shall insulate machines per manufacturer's recommendations.

Q. The chiller manufacturer shall furnish a reduced-voltage Solid State Starter for the compressor motor. Starter shall be factory-mounted and wired on the chiller. The starter shall provide, through the use of silicon controlled rectifiers, a smooth acceleration of the motor without current transitions or transients. The starter enclosure shall be NEMA 1, with a hinged access door with lock and key. Electrical lugs for incoming power wiring shall be provided.

1. Protective devices shall include:
   a. Phase rotation protection
   b. Single-phase failure protection
   c. Momentary power interruption protection.
   d. High/low line voltage protection.

2. Starter shall include:
   a. Three leg sensing overloads.
   b. 120-volt control transformer for all unit controls.

3. Three-phase voltage and current readings shall be coordinated with the unit control center, with digital read-out on the display.

R. The Contractor shall provide a flat suitably reinforced concrete pad for the unit. See details on Drawings.

S. Route the safety relief valve or rupture-disc discharge piping from chiller and purge condenser receiver to the outside using full size Schedule 40 black steel piping. Provide a safety check valve arrangement that will relieve unsafe pressures, but will close at safe levels to preserve the refrigerant charge.

T. Chillers to be constructed and compatible with refrigerant HCFC-22 or HFC-134a. The chiller capacity will be as scheduled using the refrigerant as installed.

U. The manufacturer shall provide necessary charge of refrigerant and oil to satisfactorily operate the compressor units.
V. The manufacturer shall furnish, for a period of up to five working days, a factory trained service engineer who shall adjust, provide leak testing, charging and start the unit and instruct the Owner’s operator on the care and operation of the machine.

W. A start-up log shall be furnished by the manufacturer to document the chiller’s start-up date and shall be signed by the Owner or his authorized representative prior to commissioning the chillers.

X. The manufacturer shall furnish complete submittal wiring diagrams of the centrifugal chillers, starter and associated components like flow switches, interlocks, etc., as applicable.

Y. Units shall be Trane Model RTHE, York Model YSCBBB50 or equal as listed by addenda.

Z. All electrical interlock and control wiring shall be the responsibility of the Mechanical Contractor.

AA. Chiller manufacturer shall provide and Temperature Controls Contractor shall install and connect a chilled water flow switch for each chiller.

2.2 REFRIGERANT MONITORING

A. Provide for each machinery equipment room containing refrigerants, a refrigerant sensitive infrared based stationary refrigerant gas leak monitor system designed to measure the level of multiple refrigerant gas compounds in multiple monitoring areas. The monitor equipment shall be a multiple area, self-contained wall or rack mounted device, split architecture design, recommended for eye-level installation with remote sampling probes located in the air flow path of the area where refrigerant gases are most likely to concentrate. Monitoring system shall support compliance with ANSI/BSR ASHRAE 15-1994 Mechanical Safety Code requirements.

1. Coverage: 4 point standard, field expandable to 16 points in 4 point increments. Provide 4 points of sensing.

2. Detector Type: Infrared Non-Dispersive.

3. Multiple Refrigerant System: System software gas library allows selection from 24 different refrigerant gases per monitor.

4. Sensitivity: All gases 1 PPM.

5. Measuring Range: 0 to 1000 PPM.

6. Accuracy: All gases; +/- 10 PPM from 0 to 100 PPM, +/- 10% of reading from 100 to 1000 PPM.

7. Temperature Drift: +/- 0.3% of reading °C.


9. Ambient Humidity: 5% to 90% (non-condensing).


12. Re-zero: Automatic B user definable re-zero frequency.

13. Response Time per zone: 5 to 120 seconds B depending on air sample tubing length.

14. Monitoring Distance: 500 feet per sample point.

15. Alarms: Three (3) levels of refrigerant alarm and one (1) system fault alarm. Set as per manufacturer's recommendations. The relays shall be user defined B latching (manual) or non-latching (auto). All relays are SPDT, 5 amp, 120 VAC rated.

16. Provide a factory authorized service representative to test and adjust unit following installation. In addition, representative to train Owner's maintenance personnel to adjust, operate and maintain refrigerant monitoring devices.

17. Power: 120 VAC +/- 10%. Note: Upon power failure, the system alarm contact will change state. Upon return of power the system alarm will reset and the system will reboot automatically and self test major subsystems of the equipment.

18. Power consumption: Less than 40 watts.

19. Communications: Full two-way communications through RS-485 (MODBUS-RTU). HGM300 / RDM800 and building management system maximum distance via RS-485 is 4500 feet. HGM300 -RS-232C port for local / modern communications B special configuration software available upon request. (Software version 1.2) Provide dual-loop 4-20mAdc output available.

20. Trend / Data logging: User defined timing of PPM trend B up to 100 data entries per zone. Graphic display of alarm and fault logs provided.

21. Water Trap: Built in water trap to protect infrared sensor.

22. Manufacturer: Subject to meeting all specified requirements: Bacharach HGM/RDM Series or MSA Sensor Series.

23. Provide local alarm within the Chiller Room to sound if refrigerant vapor concentration exceeds threshold. Alarm shall be UL listed, and shall provide a visual and an audible alarm with a sound pressure level of at least 15 dBA above operating ambient sound pressure level of the Chiller Room.

24. Warranty: Two (2) years.

25. Accessories provided: Purge line charcoal filter (with bracket), purge line end filter, air sample end filters and installation / operations manual are provided.

26. All components shall be field replaceable.

2.3 COOLING TOWERS

A. Furnish and install as shown on the Drawings, factory assembled, induced draft, cross-flow cooling towers with vertical air discharge. Towers shall be noncombustible. The tower shall be composed of single independent cells.
B. The casing shall be constructed entirely of hot-dip galvanized steel panels supported by heavy gauge hot-dip galvanized steel angle framework, all finished in hot-dipped galvanizing.

C. All galvanized steel components shall have an overall non tarnishing, non rusting finish.

D. Louvers shall be fiberglass reinforced polyester (FRP).

E. The cold water basin shall be constructed of stainless steel. The basin shall be self-cleaning with drain and clean-out connections.

F. The suction connection shall be provided with an anti-cavitation device and large area, lift-out, hot-dip galvanized steel strainers. A brass, float operated make-up valve shall be provided complete with a larger diameter plastic float, arranged for easy adjustment.

G. Hot water distribution basins shall be open gravity type constructed of hot-dip galvanized steel. Distribution weirs and plastic metering orifices shall be provided to assure even distribution of water over the wet deck surface. The wet deck surface shall be noncombustible and impervious to rot, decay, fungus or biological attack. The surface shall be manufactured and performance tested by the cooling tower manufacturer to assure single source responsibility and control of the final product.

H. The drift eliminators shall be constructed of non flammable non rotting material. Wood not accepted. They shall have a minimum of two distinct changes in air direction and limit draft loss to less than 0.2% of the total water circulated.

I. The fan shall be fixed pitch, multiple blade heavy duty, cast aluminum. It shall discharge through a fan cylinder designed for streamlined air entry and minimum tip loss for maximum fan efficiency.

J. The fan and shaft shall be supported by heavy duty, relubricable ball bearings with special moisture seals, slingers and housings designed to prevent moisture accumulation.

K. The fans shall be driven through a belt drive especially designed for guaranteed service of this type or through the use of a right angle gear reducer. Gear reducer option to include five-year warranty and five-year oil change intervals.

L. The fan motor shall be totally enclosed, 1800 rpm, squirrel cage, ball bearing type with special moisture protection on windings, shafts and bearings. Motors to be high efficiency, high power factor, premium grade type. Refer to "MOTORS AND MOTOR STARTERS."

M. Access doors shall be provided on both sides of the towers for access to eliminators and the plenum section. A heavy gauge hot-dip galvanized wire fan guard shall be provided over each fan cylinder.

N. Cooling tower performance shall be certified by the Cooling Tower Institute as provided in Standard STD-201 or, lacking such certification, a field performance test shall be conducted by the Cooling Tower Institute within the warranty period and in accordance with CTI Acceptance Test Code ATC-105.

O. Include with each tower cell an electric immersion heater and starter furnished with tower of size shown on the Drawings. Include with each cell a low water cut-off device, thermostat, heater contactors and pan probe. Each cell heating system to be wired to act independently. Towers to be Marley AV Series, Baltimore Air Coil Series 1500, or equal as listed by addendum.
P. See Drawings for additional tower accessories, capacities and configuration.

2.4 PUMPS

A. Pumps shall be by manufacturers as listed on Drawings, or equal as listed by addendum.

B. Pump capacities and characteristics shall be in accordance with that scheduled on the Drawings and with the following Specifications. Pump characteristics shall be such that motor horsepower will not exceed nameplate rating when pump is operating under any condition between cut-off and maximum published curves of each pump. Pumps shall be selected at or near the maximum efficiency point. The pump shall not be selected where the Design Point is to the right of the Best Efficiency Point by more than 10% of the design capacity.

C. Impeller diameters shall not exceed 85% of the volute cut-water diameter. Pumps shall be hydraulically and dynamically balanced and tested before shipment from the factory.

D. Pumps shall be end suction vertical split case or double suction horizontal split case with drain type baseplate and spacer type couplings, bronze wearing rings, bronze enclosed impellers, high quality steel shafts with mechanical shaft seal, integral seal flushing and dust-proof and moisture-proof ball bearings. See Schedule for type of pumps required. The Contractor shall furnish one spare seal for each size pump. Pumps shall have tappings for gauges. Provide shields over drive couplings.

E. Unless indicated otherwise on drawings, end suction vertical split case pumps shall be Aurora 340 Series, B & G 1510 Series, Armstrong 4030 Series, Taco FI Series, or equal as listed by addenda.

F. Motors shall be high efficiency, high power factor, premium grade type. Refer to "MOTORS AND MOTOR STARTERS."

G. Unless indicated otherwise on Drawings, in-line pumps shall be Armstrong AS@ or AH@ Series, B and G Model 60 Series, or equal as listed by addendum, circulating pump, designed for quiet operation and guaranteed by the manufacturer for the intended application. Pump shall be bronze fitted construction, three-piece design. The shaft shall have an integral thrust collar and shall be supported by oil-lubricated bronze sleeve bearings. Pump to be equipped with a watertight, long-life mechanical seal and be suitable for 125 psi working pressure.

2.5 AIR HANDLING UNITS

A. General:

1. Any exceptions to the Specifications must be clearly defined. The Contractor shall be responsible for expenses that occur due to any exception made. Air units shall be Trane Modular Climate Changer, York AirPak, Carrier Aero, McQuay Vision Series, or equal as listed by addendum.

2. Certify air volume, static pressure, fan speed, brake horsepower and selection procedures of air units in accordance with ARI 430. Certify unit with inlet vanes in wide-open position. Certify coil capacities, pressure drops and selection procedures of air unit in accordance with ARI 410-87.
3. Fabricate draw-through type air unit (suitable for the scheduled air pressure operation) with fan section(s), coil section(s), mixing box sections, access section(s) and filter section(s).

4. Provide 5 inch minimum/8 inch maximum height factory installed base rails to support all sections of units. Construct base rails of minimum 12 gauge galvanized steel channels or I-beams.

5. Factory fabricate air units of sizes, capacities and configuration as indicated on attached equipment schedule. Configurations and sizes shall be as required to be properly accommodated in the spaces shown on Drawings.

6. Units shall be selected for optimum performance. Submittal data shall include fan curves showing selection at peak operating efficiency and minimum noise level. Units having installed noise levels unsatisfactory to Architect shall be removed and replaced with quieter units.

B. Delivery, Storage and Handling:

1. Deliver products to site on a factory-installed base rail or shipping skid. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish. Units shall be fully assembled on base rails up to practical shipping limitations. On units not shipped fully assembled, manufacturer shall tag each section to indicate location in direction of airflow to facilitate assembly at the job site.

C. Environmental Requirements:

1. Do not operate units for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings lubricated and fan has been test run under observation.

D. Extra Stock:

1. Provide one set of 2 inch pleated media filters (see "FILTERS" this section) for the unit inlet section.

E. Submittals:

1. Submit drawings and product data under provisions of Section 15000. Submittals shall show unit configuration in direction of airflow, and shall indicate unit overall dimensions and service clearances. Product data shall indicate shipping/operating weights, coil performance, fan performance, motor electrical characteristics and finishes of materials. Submit sound power levels for each air unit at scheduled conditions. Provide fan curves with specified operating point clearly plotted. Fan curves shall indicate air volume, static pressure, fan speed and brake horsepower. Submit product data on filter sizes and quantities, filter performance and filter frames.

F. Casing:

1. Unit shall be constructed of a complete (galvanized steel) structural frame system with removable panels. Unless noted otherwise on Drawings, casing wall panels shall be double wall construction in all unit sections. Exterior wall shall be minimum 18 gauge galvanized steel. Unless indicated otherwise, interior wall shall be
minimum 20 gauge solid galvanized steel. All portions of the interior of the unit exposed to the airstream shall be covered with steel to allow cleaning and prevent fiberglass erosion into the airstream. Unit shall be designed and constructed such that structural frames are freestanding and wall panels are non-load bearing. Removal of all wall panels shall not affect the structural integrity of the unit. Units with welds on exterior surfaces or welds that have burned through from interior welds shall also receive a final shop coat of zinc-rich protective paint in manufacturer's standard color. All interior welds shall be coated with red oxide or zinc chromate primer.

2. Panels shall be fully removable to allow for a proper way to thoroughly clean panels of microbial growth and to access internal parts. Secure panels to structural frames with appropriate fasteners. Seal joints between exterior panels and structural frames with closed-cell foam gasketing for leak seal and thermal and acoustical break.

3. Construct casing sections for operation at 4 in. W.C. negative static pressure, except that section downstream of supply air fan shall be constructed for 6 in. W.C. positive static pressure. Closed cell foam gasketing shall be applied where casing sections are joined.

4. Insulate casing sections with 2 inch thick, 3 pound per cubic foot density fiber glass insulation. Provide double wall casing construction and encase insulation between exterior and interior casing panels such that no insulation is exposed to airstream. Insulate all structural channels connected to casing panels and cover openings in structural channels with galvanized steel. Insulation shall comply with NFPA 90A.

5. As required for routine service access, unit shall be supplied with full height, galvanized, (insulated) double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type Neoprene gasket to prevent air leakage, and Ventlock style handle that can be opened from unit inside or outside of unit. Access doors are to open outward for negative pressure and inward for positive pressure.

6. Units shall have a full size removable service door on drive side of fan section. Doors shall be constructed as specified above. Fan section drive side access door shall contain an 8 inch square sealed glass and wire view window.

7. Drain pan(s) shall be provided to completely cover bottom of each cooling coil, hot water heating coil, access and supply fan sections for each air unit. Drain pans shall be double wall construction with insulation encased between exterior and interior walls. Unless noted otherwise, interior pan for cooling coil section shall be stainless steel construction, sloped in two planes to assure positive drainage, as per ASHRAE Standard 62-89. Interior drain pan for other casing sections shall be galvanized steel. Contractor is to install full size ball valve (with brass plug at outlets) at drain outlet from non-cooling coil pan(s).

G. Fans:

1. Provide supply fan section with air foil double width, double inlet centrifugal fan as required for stable operation and suitable for class of service intended.

2. Fan shall be selected for optimum performance and minimum noise level. Fan selected shall have stable operating performance with a 50% reduction in total air flow capacity. Fan performance shall be such that on a decrease in fan static
pressure (below the design point), fan air flow shall **increase** (while maintaining constant fan speed).

3. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that the fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

4. Provide self-aligning, grease lubricated pillow-block ball bearings selected for L-50 200,000 hour average life. Extend fan bearing grease lubrication lines to drive side of unit with tubing and zerk fittings rigidly attached to the casing.

5. Fans shall be mounted on galvanized steel isolation bases. Internally mount motors on same isolation bases and internally isolate fans with 2 inch deflection spring isolators, unless noted otherwise on Drawings. Install flexible canvas duct connection between fan and casings to ensure proper isolation and prevent vibration and noise from being transmitted through the unit and ductwork. Flexible canvas connection shall comply with NFPA 90A.

6. Statically and dynamically balance fan section assemblies. Fan section assemblies include fan wheels, shafts, bearings, drives, belts, isolation bases and isolators. For fan sections controlled by variable frequency drives, balance at all speeds between 30% and 100% of design RPM. The filter-in measurements shall not exceed 5 mils in the horizontal, vertical and axial planes. Copy of balance report shall be furnished to Engineer before units are started by Mechanical Contractor. If factory balancing is not available, unit manufacturer shall include services of field vibration analysis company to perform analysis as specified above with written report to Engineer for verification.

7. Fan sections of 16,000 CFM or greater shall have totally enclosed belt guards to prevent injury to mechanics who enter fan sections, as per OSHA Standards. Construct belt guards of galvanized expanded metal to allow viewing of belt tension. Belt guards shall have removable front and top panels and tach holes opposite fan and motor shafts.

8. Fan sections with plug fans shall have galvanized expanded metal access door guards to prevent unauthorized entry into fan sections when access doors are opened. Design access door guards for removal from outside of unit.

**H. Motors and Drives:**

1. Fan motors to be mounted and isolated on the same integral base as the fan. Motors shall have slide base mount for adjustment of belt tension.

2. Motors shall be high efficiency, high power factor, premium grade type as specified previously. Where units are for variable air volume service, motors shall be inverter duty rated. Refer to "MOTORS AND MOTOR STARTERS."

3. Motors shall be totally enclosed fan cooled.

4. V-belt Drive shall be constant pitch rated at 1.3 times the motor nameplate. Fans with variable frequency drives shall be furnished with fixed pitch sheaves with 1.5 service factor. Constant volume air units shall have adjustable pitch pulleys.
I. **Water Coils:**

1. Coils shall be manufactured by the same company as the supplier of the air unit. All coils shall be fully enclosed (including headers and U-bends) in an insulated coil section casing. Coils shall be designed with aluminum plate fins and 2" diameter copper tubes. Coils shall be drainable and shall have non-trapping circuits. Coils shall have minimum of two rows (of tubes).

2. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Fin spacing shall not be closer than 10 fins per inch.

3. Construct headers of copper tubing. Supply and return water piping connections shall penetrate coil section casings to allow for field tie-in. Clearly label piping connections.

4. Cooling coils in excess of 48 inches total height shall have intermediate stainless steel drain pan(s) for the upper coil section. The intermediate pan(s) shall have drop tubes to drain condensate to the bottom pan.

J. **Filters:**

1. Provide factory fabricated filter section(s) of the same construction and finish as unit casing with filter guides and hinged, removable double wall access doors for filter removal. Block-offs shall be provided by the unit manufacturer as required to prevent air bypass around filters. Unit inlet filter section shall be flat filter type, angle filter type, or angle filter type/combination filter-mixing box section, as indicated on Drawings. Unless indicated otherwise on the Drawings, inlet filters shall be 2 inch extended area (pleated media) 30% efficient panel type.

2. Rigid (cartridge) filter sections shall have high efficiency, 12" depth cartridge type filters with disposable 2" extended area (pleated media) 30% efficient panel pre-filters in the final filter position. High efficiency filters shall be extended surface, supported pleat, water resistant glass fiber media type, and rated in accordance with ASHRAE 53-76 and UL Class 1 or Class 2; 90 to 95%. Filters shall be removable from both sides of the filter section be removable from both sides of the filter section. Insulate filter section with 2 inch thick, 1-1/2 lb. per cubic ft. density fiberglass insulation, and minimum 20 gauge double wall panels of solid galvanized steel. Foil faced insulation shall not be acceptable as a substitute for double wall construction. Each filter cell is to be sealed against leakage by molded gaskets, installed in filter mounting tracks, and by gaskets between adjacent filters. The track gaskets shall be installed so that seal is affected on the air entering face of the filter. The hi-efficiency media packs shall be inserted into galvanized steel cell side with galvanized steel header on the air entering side. Hi-efficiency filters shall be installed in unit at time, approved by owner, during final air balancing of unit. (Do not install hi-efficiency filters prior to this approved time.)

K. **Damper Section:**

1. Damper section casing shall be same construction and finish as unit casing with hinged double wall access doors.

2. Mixing box section and combination filter-mixing box sections shall have parallel blades and mechanically linked dampers.
3. Dampers shall be double-skin galvanized steel air-foil blade type with blade edge seals, rated for maximum leakage rate of 5 cfm/ft² at 1 inch W.C. Blades shall rotate on stainless steel (sleeve) bearings.

2.6 ELECTRIC AIR COILS

A. This specification shall apply to all electric heating systems, separate duct heaters, unit heaters and factory supplied heaters as part of packaged systems.

B. Heating coils shall be U.L. listed and be as manufactured by unit supplier or shall be Indeeco Type QUA, Redd-i Heat Model R, or equal as listed by addendum. Coils shall be integral to cabinet or may be for duct installation with insulation to prevent condensation. Coil shall be complete with automatic primary reset, thermal cut-out and magnetic contactor for each stage, pre-wired and mounted on the coil. **Contactors must be all phase disconnecting type.** In addition, the control panel shall contain a supplementary manual reset. The unit shall comply with all NEMA and NEC regulations. Disconnect switches for each coil shall be included in the control panel and be of the cabinet interlocking fused disconnect type. Fuses shall be for all phases and rated at full current delta or wye connected. Provide control voltage transformer as required for coordination with the control voltage required by the Temperature Controls Supplier. Provide pressure differential airflow switch factory mounted, wired and piped. Coordinate with the Temperature Controls Supplier for calibration and sequence of operation required. Coils to be derated for maximum density of 35 watts per square inch and be of the 80% nickel, 20% chromium composition type. All terminals shall be stainless steel tubular crimped type not screw post type, and all factory wiring shall be Grade "A".

C. Position coils so that clearance of 36 inches is maintained in front of panel for at least a 30 inch width and hinged door is free to open to 90 degrees.

2.7 BOILERS

A. Provide where shown on the Drawings U.L. Listed forced draft, gas, fully automatic package boilers for water heating with capacity as scheduled on drawings. Boilers shall carry a 20 year prorated warranty against damage caused by “thermal shock.”

B. Boiler shall be of the horizontal inclined water tube type designed and constructed in accordance with ASME Code Section IV for a maximum allowable working pressure of 125 psig and to carry the appropriate ASME stamp. Boiler tubes shall be 2” O.D. hard drawn, 13 gauge, copper tubes and magnesium anodes. Tubes must be easily obtainable from competitive sources.

C. Tubes shall be rolled and flared into flat rectangular tubesheets mounted in two rectangular box headers. Boiler head plates shall be removable to provide easy access to the boiler tubes for inspection and cleaning. Head plates shall be 5/8” thick SA515 Grade 70 steel with reinforcing rib(s).

D. Firebox shall be made of high temperature castable refractory to withstand not less than 2750°F. Access shall be provided to the fire box and burner fire head by means of a removable refractory section.

E. The boiler jacket shall be of not less than 20 gauge mirror finish stainless steel.
F. Boilers shall be equipped with a combination pressure/temperature gauge, ASME rated relief valve (working pressure 125#), operating control, high limit control with manual reset, firing rate control with float type low water cut off, manual reset low water cut off, etc.

G. Forced draft burners shall be U.L. listed gas fired forced draft flame retention type. Burner to be equipped for full modulation and have flame safeguard controls to meet or exceed U.L. standards. Gas burner is to be equipped with main and pilot gas cocks, main and pilot gas valves, and gas pressure regulators. Gas valves and controls are to be provided to meet U.L. 795 (FM/IRI optional) Code requirements.

H. Blower motor characteristics shall be as scheduled on the drawings.

I. Control power shall be 115 volts, 60 Hz, 1 phase.

J. Boiler shall be Ajax WRF Series, Rite W Series, or equal as listed by addenda.

K. The complete unit shall be guaranteed to operate at an efficiency of 80% or greater over the operating range.

L. The complete packaged boiler is to receive factory tests to check construction, operation and function of all controls.

M. After boiler installation is completed, provide to the Owner the services of a field representative for starting the unit and training the operator. This service is not to exceed two consecutive days.

N. The factory representative is to provide a field test report giving the results of a flue gas analysis test that will be provided by the factory as part of the initial start up.

2.8 GAS VENTS

A. Vents from heating units and water heater shall be Metalbestos Types RV or QC, Ampco Ameri-Vent Type B, or equal as listed by addendum, double wall Class Type "B" vent pipe. Provide Underwriter's Collar at roof and floors with copper roof jack and flashing at roof. See "FLASHINGS" under "SHEET METAL WORK." Cap with Ampco Models EC, RC and C, Metalbestos TOP, or equal as listed by addendum, cap designed to prevent backdraft.

B. Vents and fittings from boilers shall be Metalbestos Types PS, Ampco Type VSI or equal as listed by addendum, double wall positive pressure piping system. Inner gas-carrying pipe shall be Type 316 stainless steel, outer jacket shall be aluminized steel with one-inch insulating air space.

C. For metal panel roofing, flashing shall be same as specified for "PIPE FLASHINGS" in Section 15030, except rubber boot shall be silicone construction for +250°F "high" temperature application.

D. Where indicated on the drawings, provide adjustable barometric draft regulator, Field Controls MG1 Series or equal.

2.9 FANS
A. Fans shall be constructed in accordance with AMCA standards with ratings certified in accordance with the "Standard Test Code for Centrifugal and Propeller Fans" as adopted by the AMCA and ASHRAE.

B. Curb-Roof Mounted Upblast Fans:

1. Roof mounted fans to be spun aluminum, belt driven or direct drive type as specified.

2. Fan shall be listed by Underwriters Laboratories (UL 762) (required for kitchen hoods only). Fan shall bear the AMCA certified ratings seal for sound and air performance.

3. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have quick release latches to provide access into the motor compartment. An external wiring compartment with integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one inch thick, three pound density foil backed heat shield shall be utilized to protect the motor and drive components from excessive heat (required for kitchen hood exhaust only). Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

4. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-96, balance quality and vibration levels for fans.

5. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. See "MOTORS AND MOTOR STARTERS."

6. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

7. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

8. Upblast fans shall be Cook Model ACRU, Greenheck Model CUBE, or equal as listed by addenda. Mushroom type exhaust fans shall be Cook Model ACE, Greenheck Model G or GB, or equal as listed by addenda.

9. Provide 12 inch high prefabricated factory roof curb, all aluminum constructed with flashing flanges and cants, nailer strip all designed to support the weight and slope of the fan assembly.
C. **Propeller Wall Fans:**

1. Propeller wall fans shall be wall mounted, direct driven, propeller exhaust fans. Fans to be complete with all accessories specified on Drawings.

2. Fan shall be bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a 12 gauge steel wire guard. The wire guard shall be bolted to a minimum 14 gauge wall panel with continuously welded corners and an integral venturi. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit test packaging.

3. All steel fan components shall be protected with an electrostatically applied, baked polyester powder coating. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

4. Propeller shall have aluminum blades riveted to a painted steel hub. The hub shall be securely fastened to the motor shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, balance quality and vibration levels for fans.

5. Motor shall be open drip proof type with permanently lubricated sealed bearings. See "MOTORS AND MOTOR STARTERS."

6. Fan shall be Cook Model SWD, Greenheck Model SE-2, or equal as listed by addendum.

D. **Ceiling, Wall or Inline Mounted, Direct Driven, Centrifugal Exhaust Fans:**

1. The fan housing shall be galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a reinforcing channel. Motor shall be resiliently mounted. Unit shall be supplied with integral wiring box. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include reinforced aluminum dampers with continuous aluminum hinge rods and brass bushings. To accommodate different ceiling thickness, an adjustable pre-punched mounting bracket shall be provided. A powder painted white steel grille shall be provided as standard. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit test packaging.

2. Wheels shall be twin DWDI centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, balance quality and vibration levels for fans.

3. Motor shall be open drip proof type with permanently lubricated sealed bearings and built-in thermal overload protection. See "MOTORS AND MOTOR STARTERS."

4. Fan shall be Cook Gemini 1000 or 2000, Greenheck Model SP, or equal as listed by addendum.

### 2.10 HOT WATER UNIT HEATERS

A. Hot water unit heaters to be Trane Model S, Modine Model HS, or equal as listed by addendum. Unit to be complete with adjustable horizontal louvers, 18 gauge back panel with deep-draw fan orifice for extreme rigidity, steel supply and return pipe tap connectors bolted to back and casings phosphatized to prevent corrosion and painted with blue gray baked enamel.
B. Fan to be high efficiency fan with aluminum blades, factory balanced.

C. Hot water headerless coils shall have aluminum fins mechanically bonded to seamless copper tubing. All coils to be one-row deep in air flow direction and tested at 375 psi air under water.

D. All motors to be totally enclosed, with built in overload protection.

2.11 THROUGH-THE-WALL UNITS

A. Packaged Terminal Air Conditioners shall be of the sizes and capacities shown on the drawings. The units shall be located as shown on the drawings and each shall consist of a chassis, wall sleeve, outdoor grille and subbase.

B. Units shall be complete with a plastic front cover and a polycarbonate double sloped drain pan.

C. Units shall be approved and listed by cULus. Unit capacity and efficiency performance shall be certified in accordance with ARI standard 310/3801993.

D. Units shall exceed ASHRAE Standard 90.1 for energy efficiency.

E. Unit chassis shall include an electrical power cord installed by the manufacturer to assure proper configuration and UL approved length. Cord shall be compatible with the unit’s required voltage and ampacity in conformance with National Electrical Code (NEC) and local codes.

F. Heating/Cooling Chassis: The chassis shall consist of the following sections and components:
   1. Chassis shall be slide-in, plug-in type; ready to operate after installation.
   2. Hermetically-sealed refrigerant system with external vibration isolated rotary type compressor, condenser and evaporator coils and capillary refrigerant control.

G. The airflow system shall consist of one permanent split-capacitor, direct-drive, two-speed fan motor for the outdoor fan, and a separate permanent split-capacitor, two-speed fan motor for the indoor fan. Outdoor fan shall be multi-blade axial flow design with slinger ring. Indoor fan shall be a cylindrical cross-flow blower fan to assure an evenly distributed air flow. All motors on the exterior side of the weather barrier shall be of an enclosed design to reduce the effects of moisture and corrosion.

H. Units shall have a resistance heater to provide specified heat output.

I. Condenser and evaporator coils to be constructed of high-efficiency, aluminum enhanced louvered fins and grooved copper tubing necessary to achieve EER and COP rating of the unit.

J. Adjustable-closing fresh air vent, with vent door secured for shipping, and optional securing in the closed position, with a manual control.

K. Heat Pump Chassis:
1. Heat pump units shall automatically change from heat pump operation to electric resistance heat when heat pump operation is unable to produce sufficient heat to maintain room temperature within 2.5°F of thermostat setpoint, or when the outdoor air switch-over temperature falls below 20°F.

2. Heat pump unit shall automatically begin an active defrost cycle when the outdoor coil temperature drops below 21°F. Defrosting shall be accomplished by active defrost with unit automatically reinitiating heat pump operation when outdoor coil reaches 54°F or six minutes has elapsed after defrost has been initiated.

L. Front Panel:

1. Units shall have a matching, easily removable, wrap-around room cabinet molded of High Impact Polystyrene (HIPS) to resist corrosion and damage. Cabinet shall have a low profile depth of 7-1/4” to minimize the unit's impact on room space. The front panel shall have the following features:

a. Air discharge area accessible for cleaning without tools when room front is removed.

M. Filtration:

1. Unit shall have indoor and outdoor air filters. Filters shall be washable polypropylene mesh. Indoor filters shall be accessible without requiring removal of room cabinet from chassis.

N. Controls:

1. Unit controls shall be easily accessible for selection of unit operation mode and thermostat setting. Control knobs shall clearly indicate the room setpoint temperature and operation range. The unit operational mode switch shall include 6 settings: low fan, high fan, low cool, high cool, low heat, and high heat.

2. Controls shall utilize solid state microprocessor based controller to allow the following operations:

a. Freeze protection that automatically activates the electric resistance heater and fan motor to warm and circulate indoor air to help prevent damage due to freezing temperatures. Freeze protection shall operate as long as unit is connected to powered electrical circuit.

b. The unit shall be capable of on board diagnostics. An LED shall flash a code displaying 1 of 9 specific failure conditions, which include: compressor failure, setpoint failure, thermostat wiring failure, indoor air thermistor failure, indoor coil thermistor failure, outdoor air thermistor failure (PTHD only), and outdoor coil thermistor failure (PTHD only).

O. Provide one-year parts and labor warranty initiated at time of building acceptance.

P. Units to be Trane PTAC Series, Carrier 52P Series, or equal as listed by addendum.

PART 3 - EXECUTION
3.1 GENERAL

A. Install equipment as per manufacturer's recommendations.

END OF SECTION 15050
SECTION 15060 - TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Management and Control System (BMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. The BMCS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure network within the building or by remote modem accessible dial-in capability. This shall include HVAC control, and all reporting and maintenance management functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.

B. Include all submittals, data entry, electrical installation, programming, start up, test and validation acceptance documentation and system warranty. Refer to General Conditions.

C. The complete temperature control system shall be DDC with electronic sensors and electric/electronic actuation of valves and dampers. All wiring required in the control system and all interlocking motor control wiring and start-stop control wiring shall be furnished and installed as part of the work of this section of Division 15. The control system shall include all interconnecting wiring and conduit as required for a fully operational system as specified. All line voltage wiring and low voltage wiring shall utilize methods and materials complying with the requirements of the Electrical Specifications, Division 16.

D. The control system shall consist of all thermostats, valves, dampers, transformers, relays and other necessary equipment to provide controls for all phases of the cooling, heating and ventilating systems as required.

E. The Temperature Controls Contractor shall furnish and install a Magnehelic pressure gauge with sensor probes and tubing to measure differential air pressure across the (final) rigid filter section, typical for each air unit. Mount gauge to unit enclosure.

F. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office. The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office.

G. The Contractor shall be responsible for all controllers, control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

H. The Building Management and Control System (BMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility for connection as a Web Based Accessed Facility. The NAC shall connect to a Local Area Network (LAN). Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Provide interface devices, software and connections as required.
I. Contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web Browser pages, as applicable, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or wide area network.

1.2 INSTRUCTIONS TO BIDDERS

A. The system specified in this document shall be manufactured by Invensys Controls, Johnson Controls, or equal as listed by addenda. Temperature Controls Contractor must have local office with full service staff within 30 mile radius of Baton Rouge.

1.3 WORK BY OTHERS

A. Valves, flow meters, water pressure and differential taps, flow switches and thermal wells shall be set in place by Contractor installing piping. Dampers, airflow stations and access doors shall be set in place by the Contractor installing ductwork. Furnishing and installing duct smoke detectors shall be under Division 16.

1.4 CODES AND APPROVALS

A. The complete BMCS installation shall be in strict compliance to the national, state and local mechanical and electrical Codes and Division 16 of these specifications. All devices shall be UL or FM listed and labeled for the specific use, application and environment to which they are applied. The system shall comply with NFPA 90A Air Conditioning and 90B Warm Air Heating, Air Conditioning.

B. System shall be designed and manufactured to ISO 9001 quality standard, and all electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

C. The unitary controllers, intelligent sensors, and intelligent actuators shall be based upon LonMark functional profile configurations.

D. All products of the BMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package.

1. UL-916: Energy Management Systems
2. ULC: UL-Canadian Standards Association
3. FCC, Part 15, Subpart J, Class A Computing Devices

1.5 WARRANTY

A. All components, system software, and parts supplied by the Temperature Controls Contractor shall be guaranteed against defects in materials and workmanship for one year from the final project acceptance date by the Owner. The Temperature Controls Contractor, at no charge, shall furnish labor to repair, reprogram, or replace components during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the Owners request for warranty service within 24 hours during normal business hours.
1.6 REMOTE ACCESS

A. The Owner shall grant to the Contractor, reasonable access to the BMCS during the warranty period. The Owner shall allow the contractor to access the BMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

1.7 SPECIFICATION NOMENCLATURE

A. The following are acronyms which may be used in this specification:

1. BMCS  Building Management and Control System
2. NAC  Network Area Controller
3. GUI  Graphical User Interface
4. PMI  Power Measurement Interface
5. DDC  Direct Digital Controls
6. SSL  Secure Socket Layer
7. LAN  Local Area Network
8. OOT  Object Oriented Technology

PART 2 - PRODUCTS

2.1 GENERAL

A. The Building Management Control System (BMCS) shall be comprised of a network of stand-alone digital controllers, a graphical user interface computer system, software, network devices and other devices as specified herein. All systems and software within BMCS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMCS.

2.2 ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the internet to a host computer in a remote location. The BMCS shall include the software and hardware ability to communicate to third party systems such as chillers, boilers, air handling systems, energy metering systems, other energy management systems, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities. Controllers/modules shall be standalone open Echelon (Lon Mark) interoperable.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

C. The supplied system must incorporate the ability to access all data through the proprietary operator interface and configuration programs. The installed system shall provide secure
password access to all features, functions and data contained in the overall BMCS. Secure Socket Layer (SSL) encryption shall be an available option for remote access.

D. The installed system must be totally scalable to allow for future expansion with the addition of controllers and/or input/output devices. It shall not be necessary to remove equipment supplied under this contract to expand the system.

E. The failure of any single component or network shall not interrupt the control functions of non-affected devices. A single network failure shall only affect shared communications or shared data; individual application controllers and network controllers shall continue normal operation minus only the data from a remote device from the affected network. Automatic default values for all network transported data shall be provided to allow continued operation until the network is restored.

F. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

G. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

H. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be a 10 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), and user workstation.

2.4 NETWORK ACCESS

A. Remote Access:

1. Provide access to the LAN from a remote location, via the Internet. The owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.5 DDC CONTROLLERS

A. HVAC control shall be accomplished using DDC based controllers. All programming, documentation and programming tools necessary to set up and configure the supplied controllers per the specified sequences of operation shall be provided.

B. All control sequences within or programmed into each controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
C. Each controller shall communicate with the NAC at a baud rate of not less than 19K baud. Each controller shall provide LED indication of communication and controller performance to the technician, without cover removal.

D. Each DDC controller shall be operational as standalone devices configured to perform the sequences specified, and with I/O selected for the application. Controllers shall be tested and listed under UL916 for Energy Management computing devices. Each controller shall be provided with a face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. The controller shall have spare Inputs/Outputs for future expansion.

E. Each DDC controller shall be configured for DIN rail mounting using industry standard clip on adapters or direct panel mounted. Each controller shall be designed with on-board jacks for quick commissioning and troubleshooting with a portable programming tool. This connection shall be extended to a space temperature port where indicated and shown on plans.

F. DDC Controllers shall be standalone EEPROM based configured to perform the sequences specified, and with I/O selected for the application. Enclosures for controller shall be flame retardant compact plastic conforming to UL94-V5 for plenum mounting or plated steel.

G. Air Unit Controllers:

1. For each air unit and fan coil unit, provide a stand alone DDC Controller featuring preprogrammed heating and cooling and ventilation control algorithms configurable to match each unit application. Separate unoccupied heating and cooling setpoints shall be provided. A standby feature shall be provided to reset the occupied temperature set point back to a user definable limit based on status from an auxiliary device, such as an occupancy sensor. For each variable air volume (VAV) air unit application, controller shall include a temperature wall module connection that may be used in applications where the wall module must: sense temperature, control set point temperature and control Occ/Unocc condition. In addition to internal I/O selected for the application, controller shall also support distributed I/O from the network.

H. VAV Terminal Box Controllers:

1. For each VAV terminal box, provide a standalone DDC VAV terminal unit controller for factory mounting featuring preprogrammed heating and cooling control algorithms. Controller shall be designed to work with pressure independent units and pressure dependent units. Pressure independent units shall contain a default algorithm to revert to pressure dependent mode on failure of the flow sensor. Controller shall be configurable for the following options: No Fan, Series Fan, Parallel Fan, Three Stages of Reheat or Modulating, Peripheral Radiation Control, Dual Duct, Exhaust Tracking, Occupancy Sensor, Window Sensor, Shared or Direct Wired Wall Module.. Controller application software shall include; set point reset for energy demand limit control or outdoor air compensation, optimum start, night purge and morning warm-up. A standby feature shall be provided to reset the occupied temperature set point back to a user definable limit based on status from an auxiliary device, such as an occupancy sensor or window contact. In addition to internal I/O selected for the application, controller shall also support distributed I/O from the network.

2. The Temperature Controls Contractor shall furnish and ship damper actuators and VAV Box Controllers to the terminal equipment manufacturer for factory installation. The control contractor shall provide the terminal equipment manufacturer with
necessary wiring and mounting instructions. Any mounting charges shall be the responsibility of the equipment manufacturer.

3. VAV box controllers shall have configured airflow calibration software for VAV applications to assist the test and balance (T&B) contractor in final calibrations. Using the controls contractors calibration tool, the T&B contractor shall be provided with a display allowing a simple command entry to place the VAV box controller in zero, minimum, and maximum CFM control modes. At each mode, a display field shall be provided for the T&B contractor to enter the actual measured value in CFM. Upon completion of entering the three values, the VAV box controller shall automatically recalibrate based upon the actual values.

2.6 NETWORK AREA CONTROLLER (NAC)

A. Contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided and existing. It is the responsibility of this Contractor to coordinate with the Division 15 and 16 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data
7. Network Management functions for all LonWorks based devices

C. The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port - 10 Mbps
2. One RS-232 port
3. One LonWorks Interface Port B 78KB FTT-10A
4. Battery Backup
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. The NAC must be capable of operation over a temperature range of 0 to 55°C
7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
F. **Event Alarm Notification and Actions:**

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault

4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

5. Provide timed (schedule) routing of alarms by class, object, group, or node.

6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

7. Control equipment and network failures shall be treated as alarms and annunciated.

8. Alarms shall be annunciated in any of the following manners as defined by the user:
   a. Screen message text.
   b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      1) Day of week
      2) Time of day
      3) Recipient
   c. Pagers via paging services that initiate a page on receipt of email message
   d. Graphic with flashing alarm object(s)
   e. Printed message, routed directly to a dedicated alarm printer

9. The following shall be recorded by the NAC for each alarm (at a minimum):
   a. Time and date
   b. Location (building, floor, zone, office number, etc.)
   c. Equipment (air handler #, accessway, etc.)
   d. Acknowledge time, date, and user who issued acknowledgment.
   e. Number of occurrences since last acknowledgment.

10. Alarm actions may be initiated by user defined programmable objects created for that purpose.
11. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

12. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

13. Provide a "query" feature to allow review of specific alarms by user defined parameters.

14. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

15. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

G. Data Collection and Storage:

1. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

   a. Designating the log as interval or deviation.
   b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
   c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
   d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
   e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

5. All log data shall be available to the user in the following data formats:

   a. HTML
   b. XML
   c. Plain Text
   d. Comma or tab separated values

6. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

   a. Archive on time of day
   b. Archive on user-defined number of data stores in the log (buffer size)
   c. Archive when log has reached it's user-defined capacity of data stores
   d. Provide ability to clear logs once archived
H. Audit Log:

1. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
   a. Time and date
   b. User ID
   c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

I. Database Backup And Storage:

1. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

2. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

3. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.7 GRAPHICAL USER INTERFACE SOFTWARE

A. Operating System:

1. The GUI shall run on Microsoft Windows Server Workstation.

2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

3. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. Real-Time Displays:

1. The GUI, shall at a minimum, support the following graphical features and functions:
   a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file
formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL’s, and links to other graphic screens.

c. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.

d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

e. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

f. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

C. System Configuration:

1. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

   a. Create, delete or modify control strategies.
   b. Add/delete objects to the system.
   c. Tune control loops through the adjustment of control loop parameters.
   d. Enable or disable control strategies.
   e. Generate hard copy records or control strategies on a printer.
   f. Select points to be alarmable and define the alarm state.
   g. Select points to be trended over a period of time and initiate the recording of values automatically.

D. On-Line Help:

1. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

E. Security:

1. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set
passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

F. System Diagnostics:

1. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

G. Alarm Console:

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms.

2.8 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.

6. User's shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

   a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
      1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

   b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

c. View logs and charts

d. View and acknowledge alarms

e. Setup and execute SQL queries on log and archive information

7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.9 SERVER FUNCTIONS AND HARDWARE

   A. A central server shall be provided. The server shall support all Network Area Controllers (NAC) connected to the network whether local or remote.

   B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

   C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

   D. The server shall provide the following functions, at a minimum:

      1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

      2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).

4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.

5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

6. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

7. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

8. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
   a. Routing of alarms to display, printer, email and pagers
   b. View and acknowledge of alarms
   c. Query alarm logs based on user-defined parameters

9. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
   a. Viewing and printing log data
   b. Exporting log data to other software applications
   c. Query log data based on user-defined parameters

2.10 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display.

C. Programming Methods:

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-
to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.11 LonWorks NETWORK MANAGEMENT

A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system shall not be accepted.

2.12 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have
the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. The library shall include applications or objects for the following functions, at a minimum:

E. Scheduling Object:

1. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.

F. Calendar Object:

1. The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

G. Duty Cycling Object:

1. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.

H. Temperature Override Object:

1. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

I. Start-Stop Time Optimization Object:

1. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

J. Demand Limiting Object:

1. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message
shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

2. The library shall include control objects for the following functions.

K. Analog Input Object:

1. Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

L. Analog Output Object:

1. Minimum requirement is to comply with the BACnet standard for data sharing.

M. Binary Input Object:

1. Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

N. Binary Output Object:

1. Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum.

O. PID Control Loop Object:

1. Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

P. Comparison Object:

1. Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

Q. Math Object:
1. Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

R. Custom Programming Objects:

1. Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

S. Interlock Object:

1. Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

T. Temperature Override Object:

1. Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

U. Composite Object:

1. Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

2. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

V. LonMark/LonWorks Devices:

1. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
2. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file and documentation for the device to facilitate device integration.

2.13 DDE DEVICE INTEGRATION

A. The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BMCS. Objects provided shall include at a minimum:

1. DDE Generic AI Object
2. DDE Generic AO Object
3. DDE Generic BO Object
4. DDE Generic BI Object

2.14 FIELD BUS COMMUNICATIONS

A. All communications shall be via twisted pairs wires, shielded where required and approved for use with system.

B. UCs and intelligent actuators and sensors shall reside directly on a peer-to-peer network.

2.15 GRAPHICAL USER INTERFACE (GUI) TERMINAL (WORKSTATION)

A. The personal computer shall be an Intel Pentium based computer (minimum processing speed of 3.2 GHz with 512 MB RAM and a 60-gigabyte minimum hard drive). It shall include a 40X CD-RW drive, 56K modem, 1-parallel port, 1-asynchronous serial port and 2-USB ports. It shall contain the network interface cards required. An optical 2-button scroll mouse and a minimum 17", 27-dot pitch LCD color monitor with a minimum 80 Hz refresh rate shall also be included.

B. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 8-PPM print speed minimum.

C. Provide prefabricated metal frame nominal 24" x 30" mobile cart designed for personal computers.

D. The GUI shall employ browser-like functionality for ease of navigating through the operating system, see "OPERATING SYSTEM (OS)" and "SYSTEM PROGRAMMING." It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification. Display of information shall be in real time.
2.16 OTHER CONTROL SYSTEM HARDWARE

A. Dampers:

1. Any automatic control dampers not specified to be integral with other equipment. Frames shall be not less than 2 inches wide and shall not be less than 13-gauge galvanized steel. Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel roll formed. Bearings shall be oilite, ball-bearing or nylon with steel shafts. Side seals shall be stainless steel of the tight-seal spring type. Dampers shall have neoprene blade edge and side seals. Dampers and seals shall be suitable for temperature ranges of -40 to 200°F.

2. All proportional control dampers shall be opposed or parallel blade type as hereinbefore specified and all two-position dampers shall be parallel blade types.

3. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6” in any dimension.

4. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all control dampers with the temperature control submittal. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC.

5. Where ultra-low leakage dampers are specified the blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 6 CFM per square foot for dampers in excess of sixteen inches square at 1 inch of WC.

B. Actuators:

1. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Actuators shall be spring return type where valves or dampers are required to fail to a safe position.

C. Control Valves:

1. All valves shall be supplied with a stamped or engraved tag indicating complete valve code number for use in future servicing of the control system.

2. Water Valves: Water control valves shall be 2-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials. Two-position valves shall be "line" size. Proportional control valves shall be sized for a maximum pressure drop of 4.0 psig at rated flow. Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs. Water valves larger than 6 inches shall be of the butterfly type with a bronze edge disc.
D. **VAV Terminal or Unitary Controller Space Temperature Wall Modules (Thermostats):** Wall modules shall be provided where shown on plans and shall be mounted 48” above finished floor. Temperature sensors shall be Resistance Temperature Detector (RTD) type of 100, 1000, or 3,000 ohm platinum, 500 ohm BALCO, or 20,000 ohm. Each room (thermostat) sensor shall provide temperature indication to the associated controller. Plastic enclosures (including sub-base) shall be UL94-5V rated. Sensor shall be accurate ±75°F within a range of 40-100°F. Each Space Temperature Wall Module shall contain:

1. Manual occupied/unoccupied override switch with visual indication of both occupied and unoccupied override modes.
2. Manual setpoint adjustment with the capability for a software-limited set point minimum and maximum values.
3. A relative set-point indication scale for visual indication.
4. A wiring port for connection of a portable operator's terminal.

E. **Duct Mounted, Pipe Mounted and Outside Air Temperature Sensors:**

1. Provide thermistor temperature sensors with an accuracy of ±2°C. Outdoor air sensors shall include an integral sun shield. For insertion type water piping sensors, provide brass wells of sufficient size for the piping and sensors installed.
2. Outdoor Air Temperature Sensors: Sensors shall contain an RTD sensing element mounting in an enclosure rated for outdoor use. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of ± 1% over the full range.

F. **Relative Humidity Sensors:**

1. Duct mounted relative humidity sensors shall be provided with sampling chamber and shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 4% over the range of 10 to 80% RH. Wall Mounted (Space) Relative Humidity Sensors shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 3% over the range of 20 to 60% RH. Outside Air Relative Humidity Sensor shall have outside weather enclosure and shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 2% over the range 20 to 90% RH. Humidity sensors to be installed adjacent to space temperature wall modules (thermostats) may be an integral component of the space temperature wall module in lieu of a separate wall mounted device.

G. **Current Sensitive Switches:**

1. Solid state, split core current switch that operates when the current level sensed by the internal current transformer exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

H. **Differential Pressure Transducer:**

1. Transducer shall be for air or water service. The device shall output a 4-20 milliamp signal which is linear in relation to the sensed pressure. Accuracy shall be ± .01% of full scale. The power shall be from the controller and shall be in the range of 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are
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no more than ± 0.05% of the full scale from 32-100°F. The transducer shall be suitable for the media and pressure measured.

I. **Differential Pressure Switch (Air):**
   1. Switch shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 9.8 amperes at 120 volts.

J. **Differential Pressure Switch (Water):**
   1. Switch shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 6 amperes at 120 volts, 100 psig design, with automatic reset. Each switch shall be provided with isolation and drain valves. Except where indicated otherwise in this specification or where flow switches are provided by equipment manufacturer, provide differential pressure switch in the piping to/from each chiller and boiler to prevent operation of each of these units if flow is not proven.

K. **DDC Control Panel Enclosures:**
   1. Except for DDC controllers factory installed within control compartments of equipment, furnish control panel enclosures of Code gauge steel with locking doors for mounting all DDC controllers. Control panels shall meet all requirements of Title 24, California Administrative Code. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of "as-built" control drawings (relating to the controls within the panel) shall be furnished within each control panel. Labels shall have full length pin hinge door with keyed lock. Provide two keys for each lock.

L. **Low Limit Thermostats:**
   1. Low limit thermostat shall be of manual reset type, with setpoint adjustment. The sensing element shall be 20 foot minimum and shall be installed completely across the coil. When any one foot of the element senses a temperature as low as the setpoint, the thermostat contacts shall open. These shall contain double pole switches for simultaneous remote alarms or as desired.

M. **Firestats:**
   1. Furnish in the inlet air stream of each recirculating air moving device a manual reset thermostat to turn off the fans if the inlet temperature exceeds 125°F. Thermostat shall be U.L. listed or Factory Mutual approved for the service intended. Where duct mounted smoke detectors are provided to automatically shut down the air moving device (see below), fire protection thermostats may be deleted.

N. **Smoke Detectors:**
   1. Duct mounted smoke detectors shall be provided and connected to the building fire (alarm) detection system under Division 16. Coordinate detector location and coordinate fan shutdown sequence as specified in the Sequence of Operations. HVAC control wiring between the fire detection system interface device and the air system controls shall be by the Temperature Controls Contractor.

O. **Miscellaneous:**
   1. On/Off Control: Equipment on/off control shall use either momentary pulsed relays or magnetically latched relays, as appropriate for the equipment's control starter.
Hand-off-auto switches or parallel on/off pushbuttons shall be provided where required to permit local override of the BMCS.

2. On/Off Status: Equipment on/off status sensing shall use positive proof of flow devices. Pumps shall have current sensing relays, and air units shall have differential pressure flow switches, or current sensing relays.

3. Interfaces: Analog setpoint control shall use an electric output signal to adjust the setpoint position of the local control loop equipment. Interfacing controls shall be configured such that loss of communications with the BMCS shall cause the setpoint controller to remain at its last commanded value.

PART 3 - EXECUTION

3.1 GENERAL

A. The BMCS shall be designed, installed, and commissioned in a turnkey operational manner. Include all labor and materials required for a complete installation.

B. Where control devices are installed on insulated piping or ductwork, provide standoff brackets or thermowells sized to clear insulation thickness. Provide extended sensing elements, actuator linkages, and other accessories as required. Wells shall be by the Temperature Controls Contractor and installed by the Piping Contractor.

C. Provide conduit, wiring, tubing and required hardware to interface the following points onto the BMCS:

D. Variable Air Volume (VAV) Air Handling Units (Each Unit):

1. Return Air Temperature
2. Discharge Air Temperature
3. Mixed Air Temperature
4. Return Air Humidity
5. Fan Start/Stop
6. Fan Status
7. Return Air Control Damper
8. Outside Air Control Damper(s)
9. Minimum O.A. Control Module CFM
10. Static Pressure Input
11. Fan Speed Control
12. Chilled Water Valve
13. Hot Water Valve
E. **Constant Volume Air Handling Units (Each Unit):**
   1. Space Temperature (Wall Module)
   2. Return Air Temperature
   3. Discharge Air Temperature
   4. Return Air Humidity
   5. Fan Start/Stop
   6. Fan Status
   7. Outside Air Damper
   8. Chilled Water Valve
   9. Hot Water Valve

F. **VAV Terminal Boxes (Each Box):**
   1. Damper Motor Control
   2. Fan Start/Stop (Fan Powered VAV Boxes Only)
   3. Velocity probe for CFM measurement
   4. Minimum/Maximum CFM Setpoint
   5. Hot Water Heating Valve
   6. Space Temperature (Wall Module)
   7. Heating Control (Where Applicable)

G. **Isolation Room:**
   1. Supply Box Cooling Setpoint
   2. Supply Box Heating Setpoint
   3. Supply Box Damper Control
   4. Supply Box CFM Measurement
   5. Supply Box CFM Setting
   6. Modulating Reheat Valve
   7. Space Temperature
   8. Exhaust Box Damper Control
   9. Exhaust Box CFM Measurement
10. Exhaust Box CFM Setting
11. Exhaust Fan Start/stop
12. Exhaust Fan Status
13. Low Pressure Alarm

H. Water Chiller(s):
   1. Start/Stop, Each Chiller
   2. Status, Each Chiller
   3. Chilled Water Return Temperature (Common Line)
   4. Chilled Water Supply Temperature (Common Line)
   5. Chiller Water Temperature Control Reset, Each Chiller
   6. Chilled Water Differential Pressure, Each Chiller

I. Water Cooling Tower(s):
   1. Fan Start/Stop, Each Fan
   2. Fan Status, Each Fan
   3. Bypass Valve Control
   4. Condenser Water Supply Temperature
   5. Condenser Water Return Temperature

J. Gas-Fired Boiler(s):
   1. Start Stop, Each Boiler
   2. Heating Water Supply Temperature (Common Line)
   3. Heating Water Return Temperature (Common Line)
   4. Boiler Leaving Water Temperature, Each Boiler
   5. Boiler 3-Way Valve

K. Pump(s):
   1. Start/Stop, Each Pump
   2. Run Status, Each Pump
L. **Exhaust Fans:**
   1. Start/Stop, Each Fan
   2. Run Status, Each Fan

M. **General:**
   1. Outside Air Temp
   2. Outside Air Humidity
   3. Fire Alarm General Alarm

N. Provide additional I/O devices, etc., as required for control sequences as described hereinafter. Provide hardware, software and programming as required.

3.2 **SEQUENCES - VARIABLE AIR VOLUME (VAV) AIR HANDLING UNITS**

A. VAV air handling unit shall be controlled by the unit's local DDC panel. Unit shall be started by local DDC panel through HOA switch mounted in cover of air unit starter. Current sensing relays shall indicate unit run status, and shall set automatic controls in operation.

B. High limit thermostat in return air shall stop unit upon detection of temperature above its setpoint. Electric low limit thermostat, upstream of the cooling coil, shall stop unit upon detection of temperature below its setpoint. A manual reset static pressure high limit in discharge of fan shall stop unit upon detection of pressure above its setpoint.

C. Air handling unit shall be disabled upon detection of products of combustion by the duct mounted smoke detector(s) and/or an alarm signal from the building Fire Detection System, See Division 16.

D. A differential pressure transmitter in the local panel shall sense the differential static pressure of the air distribution system at a location near the end of the ductwork, and shall transmit pressure changes to the DDC panel. The output shall be used by a PI algorithm in the digital control panel to modulate the fan speed to maintain the minimum static pressure required for the VAV boxes. Fan speed shall be modulated by a 4-20 ma signal for the DDC panel to the variable frequency drive. For each air unit, provide two duct pressure sensors with the higher of the two selecting sequence for the most demanding condition.

E. Provide for morning warm-up cycle on this unit as follows. Return air sensor shall transmit temperature changes to the local DDC panel. DDC panel shall close outside air damper, fully open return air damper, lockout cooling, lockout exhaust fan(s), open single duct VAV terminal units to maximum CFM, and enable fan powered VAV terminal units to operate via local thermostat control until the unit return air temperature reaches its setpoint (adjustable), terminating morning warm-up cycle. Morning warm-up shall be a separate control routine occurring prior to normal occupied mode of operation.

F. Provide for space temperature limit control during unoccupied mode. If space temperature falls below 65°F (adjustable), the air unit system shall operate the same as described for morning warm-up cycle. If space temperature rises above 85°F (adjustable), the air unit system shall operate same as described for normal occupied mode, except the outside air damper shall remain closed. This mode of operation shall continue until space temperature is within the 65°F to 85°F temperature limit.
G. Stopping the unit supply fan shall automatically de-energize the control system. All water valves shall go to the closed (bypass) position, outside air damper shall close and VAV terminal units shall be disabled. The supply fan control signal shall be modulated to minimum speed in preparation for unit restart.

3.3 MINIMUM OUTSIDE AIR (O.A.) CONTROL

A. For each air unit, provide control to maintain required minimum outside air flow rate regardless of supply fan air flow rate (between minimum and maximum CFM) in the normal mode of operation. Minimum O.A. control shall be maintained by controlling the **minimum outside air damper and return air damper in sequence** to maintain outside air flow rate. Outside air CFM shall be a control feature capable of being monitored by the existing facilities management equipment (via modem). Outside air CFM setpoint shall be fully adjustable.

B. The minimum O.A. control module shall be provided by the Temperature Controls Contractor and shall be Titus QCV-300 or similar pressure independent, electronic control retrofit VAV box with multi-point averaging velocity sensor, low leakage control damper. Pressure drop through the minimum O.A. control module shall be comparable to that for the return air damper at design air flow rate, but should not exceed 0.08 inch W.C.

C. For each VAV unit, provide low temperature limit control of mixed air temperature to 50°F by reducing O.A. flowrate and increasing R.A. flowrate to maintain to maintain low limit.

D. Minimum O.A. damper shall close whenever unit is de-energized.

3.4 SEQUENCE - CONSTANT VOLUME AIR HANDLING UNITS (HOT WATER HEAT)

A. Unit shall be started by the local DDC panel through HOA switch mounted in cover of unit starter. Differential pressure switch in discharge of fan shall transmit unit status to DDC panel, setting direct digital controls in operation. High limit thermostat in return air shall stop unit upon detection of temperature above its setpoint. Electric low limit thermostat in the mixed air shall stop unit and the makeup air unit upon detection of temperature below its setpoint.

B. Air handling unit shall be disabled upon detection of products of combustion by the duct mounted smoke detector(s) and/or an alarm signal from the building Fire Detection System, See Division 16.

C. Wall module (thermostat), located where indicated, shall transmit temperature changes to DDC panel. DDC panel shall modulate chilled water valve and hot water valve in sequence to maintain space conditions. Both cooling and heating setpoints shall be adjustable from the wall module (thermostat), but local setpoint shall have programmable High/Low temperature control limits (initially 75°F/68°F). When pressed, an override button integral to the wall module (thermostat) shall place the system in operation for a programmable time period (three hours initially).

D. Stopping the unit supply fan shall automatically de-energize the control system. All valves shall close to the coil, and the outside air damper shall close.

E. Provide for space temperature limit control during unoccupied mode. If space temperature sensor temperature rises above 85°F or falls below 65°F, the unit shall operate same as described for normal occupied mode, except outside air damper shall remain closed.
3.5 SEQUENCES - SINGLE DUCT VAV TERMINAL UNITS

A. Variable air volume terminal units shall be controlled by DDC VAV terminal unit controllers.

B. A wall mounted module (thermostat), located where indicated, shall transmit temperature changes to the terminal unit DDC controller. Unless indicated otherwise, space temperature setpoint shall be adjustable from the wall module (thermostat), but local setpoint shall have programmable high/low temperature control limit (initially set 75°F/68°F). When pressed, an override button integral to the wall module (thermostat) shall place the system in operation for a programmable (three hours initially) time period.

C. On a drop in room temperature below setpoint, the terminal unit shall be modulated from a maximum air flow to minimum air flow. On a further drop, the hot water heating valve (where applicable) shall be modulate to maintain space conditions. On a rise in room temperature, the reverse shall occur.

3.6 SEQUENCES - WATER CHILLERS

A. A water flow switch in the chilled water piping at each chiller shall be installed to prevent operation of the chiller if water flow is not proven.

B. Chilled Water Bypass Control: A differential pressure transmitter in the local chiller plant panel shall sense the chilled water differential pressure across each chiller and shall transmit pressure changes to the direct digital controller. The output shall be used by a PI algorithm in the digital control panel to modulate the associated chilled water bypass control valve to maintain minimum water flow required for the chiller.

C. Chilled water pumps shall be started and stopped via their respective HOA switches. In the "Auto" position, the pump shall be started and stopped by the local chiller plant control panel, with run status feedback provided to the local chiller plant control panel via current sensing relays. The chilled water pumps shall run for an additional two minutes after the individual chiller system has been disabled.

D. The lead chiller system shall be enabled when the maximum chilled water bypass valve position (see below) is greater than 30% open (adjustable) for at least 30 minutes. The lead chiller system shall be disabled when the maximum chilled water bypass valve position is less than 5% open (adjustable) for at least 30 minutes. The lead chiller system shall also be enabled when any air handling unit is on and the outside air temperature is greater than 50 degrees F (adjustable) and shall be disabled when the outside air temperature falls below 45 degrees F (adjustable).

E. The lag chiller system shall be enabled when the chilled water setpoint is equal to the minimum chilled water setpoint and the chilled water common supply water temperature is greater than the child water setpoint plus 2 degrees F (adjustable), after a 15 minute delay (adjustable). The lag chiller system shall be disabled when the chilled water setpoint is equal to the minimum chilled water setpoint plus 3 degrees F (adjustable), after a 15 minute delay (adjustable). The lag chiller system shall also be enabled if there is a call for the lead chiller and the lead chiller system is in alarm. When the lead chiller system has been restored, the lag chiller system shall continue to run for 5 minutes before becoming disabled.

F. The DDC controller shall monitor all of the chilled water valve position for all the air units and select a chilled water valve for its maximum position. If this maximum chilled water valve position is more than 95% open, the chiller reset signal shall be set downward at a rate of 0.1 degrees every minute. If this maximum chilled water valve position is between 95% a 75% open, the chiller reset signal shall be left at its last commanded value. If this maximum
chilled water valve position is less than 75% open, the chiller reset signal shall be sent upward at a rate of 0.1 degree F every minute. This chiller reset signal shall be viewed with the engineering units of degrees F. The DDC chiller control panel shall send a 2-10 Volt Dc signal to the chillers to maintain a 0-65 degrees F chilled water setpoint. There shall be a minimum chilled water setpoint signal of 45 degrees F (adjustable) and a maximum chilled water setpoint signal of 55 degrees F (adjustable).

G. When the outside air temperature drops below 35 degrees F, both chilled water pumps shall be enabled, and the chillers shall be disabled (unless there is a call for cooling in the occupied mode).

3.7 SEQUENCES - CHILLER ROOM VENTILATION
A. Provide thermostat interlocked with the exhaust fan and the intake louver damper. On a rise in temperature the intake louver shall open and the exhaust fan shall start. The reverse shall occur on a drop in temperature. Interlock the refrigeration monitor control (see Section 15050) with the exhaust fan and wall intake to open the intake damper and energize the fan whenever the refrigerant monitor goes into alarm.

3.8 SEQUENCES - CONDENSER WATER
A. Cooling tower shall be controlled by local DDC panel. Cooling tower shall be enabled whenever water chiller is enabled. A current sensing relay shall indicate run status of each fan.

B. A sensor in the condenser water line shall control tower fan(s) in sequence with 3-way tower bypass valve. As temperature drops, fan shall cycle "OFF". After fan is "OFF", if temperature drops further, the tower bypass control valve shall modulate to bypass water around tower. Valve arrangement must be capable of full water-tight closure. The 3-way tower bypass valve is to be interlocked with each condenser water pump such that when all pumps are off, the bypass valve closes to the sump. Provide a time delay feature to allow the valve to close to bypass prior to de-energizing pump and a time delay feature to start the pump prior to allowing the bypass valve to open.

3.9 SEQUENCES - HEATING WATER BOILER(S) AND PUMPS
A. A local DDC controller will enable the boilers and control the associated pumps. The hot water pumps (P-3 and 4) shall be controlled through the HOA switch mounted on the hot water pump starter through the "Auto" position. The pump (P-3 and 4) will be enabled during normal occupied mode when the outdoor air temperature is below 70 degrees F (adjustable). The hot water pump (P-3 and 4) will be enabled when there is a demand for heating from any AHU. The hot water pump (P-3 and 4) will be started for freeze protection when the outside air temperature falls below 35 degrees F. the start sequence for the boilers will be initiated when the hot water pump (P-3 and 4) is enabled by any AHU's hot water valve or VAV terminal heating coil valve is open greater than 20% for at least 3 minutes.

B. The boiler sequence will energize and the DDC controller shall check the status of the hot water pump and it will stage the boiler(s) in sequence. A hot water flow switch will be installed across the hot water entering and leaving pipe on each boiler to prevent boiler operation until hot water flow has been proven. Hot water flow must be maintained for at least 30 seconds before the boilers are enabled. If the hot water pump (P-3 and 4) does not start after it has been energized for 30 seconds, the standby hot water pump and boiler will be energized. Hot water boiler pumps (P-B1 and B2) shall have intermittent pump control interface with each
respective boiler (see equipment schedule) to enable each pump prior to energizing the burners and to provide for the pumps to continue to operate for a pre-determined time period after the boilers have "shut-off".

C. The boiler system water temperature will be reset by an analog signal from the local DDC to the boiler control panel. The system temperature setpoint will be automatically reset form 120 degrees F to 180 degrees F as the outside air temperature changes from 60 degrees F to 20 degrees F.

3.10 SEQUENCES - EXHAUST FANS

A. Except during morning warm-up (see "Sequences - VAV Air Handling Units") starting any air handling unit shall start the exhaust fan. When all air handling units are stopped, the exhaust fan shall stop.

3.11 SEQUENCE OF OPERATION ISOLATION ROOMS

A. VAV BOX: Variable air volume terminal air units will be controlled by individual space Thermostats.

B. ROOM CONTROL: On a rise in room temperature above setpoint, the hot water valve will close and the terminal unit will be modulated from minimum air flow to maximum air flow. On a drop in room temperature the reverse will occur.

C. EXHAUST FAN: Exhaust fan will be started and stopped by local DDC panel through HOA in fan starter. Run status feedback to ddc panel will be provided via current sensing relay in fan starter.

D. OCCUPIED MODE: In occupied mode, room supply air VAV box and exhaust control module will operate at scheduled maximum air flow rate. In unoccupied mode, supply air VAV box will modulate between scheduled minimum/maximum air flow rates and the exhaust control module will modulate between scheduled minimum/maximum, tracking the supply air VAV box to maintain a constant CFM offset between supply and exhaust air.

E. SAFETIES: Warning will be indicated at facility management system operator workstation if exhaust control module exceeds 90% (adjustable) full open. Warning indication will alert hospital maintenance personnel to check condition of isolation room filters and Exhaust fan.

F. PRESSURE MONITOR: Room pressure monitor will be provided for isolation room. Pressure monitor will have remote mounted sensor and cable. Normally closed door switch installed in ante room to patient door to activate door delay time sequence. Low pressure alarm will be interlocked with facility management system to alarm operator workstation.

G. ISOLATION ROOM: Isolation room control systems will be served from the emergency power supply.

3.12 SEQUENCE OF OPERATION - HOT WATER UNIT HEATERS

A. Provide heavy duty line voltage wall mounted thermostat with ON-OFF-AUTO switch. In "ON" position, fan shall be energized and control valve shall open on a drop in temperature below setting. In "OFF" position, fan shall be de-energized and control valve closed. In "AUTO" position, when temperature drops below setting, fan shall be energized and control valve shall open. When temperature rises above setting, fan shall be de-energized and control valve shall close.
3.13 SEQUENCE OF OPERATION - EMERGENCY POWER

A. Upon loss of power to any buildings (except #3), temperature control software shall de-energize all HVAC equipment in the respective building.

B. Should the emergency generator become the source of power for the building, only the HVAC controls and equipment served by the emergency panel shall continue to operate. Refer to electrical panelboard schedules for identification of this equipment in each building.

C. Building #6 (central plant) operation during generator operation (does not apply to generator exercising) shall be as follows: Only one “set” of equipment for the cooling plant and/or heating plant shall be enabled (i.e., CH-1, P-2, P-3, P-5, CT-2, B-1, P-8 and P-9). Generator sizing is not sufficient to operate entire plant.

D. After normal building power has been restored, all HVAC equipment shall be scheduled to restart.

3.14 INTERLOCKING - MISCELLANEOUS

A. All electrical interlocking shall be done by the Temperature Controls Contractor. The Temperature Controls Contractor shall furnish all switches and other devices necessary to accomplish the interlocking specified herein and shall furnish to the Architect for approval ten copies of all wiring diagrams necessary to accomplish the interlocking.

B. Provide a switch for each air unit at the location shown on Drawings. Switches shall have ON-OFF position. In OFF position, air units shall be off and valves closed to coils. In ON position, all units and unit controls shall be energized.

C. At each air unit switch position, provide a manual override switch that will override the setting of the BMCS and energize all controls required so that the air unit and all associated boxes, chillers, pumps and controls shall operate. Provide (programmable) 6 hour timed override capacity.

D. The chiller(s) shall be interlocked with the chilled water pump(s) and water flow switches so that the chiller(s) cannot operate if water is not flowing.

E. Interlock VAV terminal boxes with the air handling unit serving the boxes such that the boxes are de-energized when the air unit is de-energized.

3.15 SUBMITTALS

A. Provide ten copies of submittal data within 90 days of contract award.

B. Submittal shall consist of:

1. System architecture showing all digital devices, computers and network configuration.

2. Equipment lists of all proposed devices and equipment including data sheets of all products.

3. Valve, damper, and well and tap schedules showing size, configuration, capacity and location of all equipment.
4. Data entry forms for initial parameters. Contractor shall provide English listing of all analog points with columnar blanks for high and low warning limits and high and low alarm limits, and a listing of all systems with columnar blanks for beginning and end of occupancy periods; and samples of proposed text for points and messages (for at least two systems of at least 15 points total) including sample 480 character alarm message. All text shall be approved prior to data entry.

5. Schematic device wiring and piping interconnection diagrams including panel and device power and sources.

6. Software design data including flowchart of a typical DDC program showing interrelationship between inputs, PID functions, all other functions, outputs, etc.

7. Detailed description of system operation.

8. Include complete list of all points monitored.

3.16 INSTALLATION

A. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All wiring shall be in accordance with all local and national codes. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications, Division 16. All electronic wiring shall be #18 AWG minimum THHN and shielded if required, except standard network cabling shall be as tested and recommended in lieu of #18 gauge twisted, #22 or #24 gauge is acceptable if used as a part of an engineered structured cabling system. The control manufacturer must submit technical and application documentation demonstrating that this cabling system has been tested and approved for use by the manufacturer of both the control system and the engineered structured cabling system.

B. The Temperature Controls Contractor shall enter all computer data into the related computers including all control programs, initial approved parameters and settings, graphics, and English descriptors.

C. Tagging: Identify all cables at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable.

D. Install panels and controllers within a dedicated metal enclosure.

3.17 ACCEPTANCE

A. The Temperature Controls Contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operations approved.

B. Witnessed acceptance demonstration shall display and demonstrate each type of data entry to show site specific customizing capability; demonstrate parameter changes; execute digital and analog commands; and demonstrate DDC loop stability via trend of inputs and outputs.

C. The control contractor shall furnish a portable UC programming tool with preloaded software and necessary interface cable to the balancing contractor for use during system balancing.
The balancing contractor shall be responsible for proper use and care of this tool, and shall return it to the control contractor immediately upon balancing completion. The control contractor shall provide the balancing contractor up to four hours training on the use of this tool in order to exercise actuators and enter calibration and balancing parameters. Additional training or assistance required by the balancing contractor shall be contracted directly with the control contractor by the balancing contractor.

3.18 DOCUMENTATION

A. Three Operators Manuals and three (As-Built) Record Drawing Manuals shall be provided to the Owner.

B. The Operators Manual shall be provided with graphic explanations of keyboard use for all operator functions specified under Operator Training.

C. Diskette or CD-ROM with all AutoCAD or Visio drawings, and configuration data files including all point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, graphics, etc.

D. The record drawing manuals shall include all materials required under the paragraph "SUBMITTALS" on this specification, updated/corrected to show as-built condition change orders, field modifications, etc.

E. Software: The Temperature Controls Contractor shall maintain diskette/CD copies of all graphics, data files and application programs for reload use in the event of a system crash or memory failure. One copy shall be delivered to the owner during training sessions, and one copy shall be archived in the Temperature Controls Contractor's local software vault.

3.19 TRAINING

A. All training shall be by the Temperature Controls Contractor and shall utilize operators' manuals and as-built documentation.

B. Operator training shall include two eight-hour sessions encompassing modifying text and graphics, sequence of operation review, selection of all displays and reports, use of Portable Operators Terminals, troubleshooting of sensors (determining bad sensors), and password assignment and modification.

C. One training session shall be conducted at system completion, and the other shall be conducted forty five days after system completion.

END OF SECTION 15060
SECTION 15070 - PLUMBING FIXTURES AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

A. Plumbing fixtures shall be as specified below, or equal as listed by addendum. Unless noted otherwise, American Standard numbers are used here to establish quality and style desired.

B. Rough-in locations shall be carefully spotted to result in a symmetrical pattern with sufficient spacing to accommodate full escutcheons.

C. All fixtures shall have supplies with stops. Stops shall be chrome plated brass. Trim shall be polished, chrome plated brass, same manufacturer as fixture unless otherwise indicated. All pipe, fittings, etc., in connection with supply or drain trim shall be chrome plated. In cases where fixtures may have hot and cold water trim without hot water service, connect cold water to both trim inlets.

D. Trap separately each fixture and piece of equipment requiring connection to drainage, unless otherwise shown on Drawings. Place traps as near to the fixture as possible. No fixture shall be double trapped. Unless indicated otherwise, drain "P" traps shall be polished, chrome plated cast brass with cleanout plug and 17 gauge tubular outlet to wall. For floor drains, hub drains or other similar devices with underfloor traps, drain "P" traps shall be same material as the branch piping system. For commercial food service equipment sinks, traps and waste piping to wall rough-in may be (rough finish) DWV copper piping (not plastic piping).

PART 2 - PRODUCTS

2.1 WATER CLOSET - WC-1

A. American Standard 2257.103 or Kohler K-4330, vitreous china, wall hung, siphon jet, elongated bowl, 1-1/2 inch top spud, with Sloan Regal Pro Series, Coyne & Delany Flushboy Series, or Zurn Aqua Flush Plus water saver (1.6 gallons per flush) flush valve, and Church 9500SSC, Beneke 527SS or Bemis 1655SSC, solid polystyrene, extra heavy duty, white, open front seat with self-sustaining check hinge. Support fixture with Wade W-310/330/340 Series, J.R. Smith 0175, 0185, 0210 and 0220 Series, or equal by Josam or Zurn, adjustable series floor supported closet carrier with rear anchor lug (foot) for "single" closet carriers; carrier feet (and rear lug) shall be securely bolted to floor. Bowl shall be installed such that rim height is 15 inches above finished floor unless indicated otherwise on Drawings, refer to Architectural Drawings for exact rough-in position.

2.2 WATER CLOSET - WC-2

A. Same as WC-1 except that water closet shall be designed and installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI A117.1 Standard. Flush valve handle shall be constructed to meet ADA, shall be positioned on wide side of the stall, and shall not be installed higher than 44 inches above finished floor. Bowl mounting height shall be such that top of seat is 17 to 19 inches from finished floor; refer to Architectural Drawings for exact rough-in position.
2.3 WATER CLOSET - WC-3

A. American Standard 2234.015 or Kohler K-4350, vitreous china, siphon jet, elongated bowl, **floor mounted**, 1-1/2 inch top spud, bolt caps, with Sloan Regal Pro Series, Coyne & Delany Flushboy Series, or Zurn Aqua Flush Plus (1.6 gallons per flush) flush valve, and Church 9500SSC, Beneke 527SS, or Bemis 1655SSC, contoured solid polystyrene, white, open front seat with self-sustaining check hinge.

2.4 URINAL - UR-1

A. American Standard 6561.017 or Kohler K-4989-T, 1 gallon per flush, vitreous china, wall hung, siphon jet urinal with extended shields, integral flush spreader and trap, 3/4 inch top spud, Sloan Regal Pro Series, Coyne & Delany Flushboy Series, or Zurn Aqua Flush Plus water saver flush valve. Support with Wade W-400, J.R. Smith 637, or equal by Josam, floor mounted chair carrier.

2.5 URINAL - UR-2

A. American Standard 6541.132 or Kohler K-5016-T, vitreous china, wall hung, siphon jet urinal, 1 gallon per flush, elongated (13-1/2 inch minimum from finished wall) integral flushing rim, 3/4 inch top spud, Sloan Regal Pro Series, Coyne & Delany Flushboy Series, or Zurn Aqua Flush Plus water saver flush valve. Support with Wade W-400, J.R. Smith 637, or equal by Josam, floor mounted carrier.

B. Unless indicated otherwise, urinal shall be designed and installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Unless indicated otherwise on Drawings, urinal shall be installed with rim height at 17 inches (maximum) above finished floor, and flush valve operator 44 inches (maximum) above finished floor.

2.6 LAVATORY - L-1

A. American Standard 0355.012 or Kohler K-2005, vitreous china, 20 inch x 18 inch integral back **wall hung** lavatory with front overflow, self-draining deck area with contoured back and side splash shields, American Standard 5402.102V Heritage or Kohler K-7404-KE (with K-16010-2 handles) centerset faucet with vandal-resistant dual brass crown handles, 1.5 to 2.25 GPM flow restrictor, vandal-resistant aerator and chrome plated brass grid drain. Support with Wade 520, J.R. Smith 700, or equal by Josam, concealed arm floor mounted chair carrier.

2.7 LAVATORY - L-2

A. American Standard 0355.012 or Kohler K-2005, vitreous china, 20 inch x 18 inch integral back **wall hung** lavatory with front overflow, self-draining deck area with contoured back and side splash shields, Delta 523-WFHGMHDF, American Standard 2385.003 or Kohler K-15597 centerset faucet with vandal-resistant single lever handle, 0.5 GPM flow restrictor spray spout and chrome plated brass grid strainer drain. Support with Wade 520, J.R. Smith 700, or equal by Josam, concealed arm floor mounted chair carrier.

B. Lavatory shall be designed and installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Unless indicated otherwise on Contract Drawings, lavatory is to be installed with rim height 34 inches
(maximum) above finished floor. Lavatory shall have a minimum clearance of 29 inches measured from floor to the bottom of the lavatory apron. Exposed drain and water piping under lavatory shall not interfere with required knee clearance, 8.5 inches measured horizontally from front edge toward rear of lavatory. Provide two-piece, snap-on, PVC insulated covers over traps and both hot/cold water supplies. For lavatories with drain type trap primers, include matching cover for trap primer line. Covers shall meet 25/50 Flame/Smoke Rating per ASTM-E84, Truebro "Handi Lav-Guard", Plumberex PRO-2000 Series, or equal.

2.8 LAVATORY - L-3
A. American Standard 0476.028 or Kohler K-2196, vitreous china, nominal 20 inch x 17 inch, self-rimming counter-top lavatory, American Standard 5401.102V Heritage or Kohler K-7404-KE (with K-16010-02 handles) centerset faucet with dual brass crown handles, 1.5 to 2.25 GPM flow restrictor, vandal-resistant aerator and pop-up drain.

2.9 LAVATORY - L-4
A. American Standard 0476.028 or Kohler K-2196, vitreous china, nominal 20 inch x 17 inch self-rimming counter-top lavatory, Delta 523-WFHGMHDF, American Standard 2385.003 or Kohler K-15597 centerset faucet with vandal-resistant single lever handle, 0.5 GPM flow restrictor spray spout and chrome plated brass grid strainer drain.

B. Lavatory shall be designed and installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Unless indicated otherwise on Contract Drawings, lavatory is to be installed with rim height 34 inches (maximum) above finished floor. Lavatory shall have a minimum clearance of 29 inches measured from floor to the bottom of the lavatory apron. Exposed drain and water piping under lavatory shall not interfere with required knee clearance, 8.5 inches measured horizontally from front edge toward rear of lavatory. Provide two-piece, snap-on, PVC insulated covers over traps and both hot/cold water supplies. For lavatories with drain type trap primers, include matching cover for trap primer line. Covers shall meet 25/50 Flame/Smoke Rating per ASTM-E84, Truebro "Handi Lav-Guard", Plumberex PRO-2000 Series, or equal.

2.10 MOP SINK - MS-1
A. Powers-Fiat Model SB-2424, Stern-Williams EB-54, or equal as listed by addendum, 24 inches x 24 inches one piece, precast terrazzo mop basin with 2 inch thick x 6 inch high sides. Basin shall have 3 inch drain with strainer. Provide Powers No. 832-AA or Stern-Williams T-15-VB faucet with vacuum breaker, integral stops, wall brace, pail hook and threaded spout, Powers No. 832-AA or Stern-Williams T-35 30 inch hose with bracket and Powers No. 889-CC or Stern-Williams T-40 mop hanger. Contractor shall provide suitable wall reinforcement for all wall supports.

2.11 MOP SINK - MS-2
A. Eagle F1916, Metcraft 6392-3, or equal as listed by addendum, 32 inch x 32 inch x 6 inch high angled mop sink, 16 gauge type 304 stainless steel sink, polished to a #4 satin finish. Provide 2" brass caulk drain with stainless steel grid strainer. Include same trim as specified for MS-1.
2.12 SINK - SK-1
A. Elkay LR-3322 or Just DL-2233-A-GR, counter-top, 33 inch x 22 inch stainless steel sink, 18 gauge ledge back, self-rimming, double bowl with Elkay LK-35 or Just J-35 duo strainers and Elkay LK-4101, Just J-901 or Delta 400 single metal lever swing spout faucet less hose spray and 2.0 to 2.5 GPM flow restrictor.

2.13 SINK - SK-2
A. Elkay LR-1720 or Just SL-2017-A-GR countertop, 17 inch x 20 inch stainless steel sink, 18 gauge ledge back, self-rimming, with Elkay LK-35 or Just J-35 duo strainer and Elkay LKC-2432, Just JWF200, or equal as listed by addenda, hi-arc dual handle faucet. Provide wrist blades on faucet and grid strainer and 2.0 to 2.5 GPM flow restrictor. Provide solids interceptor (plaster trap) in lieu of P-trap. Unit to be Wade 5740, Smith 8710, or equal as listed by addenda.

2.14 SINK - SK-3
A. American Standard 9512.013 or Kohler K-12867, wall hung vitreous china, blow-out action clinical service sink with stainless steel rim guard, American Standard 8345.100 or Kohler K-7309-5A, wall mounted, chrome plated faucet with 6 inch wrist handles, American Standard 7880.024 or Kohler K-13960, bedpan washer, Sloan 117H or equal by Delany flush valve. Provide Wade 640 Series, J.R. Smith 900 Series, or equal as listed by addenda, chair carrier support with rectangular steel uprights welded to base, with waste outlet coupling and cast iron waste fitting to match sink.

2.15 SINK - SK-4

2.16 PENAL WATER CLOSET - PWC-1
A. Compact, back supply toilet shall be Acorn 1675 Series, Metcraft 4105, or equal as listed by addenda. Fixture shall be fabricated of Type 304 stainless steel. Toilet shall be blowout type and shall have crevice-free, self-draining flushing rim and integral, elongated contoured seat and concealed wall supply. Exterior surfaces shall be polished to a #4 finish. Integral seat, cabinet waste flange, trap covers and flushing rim shall be 14 gauge. All exposed welds shall be ground smooth. Visible voids, seams or crevices will not be acceptable. Toilet trap shall be fully enclosed. Fixture shall withstand loadings to 2,000 lbs. with no deflection and to 3,000 lbs. with no permanent damage. Unit to be complete with necessary fasteners and supports for proper installation. Provide Sloan 611, Delany F540 or equal as listed by addenda, 1.6 GPF, flush valves.

2.17 PENAL WATER CLOSET - PWC-2
A. Same as PWC-1, except unit and installation to meet the Americans with Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Bowl mounting
2.18 PENAL FLOOR TOILET - PFT

A. In floor, detox floor toilet shall be Acorn 1699, Metcraft 4500 or equal as listed by addenda. Fixture shall be fabricated using 14 gauge Type 304 stainless steel, seamlessly welded to form a one-piece, vandal resistant toilet. Unit to be complete with solid stainless steel bars, 3/8" diameter integrally welded to the flushing rim to provide a safety grate over the sump. The center bar shall be secured by stainless steel, vandal resistant security screws which permit removal for waste line cleaning.

B. Provide Sloan 110-HLC, Delany F538-T48 (MOD) or equal as listed by addenda, remote mounted flush valve. Provide wall mounted stainless steel flush valve box with access panel.

2.19 PENAL LAVATORY - PL-1

A. Stainless steel lavatory shall be Acorn Model 1652, Metcraft Model 5118, or equal as listed by addenda. Fixture shall be fabricated of Type 304 stainless steel with rectangular bowl and all exterior surfaces polished to #4 finish. All exposed welds shall be ground smooth. Visible voids, seams or crevices will not be accepted. Cabinet interior shall have fire-resistant second deadening material. Provide hot and cold metering valves.

B. Unit and installation to meet the Americans with Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Bowl mounting height shall be such that top of set is 17 to 19 inches from finished floor, refer to Architectural Drawings for exact rough-in position. Unit to be complete with necessary fasteners and supports for proper installation.

2.20 PENAL COMBO LAV/WATER CLOSET - PC-1

A. Combination lavatory/water closet shall be Acorn 1418-AL, Metcraft Model No. 3118-45 R or L, or equal as listed by addenda. Fixture shall be fabricated of Type 304 stainless steel with exterior surfaces polished to #4 finish. Cabinet shall be 14 gauge. Unit shall include recessed toilet tissue holder. Integral toilet seat to have #7 high polish sanitary finish. Water closet to be offset. All exposed welds to be ground smooth. Provide right or left hand unit as indicated on drawings. Visible voids, seams or crevices will not be accepted. Fixture shall withstand loadings to 2,000 lbs. with no deflection and no permanent damage with loadings to 5,000 lbs. Unit to be complete with hot and cold self-closing valve and Sloan 603, Delany 623, 1.6 GPF, or equal flush valve as listed by addenda. Unit to be complete with necessary fasteners and supports for proper installation.

2.21 PENAL COMBO LAV/WATER CLOSET - PC-2

A. Combination lavatory/water closet shall be Acorn 1440 Series, Metcraft 3115-90, or equal as listed by addenda. Unit to be similar to PC-1 except water closet shall not be offset.

2.22 PENAL COMBO LAV/WATER CLOSET - PC-3

A. Combination handicap lavatory/water closet shall be Acorn 1432 ALAR right or left, Metcraft Model 3137-90 right or left, or equal as listed by addenda. Units to be fabricated of Type 304 stainless steel with exterior surfaces polished to #4 finish. Cabinet shall be 12 gauge.
Integral toilet seat shall have #7 high polish sanitary finish. Unit shall include lavatory valve and deck-mounted spout, flush valve and recessed toilet tissue holder. All exposed welds to be ground smooth. Visible voids, seams or crevices will not be accepted. Fixture shall withstand loading to 2,000 lbs. with no deflection and no permanent damage with loadings to 5,000 lbs. Unit and installation to meet the Americans with Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1. Water closet bowl mounting height shall be such that top of seat is 17 to 19 inches from finished floor, refer to Architectural Drawings for exact rough-in position. Unit to be complete with necessary fasteners and supports for proper installation.

2.23 PENAL URINAL - PUR-1
A. Wall hung top supply blowout urinal shall be Acorn 1700 Series, Metcraft 7110 or equal as listed by addenda. Fixture shall be fabricated of Type 304 stainless steel with exposed surfaces polished to a #4 stain finish. All exposed welds shall be ground smooth with no visible voids, seams or crevices. Trap shall provide 4" seal and shall pass a 1.9" ball. P-trap shall also be fitted with integrally welded stainless steel beehive dome strainer. Back and underside of fixture shall have fire-resistant, sound-deadening material. Provide Sloan 613, Delany F576 or equal, as listed by addenda flush valve (top mounted). Unit to be complete with necessary fasteners and supports for proper installation.

2.24 PENAL SHOWER - PS-1
A. Front mounted, front access, stainless steel security shower shall be Acorn 1741FA, Metcraft Model 8600, or equal as listed by addenda. Units to be constructed of 14 gauge Type 304, #4 finish, stainless steel panel and mounting frame with recessed soap dish. Provide fixed direction severe service showerhead and single temperature air metering valve with 2.5 GPM flow control. Unit to be complete with necessary fasteners and supports for proper operation.

2.25 PENAL SHOWER - PS-2
A. Front mounted, front access, stainless steel, handicap security shower to be Acorn 1741FA, Metcraft Model 8606, or equal as listed by addenda. Unit to be constructed of 14 gauge, Type 304, #4 finish, stainless steel panel and mounting frame, recessed soap dish, fixed direction severe service showerhead, hose assembly with vacuum breaker and hook and Bradley single temperature air metering valve with 2.5 GPM flow control. Unit and installation to meet the Americans with Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Refer to Architectural Drawings for exact rough-in position. Unit to be complete with necessary fasteners and supports for proper operation.

2.26 PENAL SHOWER - PS-3
A. Chase mounted stainless steel security shower shall be Acorn 1741 Series, Metcraft Model 8120, or equal as listed by addenda. Units to be constructed of 14 gauge Type 304, #4 finish, stainless steel panel with recessed soap dish, fixed direction, severe service showerhead and single temperature air metering valve with 2.5 GPM flow control. Unit to be complete with necessary fasteners and supports for proper operation.

2.27 PENAL SHOWER - PS-4
A. Chase mounted handicap stainless steel security shower shall be Acorn 1741 Series, Metcraft Model 8125, or equal as listed by addenda. Units to be constructed of 14 gauge Type 304, #4 finish, stainless steel panel with recessed soap dish, fixed direction, severe service showerhead, hose assembly with vacuum breaker and hook, and Bradley single temperature air metering valve with 2.5 GPM flow control. Unit and installation to meet the Americans with Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Refer to Architectural Drawings for exact rough-in position.

2.28 PENAL BATHTUB - PB-1


2.29 PENAL DRINKING FOUNTAIN - PDF-1

A. Drinking fountain shall be Acorn Penal-Wave Model 1672, Metcraft Model 5191R or equal as listed by addenda, ADA compliant drinking fountain fabricated from 14 gauge, Type 304 stainless steel. Construction shall be seamless, welded, and exposed surfaces shall have a satin finish. Fixture shall be supplied with an ADA compliant control valve, a bubbler and necessary fasteners for proper installation. Units to conform with ANSI, UFAS and ADA requirements for accessibility.

2.30 PENAL DRINKING FOUNTAIN - PDF-2

A. Drinking fountain shall be Willoughby Model DF-1015-96-HC-FA, Metcraft Model 5691, or equal as listed by addenda. All features same as PDF-1 above, except unit to be designed for front access.

2.31 ELECTRIC WATER COOLERS - GENERAL

A. Water coolers shall be type as indicated below, or equal as listed by addendum. Cooler shall have stainless steel top and backsplash and shall have a minimum capacity of 12.0 GPH (unless noted otherwise) at ARI Standard 1010-73 conditions unless indicated otherwise. Contractor shall provide suitable wall reinforcement for all wall supports. Coolers shall meet the Standards of the Safe Drinking Water Act and the Lead Contamination Control Act.

B. Cooler front and side enclosure shall be stainless steel, satin polish finish.

2.32 EWC-1

A. Wall hung, wheelchair type cooler for 6.5 GPH at ARI conditions, similar to Oasis P8AM or Haws HWBFA8, with front and side mounted push actuators.

B. Unless indicated otherwise, cooler shall be installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Unless indicated otherwise on Drawings, cooler shall be installed with bubbler (spout) no higher than 36 inches above finished floor, and with a clear knee space of 27 inches measured between bottom of the cooler apron and finished floor.
2.33 EWC-2

A. Wall hung barrier free split-level type cooler for 7.8 GPH at ARI conditions, similar to Oasis P8AMSL, Elkay EZSTL-8 or Haws HWBFA8L, with front push actuators.

B. Unless indicated otherwise, cooler shall be installed to meet The Americans With Disabilities Act (ADA) Standard for physically impaired people and ANSI 117.1 Standard. Unless indicated otherwise on Drawings, cooler shall be installed with the lower bubbler (spout) no higher than 36 inches above finished floor, and with a clear knee space of 27 inches measured between bottom of the cooler apron and finished floor; include apron adaptor.

2.34 ICE MAKER SERVICE BOX

A. Guy Gray Model BIM 875, 20 gauge steel, white finish, flush mounted water service box with brass angle valve.

2.35 HOSE BIBBS

A. Hose bibbs shall be Woodford 24P or Prier C-135SP-VB, chrome plated, cast brass, angle pattern faucet with 3/4 inch hose end, lockshield with loose key and chromed back-flow preventer.

2.36 DRAINS - GENERAL

A. Body castings shall be of high grade, even grain cast iron, free from defects which might affect their serviceability and with 1/4 inch minimum wall thickness. All floor drains shall be installed with a deep seal P-trap. All grates, strainers and trims to be nickel bronze.

2.37 FLOOR DRAINS - FD-1

A. J.R. Smith 2010-A, Josam 30000A or Wade 1100-A with adjustable, 6 inch diameter, heavy duty, nickel bronze strainer, bottom caulk outlet and non-puncturing membrane clamping device. Where noted on Drawings, provide 2 inch trap primer connection at inlet to drain "P" trap.

2.38 FLOOR DRAINS - FD-2

A. Same as FD-1, except provide grate with vandal proof screws.

2.39 FLOOR DRAINS - FD-3

A. J.R. Smith 2110, Josam 32100 or Wade 1310 Series, cast iron floor drain with nominal 8 inch diameter top, clamping collar, flat bottom strainer and trap primer where noted. Where indicated on Drawings, provide 6 inch diameter funnel attachment. Unless indicated otherwise on Drawings, position top of drain 3/8 inch to 2 inch below finished slab. General Contractor to taper finish of slab to form a smooth trough of 2 foot radius around the center of the drain, except provide leveling grout or limit radius of contour where taper would extend beyond equipment room or interfere with proper installation of mechanical equipment.
2.40 TRAP PRIMER - TP-1

A. Dearborn 831-1, J.R. Smith 2698 "Prime-Eze", Josam 88260, or equal as listed by addendum, water saver trap primer with chrome plated cast brass P-trap with cleanout, 17 gauge tubing outlet, slip joint nuts, 2 inch chrome plated primer tube and escutcheons. Include required slip joint nuts to match plumbing fixture drain outlet. In Toilet Rooms requiring floor drains, provide water saver trap primer (in lieu of the drain trap as previously specified in this section) for the lavatory drain. Where there are multiple floor drains and lavatories per toilet room, install sufficient quantity of trap primers to match quantity of floor drains. Extend 2 inch copper trap primer tubing (same as specified for water piping) from primer tube wall fitting connection to floor drain; trap primer line shall be installed concealed from view and sloped to prevent trapping water within the trap primer line.

2.41 TRAP PRIMER - TP-2

A. Trap primer valve shall be fully automatic, all brass construction, 2 inch inlet, 2 inch outlet, activated by drop in building water pressure, no adjustment required. Trap primer valve may be located anywhere in an active cold water line, above the floor drains. Two to four traps in close proximity to the valve may be served by a single trap primer valve utilizing a pre-manufactured distribution unit. Trap primer valve shall be Precision Plumbing Products (PPP) Prime-Rite Series, MIFAB MR Series, or equal, listed by Uniform Plumbing Code, and meeting ASSE Standard #1018. Extend 2 inch copper trap primer (water) line from trap primer valve to floor drain, as noted on Drawings; trap primer line shall be sloped to prevent trapping water in line.

2.42 CLEANOUTS

A. Provide cleanouts where shown on Drawings and wherever required for easy service of the installation. Cleanouts shall be same size as pipe, except cleanout plugs larger than 4 inches will not be required.

B. Body casting shall be of high grade, even cast iron, free from defects which might affect serviceability and with 1/4 inch minimum wall thickness.

C. Floor cleanouts shall be J.R. Smith 4000, Josam 56000 or Wade 6000 Series with tops suitable for surface in which they are installed. Where a floor material covers the cleanout, the top shall be of a type which is readily incorporated into the covering system without ridges or recesses. Tops must be flush with finished floor, except where carpet is used, a top incorporating a small round marker shall be furnished. Use square tops in floors such as, tile, brick, slate, etc. Cleanouts in unfinished concrete floors shall have heavy, nickel bronze tops. Wall cleanouts shall have heavy, stainless steel or chrome plated covers, no larger than 6 inches diameter, which shall completely cover hole. Cleanouts in inmate areas to have vandal proof screws. Outdoor cleanouts shall be as detailed on Drawings.

2.43 VALVE BOXES

A. Unless indicated otherwise on Drawings, all valves underground shall be installed in two piece cast iron valve boxes, Tyler Series 6870 Roadway Box or Mead Pipe 460/560 Series. Provide extension wrench tool for operation of valve from above grade.

2.44 WATER HEATERS - GENERAL
A. Where applicable, provide for certificate inspection of water heater(s) as required by State Authorities; this inspection is to be occur prior to Substantial Completion of the Work.

2.45 DOMESTIC ELECTRIC WATER HEATER

A. Heater shall be U.L. listed and have a glass-lined welded steel tank rated for 150 psi working pressure. Tank shall have a one year limited warranty and be insulated with blanket type fiberglass or foam insulation and enclosed in baked enamel finish steel jacket. Heater shall be complete with immersion type heating element, automatic thermostat, high limit cutoff, cold water baffle and magnesium anode and brass/bronze drain valve. Heater shall be complete with AGA rated temperature and pressure relief (T & P) valve listed and installed in accordance with ANSI Z21.22. Unless indicated otherwise on Drawings, discharge of T & P valve shall be piped full size to outside of building. Unit size, capacity, and voltage shall be as indicated on Drawings. Heater shall meet ASHRAE 90.1 Standard. Heaters shall be Rheem 81V/81SV/81VP Series, Rudd PE/PES/PEP Series, A.O. Smith EEST/ELJF/ELSF Series, or equal as listed by addendum.

B. Point of use (utility) type heaters may have field installed drain valve at low side inlet in lieu of factory tank mounted valve. Also, when point of use type heaters are to be installed above the plumbing fixture served, Contractor shall provide Watts No. 36A, or equal, water heater vacuum relief valve at the water inlet to the heater.

2.46 DOMESTIC GAS-FIRED WATER HEATER (ATMOSPHERIC)

A. Water heater shall be as manufactured by PVI, A. O. Smith, or equal as listed by addendum, atmospheric gas fired water heater as scheduled on the Drawings for natural gas operation. The water heater shall fit properly into the space provided and shall conform to the requirements indicated on the Drawings.

B. The multi-flue tank shall be constructed in accordance with ASME Code Section IV Part HLW and stamped with the appropriate symbol for 125 psi working and 187 psi test pressure and be National Board stamped and registered. The tubes shall be covered with pure, dead soft copper, expanded, and welded into the tube sheet. After complete tank fabrication, the interior tank surfaces shall be coated with three separate coats of a thermosetting, polymerized fluorocarbon lining with high temperature resistance and hydrophobic qualities. Glass-lined tanks ASME stamped for 160 psi working pressure and 160 psi test pressure are acceptable as equal. Manufacturer's warranty shall be a part of the submittals and the water heater tank shall be covered by the manufacturer's three year (minimum) non-prorated warranty against failure.

C. The tank shall be insulated with heavy density fiberglass insulation and trimmed with a baked enamel steel jacket. The water heater shall have factory installed ASME rated temperature and pressure relief valve and solid brass drain valve. The entire water heater shall be Underwriters Laboratories listed and packaged so that there is one responsibility, that of the manufacturer. Heater shall meet the ASHRAE 90.1 Standard.

D. Heater shall have intermittent electronic ignition, 120 volt (12 ampere maximum). Heater may use electric fan power venting system; provide for any power required and provide draft regulators/dampers as necessary to regulate draft and prevent backdraft. Heater may be equipped with fail safe, electrically operated flue damper.

E. Start-up shall be performed by an authorized start-up agency of the manufacturer, with a written report to the Architect.
2.47 DOMESTIC WATER CIRCULATORS

A. Provide circulating pumps suitable for domestic hot water system where shown. Pumps shall be close-coupled, in-line type, bronze or stainless steel fitted, with mechanical seal and with capacities as scheduled.

B. Provide return line temperature controller (aquastat) and interlock with pump power wiring.

C. Provide plug and cord electrical connection through plug-in timer. Timer shall be Intermatic DT1C, or equal, programmable 24-hour plug-in timer with LCD readout, battery back-up, U.L. listed, 1/3 HP inductive load rating.

PART 3 - EXECUTION

3.1 GENERAL

A. Immediately after installation of plumbing fixtures, cover each fixture with a fixture protector. Take every possible precaution for the protection of fixtures and connections and replace any fixture or other work damaged with no additional cost to the Owner.

B. Provide suitable (silicone base) caulking material between fixture and wall/floor/countertop (as applicable) for each fixture type such as water closets, urinals, lavatories, sinks, showers, etc.; caulking material shall form a neat bead around the perimeter of fixture to form a watertight joint.

END OF SECTION 15070
SECTION 15080 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The General Conditions of the Contract and Supplementary Conditions of the Contract shall govern the work under this Section of the Specifications. The Contractor is specifically directed to refer to said Conditions.

B. It is understood that these Specifications, and the accompanying Drawings, contemplate complete apparatus, fully erected and in successful operating condition. All work must be performed in the best and most substantial manner.

C. These Specifications are intended to provide complete, and in proper operation, all sprinkler system piping, equipment, heads, valves, controls and accessories, all as specified herein or shown on the accompanying Drawings, or reasonably implied in either. The building shall be provided with complete coverage sprinkler system, classification as required. Include a separate valved zone branch serving any elevator shaft and equipment areas. System shall consist of a calculated wet system unless indicated otherwise. Verify all pertinent criteria. The systems shall conform to layout shown and meet all requirements of agencies listed under "REGULATIONS AND STANDARDS" below. Refer to Drawings for additional information.

D. Hydraulic calculations shall include an allowance for hose(s). Water velocity in sprinkler piping shall not exceed 20 feet per second at design water flow rate, and friction loss shall not exceed 0.35 psi per linear foot of piping.

E. All spaces of the building shall be completely protected by automatic wet-pipe sprinkler system for the occupancy hazard intended for the individual spaces. Unless required otherwise or noted, sprinkler protection shall be light-hazard classification system with heads spaced at a maximum of 225 sq. ft. per head. Wet-pipe systems must be hydraulically calculated for a minimum of 0.1 GPM per sq. ft. for the most remote 1,500 sq. ft.

F. In electrical switchgear rooms, transformer areas and electrical closets, sprinkler protection shall be designed for 0.15 GPM per sq. ft. over the most remote 3,000 sq. ft. Provide wire guards over sprinklers within these spaces and in mechanical rooms.

G. All costs for sprinkler service, piping mains and utility company charges, are included in this work; include in bid.

1.2 SYSTEM LAYOUT

A. Where Drawings indicate layout of system components, the layout shall be verified to comply with "REGULATIONS AND STANDARDS" and shall be revised if required to comply. Revision shall be at Contractor's expense. Any such revisions shall be verified with the Architect.

B. Sprinklers shall be placed at center points of 2'-0" x 2'-0" lay-in ceiling tiles. Coordinate sprinkler layout with light fixtures, speakers, HVAC grilles/diffusers, etc., and resolve any conflicts/discrepancies with project's Field Architect. Refer to architectural reflected ceiling plans for ceiling appurtenances.
C. Sprinkler layouts shown these Drawings are to establish desired arrangement and areas to be sprinkled. Contractor shall provide additional sprinklers or adjust sprinkler location and/or type where required to satisfy Code Regulations, Contract Documents and Code Authorities. System required is not necessarily limited to the number of heads and locations shown.

1.3 ELECTRICAL WORK

A. See "COORDINATION."

1.4 SPRINKLER SYSTEM CONTRACTOR

A. It is intended that the work under this Section is to be performed by a qualified Fire Protection Piping System Contractor regularly engaged in this type of work. This Contractor is to hold a current license to perform this work and be certified by the State Fire Marshal. All documents shall bear this certification.

1.5 REGULATIONS AND STANDARDS

A. It is the intention of these Specifications and the accompanying Drawings, that all elements and features of the fire protection system shall be in accordance with the standards of the National Fire Protection Association (NFPA), the State Fire Marshal, the applicable building Codes and Property Ins. Association of Louisiana whether so indicated or not. NFPA standards are on file in office of Architect and may be examined at the Contractor's request. Standards and Codes applicable, but not limited to, shall be the latest editions adopted by the authorities having jurisdiction for the following:

1. NFPA 13: Installation of Sprinkler Systems
2. NFPA 24: Private Fire Service Mains and Their Appurtenances
3. NFPA 231: General Storage
4. NFPA 231C: Rack Storage of Materials
6. SBC: Standard Building Code
7. ASME A17.1: Safety Code for Elevators and Escalators
8. SFPC: Standard Fire Prevention Code

1.6 AREAS SUBJECT TO FREEZING

A. For areas requiring protection and not receiving direct heating during times of potential freezing, such as building overhangs, porches, equipment rooms, canopies, attics, etc., provide a dry pipe system or anti-freeze loop system for these areas only.

1.7 MANUFACTURER'S OR TRADE NAMES

A. Where the Drawings or Specifications mention the name of manufacturers or the products of
specific manufacturers, it is intended that the Contractor shall furnish the item or items as specified. Products of manufacturers that are not mentioned shall be subject to prior review by the Architect and shall in any case be in accordance with regulations and standards as stated above.

1.8 SHOP DRAWINGS AND SUBMITTAL DATA

A. Within fifteen days of award of the Contract, the Contractor shall submit three copies of system piping shop drawings and six copies of manufacturer's data and descriptive literature and drawings for all equipment and materials. Additionally, provide a reproducible (sepia) copy of the system piping shop drawings. All drawings, literature and data on all equipment shall be submitted at the same time; this material shall contain complete layout, capacity data, dimensions and all other pertinent information necessary for the Architect to properly review and evaluate the item and that necessary to meet the requirements for submittal to the State Fire Marshal.

B. The Contractor shall obtain approval of agencies listed under "REGULATIONS AND STANDARDS" before submitting to the Architect, except that data for State Fire Marshal's review shall be submitted to the Architect prior to submitting to the Fire Marshal. All required review fees and application requirements shall be by the Contractor. No item of equipment or material shall be placed on order until Final Review comments have been received from the Architect. See "DRAWINGS" below.

1.9 ORDINANCES, RULES AND REGULATIONS

A. All material and construction shall conform to the requirements of all building, plumbing and sanitary codes and laws in force in the locality in which the work is to be done. All materials and construction shall also conform to the rules and regulations listed above under "REGULATIONS AND STANDARDS."

1.10 DRAWINGS

A. The Contractor shall submit detailed drawings for all sprinkler systems showing exact locations and sizes of all elements in the systems before fabrication is begun. Architect shall have the prerogative of changing the position or configuration of these systems without changing the total scope of work involved to comply with "REGULATIONS AND STANDARDS."

B. Drawings shall include connection to water source with all pertinent and current water source data.

1.11 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship under this Contract for a period of one year from date of final acceptance of his work and shall repair or replace any such defective materials and workmanship without cost to the Owner.

B. The guarantee shall include complete service, including adjustment service and inspection, during the guarantee period as required by agencies listed under "REGULATIONS AND STANDARDS."
PART 2 - PRODUCTS

2.1 PIPING

A. General: Furnish and install in a neat workmanlike manner, all piping shown on Drawings or that is specified or required to provide a complete, properly operating installation. All piping and accessories shall conform to standards as applicable.

B. Run piping parallel with the lines of the building, unless specifically shown or noted otherwise. All pipe, fittings, valves, etc., shall have sufficient clearance from other work to finish at least 1/2 inch from other work or finished covering of other piping.

C. Provide all necessary hangers, anchors, thrust blocks, etc., to properly support and protect piping system, as required by agencies listed under “REGULATIONS AND STANDARDS.”

D. Under no circumstances is the Contractor to attach to or support from any bar joist bridging. Any supports to the bar joists or any structural systems are to be approved by the Architect. All supplemental angle or channel iron required to support equipment of this Specification is to be furnished by the Contractor and is to be independent of any other supports.

2.2 SLEEVES AND PLATES

A. Wherever pipes pass through concrete slabs, furnish and install sleeves, properly located for the work.

B. Use sleeves of sufficient size to allow the specified pipe covering to pass through the sleeves and finish sleeves flush with walls and ceiling.

C. Sleeves shall be galvanized steel not lighter than 24 gauge.

D. Seal spaces between sleeve and pipe. Use packing device or material for U.L. rating to match rating of wall or floor/ceiling as rated under U.L. File R9658.

2.3 ESCUTCHEONS

A. Where pipes passing through floors, walls or ceiling exposed to view in finished areas, provide pressed steel split plates which cover the opening and fit snugly to pipe.

2.4 PIPING MATERIALS

A. All piping shall be in accordance with the NFPA 13 and applicable sections of NFPA 24. Piping materials shall be in accordance with the following:

1. **Interior Sprinkler Piping:** (Including Standpipes and Risers) Schedule 40 steel pipe with approved cast iron or malleable iron threaded or grooved end fittings. Piping may be joined by approved welding methods with listed fittings. Piping 5 inches in diameter and larger joined by approved welding or roll grooved methods may be "Thin-Wall" pipe, in accordance with NFPA 13:3-1.

2. **Drain Piping:** All piping subject to alternatively wetting and drying cycles such as test and drain piping shall be Schedule 40 galvanized steel with screwed galvanized malleable iron fittings.
3. **Piping for Dry Pipe and Pre-Action Sprinkler Systems:** Pipe and fittings shall be same as specified for drain piping.

4. **Exterior Fire Piping:** Approved cast iron or ductile iron water pipe with mechanical joints, 250 lb. pressure class. Piping beyond five feet outside the building walls may be AWWA Standard C-900 PVC pressure pipe Class 150. The pipe shall have an integral bell end with a pressure pipe elastomeric ring type seal. The pipe shall be manufactured to cast or ductile iron size outside dimensions. Fittings shall be gasket/mechanical joint cast or ductile iron, Class 250 (minimum) produced in accordance with AWWA C-111.

### 2.5 VALVES

A. Furnish and install all valves as indicated or as required by agencies listed under "REGULATIONS AND STANDARDS." See also "MONITORING DEVICES."

### 2.6 SPRINKLER HEADS

A. Provide heads, type and location as required for the classification determined. Except where indicated otherwise on Drawings, heads in areas with finished ceilings shall be pendant mounted, concealed type, color of cap to match color of ceiling. Heads in detention areas (i.e., cells, day rooms, etc.) to be institutional pendent or institutional sidewall as required.

B. Except where required otherwise, sprinklers in light hazard occupancies shall be quick-response type.

C. For sprinklers installed in areas exposed to outdoor environments (such as exterior canopies, walkways), heads shall have corrosion resistant coating.

### 2.7 FLOW SWITCHES

A. Provide flow switches at main entrances and zones as required. Flow switches to be either paddle type or pressure actuated type, and U.L. listed as compatible with the service. If flow paddle type switches are used, include a 3 psig pressure drop allowance or provide manufacturer=s documentation otherwise.

### 2.8 MONITORING DEVICES - REQUIRED SYSTEMS

A. Where the sprinkler system is installed to comply with a Code requirement, the sprinkler system must be designed with Factory Mutual approved water flow alarm switch(es) designed for connection by others. Monitor switches shall be Factory Mutual approved gate valve switches for supervision of each O. S. & Y. valve. This monitor switch will require the plunger operator to "ride" along the tangent of the valve stem. Monitor switches employing the center-line type action of the plunger to the stem are not acceptable.

B. Monitored zone valves 1 inch to 2-1/2 inches in size may be Factory Mutual approved supervised slow close indicating type butterfly valves. Flow switches, monitor switches and monitored zone valves shall be submitted for approval. Coordinate with the Fire Detection System Equipment Supplier. Refer to Drawings.
2.9 AIR COMPRESSORS

A. Air compressors for dry pipe and/or pre-action sprinkler systems shall be a packaged assembly, listed for the application. The air compressor assembly shall be style with compressor and motor mounted to the receiver tank. Include air pressure maintenance device, pressure switch and all required accessories.

2.10 ACCESS DOORS

A. Provide access doors in ceilings and walls where required for access to valves and other devices. Doors shall be as specified under "BASIC MATERIALS AND METHODS." Where lay-in ceilings exist, no access doors are required.

PART 3 - EXECUTION

3.1 OPENINGS, CUTTING AND PATCHING

A. All cutting and patching is covered generally under another section of these Specifications. This Contractor shall coordinate with the General Contractor and do any cutting or patching not otherwise covered for this work.

3.2 STARTING, TESTING AND INSTRUCTION

A. The Contractor shall perform such cleaning, testing and Owner Maintenance Instruction as required by agencies listed under "REGULATIONS AND STANDARDS."

B. Provide inspector's test and drain at hydraulically most remote area(s). Provide required signs identifying each control valve, alarm valve and drain valve, as applicable.

3.3 COORDINATION

A. A smoke detector (by Fire Alarm System Contractor) is to be installed in the elevator machine room. Activation is to recall elevator to the designated floor.

B. Heat detectors and smoke detectors (by Fire Alarm System Contractor) are to be installed within 2'-0" of each sprinkler within elevator machine rooms and shafts. Coordinate with Electrical Work.

C. Sprinklers shall be provided within elevator machine rooms and both top and bottom of elevator shafts. Sprinklers within these spaces shall be rated for 200°F to 225°F (12°F minimum above heat detectors) and shall have wire guard protection devices.

D. Sprinkler systems in elevator machine rooms and shafts shall conform with ASME A17.1.

E. The air unit smoke detectors, all interlock wiring, the annunciator panel and signal wiring runs to the annunciator panel will be furnished and installed by the Fire Detection Contractor as part of the Electrical Work. The signal wiring runs to the central monitor and energy management panel shall be furnished and installed by the Temperature Controls Contractor as part of the Mechanical Work. Coordinate as required.
F. Coordinate all sprinkler alarm/supervisory tie-in connections with Fire Alarm System Contractor. Any fire protection system control valve(s) not shown in these Drawings, but required either by local Code Authorities or Contractor's discretion, shall be supervised via the building fire alarm system, and costs for such installation shall be included in the sprinkler contract; coordinate with Electrical Contractor.

G. This Contractor shall provide for all the switches and interlocking devices on all valves as required.

3.4 UNDERGROUND PIPING

A. Underground fire protection system piping shall be installed in accordance with the requirements of NFPA-24, *Private Fire Service Mains and Their Appurtenances*. Provide concrete thrust blocking at each change in direction of the piping and at all tees, plugs and caps in accordance with NFPA-24. Where thrust blocking is impractical, fittings with a mechanical joint retainer gland, approved for the piping material utilized, may be used in lieu of thrust blocking.

END OF SECTION 15080
SECTION 16010 - GENERAL PROVISIONS - ELECTRICAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work intended under this section consists of furnishing all labor and materials necessary to expand existing as shown and install new electrical work complete, including equipment, fixtures, switches, conduits, accessories, etc., ready for operation. Work includes the complete electrical installation of the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center. Work includes the following, but this list in no way limits the scope of work involved, and is issued only as a general scope of major items to be done.

B. Complete electrical installation of the distribution system, including feeders, switchboards, panelboards, branch circuit wiring devices, fire alarm and emergency system, etc.

C. Furnish and install a 15KV underground distribution system consisting of poles, taps, pad-mount transformers, manholes, etc.

D. Provide telephone outlets were shown on Plans or required by Owner. Telephone entrance raceways shall be provided as shown and shall be 18” minimum below grade or as shown on Plans.

E. Furnish and install new indoor and outdoor lighting system with new fixtures as shown on Plans or specified herein.

F. Furnish and install exit lighting fixtures with type as shown on Plans or specified herein.

G. Furnish and install a complete emergency light system with new fixtures as shown on Plans or specified herein.

H. Furnish and install Air Conditioning and Heating Control Wiring.

I. Furnish and install Cable Bus System.

J. Provide MATV outlets were shown on Plans or required by Owner. MATV entrance raceways shall be provided as shown and shall be 18” minimum below grade or as shown on Plans.

K. Provide Computer outlets were shown on Plans or required by Owner. Computer entrance raceways shall be provided as shown and shall be 18” minimum below grade or as shown on Plans.

L. Furnish and install an Empty Conduit System.

M. Miscellaneous electrical renovation of existing primary and secondary distribution systems as shown.

N. Provide a complete normal and emergency primary distribution system including underground feeders, manholes, pad-mount transformers and metal-clad switchgear as described further herein.

O. Furnish and install a complete emergency generator system including all appurtenances as described further herein.
P. Provide a complete electrical system consisting of secondary feeders, branch circuits, wiring devices, panelboards, and motor control centers as described further herein.

Q. Provide a complete Fire Alarm System and monitoring system as described further herein.

R. Provide testing of electrical system as described herein.

S. Provide inspection of the completed electrical system.

T. Provide complete Operation and Maintenance manuals as described herein.

U. Provide complete equipment labeling as described herein.

1.2 GENERAL REQUIREMENTS

A. Check complete set of Plans in addition to work covered under this section so all conditions are taken care of and equipment and materials are furnished and installed to make a complete and satisfactory system in working order.

B. Investigate conditions and furnish fittings, bends, junction boxes, pull boxes, etc., as required to meet conditions.

C. All duplicate equipment supplied shall be of a single manufacturer.

D. Submittal of bid shall indicate Contractor has examined site, Specifications and Drawings and has included all required allowances in his bid. Should Specifications or Drawings require items or installation not allowed by the governing authorities, the Contractor is obligated to call these items to the Designer's attention prior to bidding work.

E. Utilities shown on Drawings have been obtained from existing Drawings and verbal information. Verify all services prior to bidding work.

F. Exercise adequate planning and be responsible for timely placing of sleeves, conduit boxes, etc. Locations shown for fixtures, conduit, outlets, etc., are approximate and Designer reserves the right to make reasonable changes, without additional cost, before roughing-in.

G. It is the intent of the Specifications and Drawings to describe complete electrical system in satisfactory operating condition. All work called for in Specifications and not shown on Drawings, or shown on Drawings and not called for in Specifications, shall be performed as if described in both.

H. The various trades shall cooperate in installing their work in order that there will be no conflict of space required by conduit, piping, ducts, outlets, etc. If interference develops, the Designer is to make the decision for solution before any work is begun. If the work is completed and must be relocated due to conflict, such relocation shall be made without additional cost to the Owner.

I. The Contractor shall provide temporary electrical service to those areas as outlined by the Designer. This service shall include furnishing and connection of secondary feeders, transformers, temporary support, and electrical service to those areas to remain active and occupied during the course of construction. Coordinate with the Designer the methods and schedule of electrical work. This temporary service shall also include construction power to be used by the various Subcontractors on the job. The Contractor shall remove all temporary service from each building and site upon completion of the project.
1.3 LICENSE, LAWS, PERMITS AND FEES:

A. Only bids of Electrical Contractors licensed under Act 233 of 1956 will be considered.

B. Contractor shall submit documentation prior to beginning work, indicating license is in full force and of proper classification.

C. Electrical work shall be installed in accordance with all governing codes and laws of the State of Louisiana in effect during time of construction.

D. Applicable rules of National Electrical Code shall apply as minimum standard for work performed.

1.4 STANDARDS AND CODES

Where a referenced standard is indicated, the applicable standard shall be made a part of the specifications which refers to it to the same extent as if written out in the specification in full.

A. Meet the requirements and recommendations of applicable portions of standards listed below:
   
   I.E.E.E. Institute of Electrical and Electronic Engineers
   
   N.E.M.A. National Electrical Manufacturer's Association
   
   I.C.E.A. Insulated Cable Engineers Association
   
   A.S.A. American Standards Association
   
   A.E.I.C. Associated of Edison Illuminating Companies
   
   O.S.H.A. Occupational Safety and Health Administration
   
   Occupational and Health Standards
   
   A.S.T.M. American Society for Testing Materials
   
   U.L. Underwriters Laboratory
   
   N.E.C. National Electrical Code
   
   N.F.P.A. National Fire Protection Association
   
   N.B.F.U. National Board of Fire Underwriters
   
   A.N.S.I. American National Standards Institute
   
   U.S.A.S.I. United States of America Standard Institute

B. All standards referred to shall be current with latest addenda and supplements as of the date of the Contract Documents.

C. Comply with all governing building and safety laws, ordinances and regulations relating to building and public health and safety laws having jurisdiction.
1.5 PERMITS AND INSPECTIONS

A. Notify the Designer and the proper authorities in ample time when any work is ready for inspection or testing.

B. Contractor shall assist in making periodic inspections or tests as required by Designer. Concealed conduit and wiring shall be inspected and checked by Designer before acceptance.

C. Designer shall be notified at least 48 hours prior to tests or covering. Wiring or conduit system covered before being checked shall not be accepted.

D. See individual specification sections for further tests and inspections.

E. Contractor shall perform all tests in presence of Designer to show that the power and lighting loads are equally divided among phases of feeders serving each piece of equipment and each panelboard.

F. Do not conceal any work until it has been tested and inspected.

1.6 CONDITIONS AT SITE

A. Visit the site to be familiar with conditions under which work will be performed.

B. Submittal of bid shall indicate Contractor has examined site, Specifications, and Drawings and has included all required allowances in his bid. Should Specifications or Drawings require items or installation not allowed by governing authorities, Contractor is obligated to call these items to the Designer's attention prior to bidding work.

C. Utilities shown on Drawings have been obtained from existing Drawings and verbal information. Verify all services prior to bidding work.

D. Provide a locked, weatherproof compartment for the storage of materials and apparatus which otherwise would be subject to weather damage, theft or vandalism.

E. At all times the Contractor shall take precautions necessary to properly protect his apparatus from damage. Failure on the part of the Contractor to comply with the above to the Designer's satisfaction will be sufficient cause for rejection of the particular piece of apparatus in question.

1.7 SUBSTITUTIONS

A. For each proposed substitution, submit to the Designer at least seven (7) working days prior to bid date for prior approval. Submit sufficient manufacturer's data to indicate type, quality, and nature of actual equipment or materials proposed. Manufacturer's name alone is not adequate for approval. Where samples are required, submit production sample of actual item.

B. Bids shall be based on materials and equipment as specified or prior approved in writing.

C. The cost of any changes in design, installation, or the work of other trades, or delays in the work, resulting from substitutions, shall be the responsibility of the Contractor under this Division.
1.8 SHOP DRAWING APPROVALS

A. Comply with requirements of General Conditions.

B. All duplicate equipment supplied shall be by a single manufacturer.

C. For all equipment listed below, the Contractor shall submit for approval six (6) sets of complete certified manufacturer's descriptive and performance data. No data will be considered unless the Contractor has indicated by his signature thereon, that he has reviewed it and found it complete and in order. Submittal data shall be assembled in bound sets, one copy each per set, and all unrelated data or illustrations on submittals shall be crossed out. The Designer will review submittals for conformity to Specifications and Drawings. If the submittals are rejected or returned to the Contractor "approved as noted," the Contractor shall then resubmit six (6) complete certified submittals with all corrections. If all conditions are met, the Designer will retain two (2) copies and return four (4) approved copies to the Contractor.

1. Lighting Fixtures 9. Padmount Transformers
2. Panelboards 10. 15KV Power Cable
4. Wiring Devices 12. Transformer Labeling
6. Fire Alarm System 14. 15KV Switchgear
7. Motor Control Centers 15. 15KV Termination/Splices
8. Precast Manholes

D. Corrections or comments made on shop drawings during this review do not relieve Contractor from compliance with requirements of Drawings and Specifications. This check is only for review of general conformance with design concept of the project and general compliance with information given in Contract Documents.

E. Contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction; coordinating his work with that of all trades; and performing his work in a safe and satisfactory manner.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instruct the Owner's designated personnel in the operation and maintenance of the systems.

B. Coordinate with the Owner's designated personnel when factory technicians are available for start-up, testing and special instructions and procedures.

C. Provide four (4) complete operating and maintenance manuals bound in hard binders. Include complete identification information, (manufacturer, model, type, serial number) descriptive and performance data, operating and maintenance instructions, replacement parts data, warranties, guarantees, and names and addresses of suppliers on the following items, before energization of any equipment.

1. Lighting Fixtures 6. Pad Mount Transformers
2. Panelboards 7. 15KV Power Cable
4. Fire Alarm System 9. 15KV Switchgear
5. Motor Control Centers 10. 15KV Termination/Splices
1.10 DRAWINGS

A. Drawings are largely diagrammatic. Do not scale. Follow, Architectural, Civil, Mechanical, Structural, and Shop Drawings for all dimensional information not specifically indicated on Electrical Drawings.

B. Typical details are shown on the Plans, and in any cases where the Contractor is not certain about the method of installation of his work, he shall ask for details.

C. Lack of details or information not requested shall not be construed as reason for improper installation. If the Contractor does not ask for details or clarification, and installs work incorrectly, he shall reinstall the work in accordance with instructions or details furnished, and do so at no extra charge.

D. Lack of information not requested is no excuse for improper installation.

E. Minor deviation will be permitted as long as quality, capacity, and performance are not jeopardized.

F. General arrangement of work is indicated on Plans. Contractor shall carefully examine Plans and be responsible for proper fitting and operation of materials and equipment. Discrepancies, which prevent systems from functioning properly, shall be brought to attention of Designer prior to bid date.

G. Because of small scale of the Drawings, it is not possible to indicate all offsets, fittings, and accessories required. The Contractor shall investigate the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing fittings, bends, junction boxes, access panels, and accessories required to meet such Specifications.

1.11 RECORD DRAWINGS

A. Comply with requirements of General Conditions.

B. Prior to final inspection, the Contractor shall deliver all record documents to the Designer who will prepare final as-built drawings and transmit same to Owner.

C. Record changes in work caused by unforeseen difficulties. In the event of such changes, confer with Designer and obtain written consent before deviating from Plans.

D. Records shall indicate work as installed, and upon completion of construction, furnish an accurate plan of electrical systems as actually installed.

E. Provide additional drawings if required to accomplish the above.

1.12 GUARANTEE

A. Guarantee the entire installation to be free of defects in materials and workmanship for one year from date of notice of final acceptance. The Contractor shall furnish free of cost to the Owner materials and labor necessary to comply with this guarantee. See individual sections for warranties in excess of one year.

B. Guarantee includes performance capacities and characteristics.
C. Unless specifically called for otherwise installation of all equipment shall be according to manufacturer's recommendations to maintain equipment guarantees.

END OF SECTION
SECTION 16030 - TESTING

PART 1 - GENERAL

1.1 SCOPE

Before the electrical facilities for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center are placed in operation, the Contractor shall make suitable tests to establish to the satisfaction of the Designer that all equipment, devices, and wiring have been correctly installed, are in satisfactory working condition, and will operate as intended. All electrical testing for entire project shall be provided under Division 16.

A. The Designer reserves the right to witness all tests and he shall be notified one week before tests are to take place.

1. The results (i.e. test values) of all tests described herein which are marked with an asterisk (*) shall be recorded on forms agreed upon by the Designer.

2. Four (4) certified copies of the test data shall be given to the Designer.

3. Upon completion of all other tests described herein, the Contractor shall submit to the Designer four (4) copies of a certified report attesting that each test has been performed in accordance with these conditions.

4. Report shall include, for each test, the date of performance and name of the person in charge of the test

B. At least two months before field testing begins, the Contractor shall submit for review by the Designer a list of minimum acceptable test values Contractor plans to follow for liquid dielectric strength, equipment dielectric absorption ratios, and insulation resistances for circuits and equipment. Values shall be at least equal to minimum values specified in manufacturer's instructions or applicable national standards.

C. All measurements shall conform to established minimum acceptable test values. Designer reserves the right to approve all test results before circuits or equipment are energized for the first time.

D. Individual measurements which fall below the average of like measurements on similar equipment by more than 25 percent shall be submitted to the Designer for specific approval even though they meet the minimum acceptable values.

E. If motors, generators, or transformers must be dried to obtain required insulation resistance values, approval of the drying method shall be obtained from the Designer before applying heat.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REQUIRED TESTS

A. *Tests on all high voltage cable shall consist of three tests.

1. Factory Test
High potential, insulation, and corona test as described in Section 16120. This test shall be performed at the factory on each reel of cable prior to lagging of reels. All test reports shall be certified and transmitted to the Designer prior to the start of field testing.

2. Proof Test

Prior to installation of cable, removal of lagging, certified high potential tests by an independent testing lab shall be performed upon each reel of cable received. Any reel which differs more than 10% from factory tests shall be subject to rejection by Designer. The certified field test reports for each reel received shall be approved by Designer before installation of cable.

3. Final Tests

Upon completion of installation of cable, all terminations, elbows, stress cones, etc., the 15KV cable shall be high potential tested. Certified test reports by an independent lab shall be provided the Designer for each section of cable between terminations.

a. All 15KV cables shall be given a D.C high potential test after all splices and stress cones are made. Testing shall not include any bus work.

b. All 15KV cables shall be given a complete dielectric absorption test both before and after the high potential test. A 2500 volt motor driven megger shall be used for these tests and shall be applied until three equal “level-off” readings 10 seconds apart are obtained.

c. In setting up the test set, special safety precautions should be taken regarding grounding of the test equipment. The test set, its sphere gap, if used, and the cable sheath should all be grounded to the same ground. During the test a man shall be stationed at each point where the cable has exposed connections. However, each organization is individually responsible for the safety of its personnel.

d. In applying the high potential test, all cables shall be tested between the conductor and ground with the shield wires connected to their permanent ground. Potheads shall be connected to their permanent ground.
e. D-C high potential test voltage shall be applied at a uniform rate as follows:

<table>
<thead>
<tr>
<th>Time After Application</th>
<th>Test Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial application</td>
<td>15 KV *</td>
</tr>
<tr>
<td>At 15 sec. after</td>
<td>25 KV</td>
</tr>
<tr>
<td>At 30 sec. after</td>
<td>40 KV</td>
</tr>
</tbody>
</table>

* Existing high voltage cables shall not be high potential tested higher than 15KV.

f. Test voltage of 40KV, DC shall be held for five (5) consecutive minutes. Leakage current readings shall be taken at thirty (30) second intervals during the first two (2) minutes, and at one (1) minute intervals thereafter. If after the first minute, the leakage current increases abnormally, the test shall be stopped or continued in accordance with instructions from the person in charge.

g. Records shall include the following:

2. Megger reading versus time data.
3. High potential and leakage current readings versus time data.

B. *Tests on 480 Volt Power Cable*

1. All cable and leads shall be tested for continuity and, except for 120-volt services, shall be given a megger test.
2. All control cables shall be tested as detailed under "Control Cable."
3. Lighting circuits and other 120-volt services shall be tested during construction only for continuity and identification and shall pass operational tests to see that the circuits perform all functions for which they are designed.
4. Each 480-volt service cable from the transformers shall be meggered to industry standards. Each phase shall be tested between conductor and ground and between phases.

C. Air Insulated Transformers (480 volt primary and lower)

1. Lighting transformers and all other small transformers (480 volt primaries) shall be meggered after connections to their supply cables are made, the supply cable being meggered with the primary winding and to the open load breaker.
2. Continuity and correctness of all windings shall be checked.

<table>
<thead>
<tr>
<th>Transformer Voltage</th>
<th>Megger Test Voltage</th>
<th>Minimum Megohms Corrected to 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>480 volts</td>
<td>1000V</td>
<td>45</td>
</tr>
<tr>
<td>120/208 volts</td>
<td>500V</td>
<td>30</td>
</tr>
<tr>
<td>240/120 volts</td>
<td>500V</td>
<td>30</td>
</tr>
</tbody>
</table>
3. All of the above megger readings shall be level off readings as obtained with a motor driven megger.

D. Control Cable

1. This Specification covers the electrical tests required for acceptance for all single and multi-conductor control cables. Excluded from this Specification are such wires as telephone, intercommunication system, and thermocouple wires.

2. All control wires shall be checked for continuity and identification.

3. Continuity and identification shall be checked by means of a D-C test device using a bell or buzzer to "ring out" the wires. Phones may be used for communication only between the testers.

4. No control cable which contains shorted or grounded conductors as indicated by test shall be accepted.

E. *Power Transformers

1. Complete inspection of tank shall be made. All gaskets, valves, and seals shall be checked for tightness against gas leakage, oil leakage, and water entrance. Any oil fittings removed shall be cleaned, coated with glyptal, and replaced in accordance with standard procedures.

2. Observe oil level indicators and temperature indicators for proper operation.

3. Operationally check cooling equipment automatic throw-over operation. Manually make up alarms on fan no-voltage relays, pump no-pressure relays, pressure relief device, oil level and temperature contacts, and see that the proper flag falls at the station annunciator.

4. Test ratio of transformer on all taps using TTR test set or equivalent apparatus.

5. Check winding resistance with Kelvin Bridge on all tap positions.

6. Motor driven megger tests to high and low side windings and ground with the other winding grounded. Tests shall be held for a long enough duration to fully charge the windings.

7. Megger pump and fan motors individually with a 500 volt meeger.

8. Check control for cooling pumps and fans; check rotation of each. Simulate operation of various cooling stages by manually making up sequence contacts of TRP relays (if required) and observing resultant pump and fan operation.

9. Test operation of the fault pressure relays in accordance with manufacturer’s instructions.

10. Test operation of tap changer (de-energize transformer before operating no-load changer). Measure primary and secondary voltages with changer in each position and verify that voltage ratios are in accordance with transformer nameplate data.

11. Prior to placing transformer in regular service, tap changer shall be set to provide rated secondary voltage at no load for the value of primary voltage expected at start-up.
12. Megger readings shall be as specified below:

<table>
<thead>
<tr>
<th>Transformer Voltage</th>
<th>Megger Voltage</th>
<th>Minimum Meghoms Corrected to 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>13,200/480 volt</td>
<td>2500 V. High side</td>
<td>300</td>
</tr>
<tr>
<td>13,200/120-208 volt</td>
<td>500 V. Low side</td>
<td>80</td>
</tr>
<tr>
<td>480/120-208 volt</td>
<td>500 V. High side</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>500 V. Low side</td>
<td>100</td>
</tr>
</tbody>
</table>

13. Standard dielectric test as specified in test procedure for testing and filtering insulating oil shall be made on the insulating oil.

14. Sampling

a. The sample container shall be made of clear glass of at least 8-ounce capacity and shall be cleaned and dried.

b. Rinse sample containers with dry, lead-free gasoline or benzene and dry. Then wash them with strong soap suds, rinse thoroughly with water, and dry in an oven at 105°C before using. This is to apply only the first time the sample containers are used. Thereafter, the sample containers to be rinsed three (3) times with the oil to be tested.

c. Do not use rubber or composition rubber for gaskets or stoppers. Cork or glass material should be employed for this purpose. The test sample containers shall remain corked and in a warm dry place between tests.

d. Oil samples shall be taken from the bottom of the transformer tank by means of the oil sampling valve.

e. Before taking a sample of oil from the bottom of the transformer tank, carefully clean the sampling valve and allow enough oil to run out so that any water which may have collected in the transformer bottom is removed.

f. Outside samples shall be taken on a clear day only.
15. Testing Oil
   a. A portable oil testing set, 35KV rating, shall be employed for this test. Electrodes in the test cup shall be one (1) inch in diameter. These electrodes shall be set with gap of 0.1 inch between their adjacent faces.
   b. The test cup shall be rinsed with dry, lead-free gasoline or benzene before using the first time and dried in an oven at a temperature of moderate degree. Rinse the test cup with the oil to be used each time before testing.
   c. After the above procedure, immediately fill the test cup with the oil to be tested. The temperature of the oil should be 20-30 degrees Centigrade which should also be the temperature of the room. Fill the cup the minimum height mark on the cup above the top of the electrodes. Allow the oil to stand in the cup for three minutes before the first, and one minute before each succeeding puncture.
   d. Voltage shall be applied at the rate of 3000 volts per second until breakdown occurs, as indicated by a continuous discharge across the gap. The circuit shall be opened immediately after breakdown. Five (5) breakdowns shall be made on each filling.
   e. The minimum average breakdown shall be 30KV. If the oil breakdown is less than 30 kV but more than 10 kV, it will require filtering. If the oil breakdown is less than 10 kV, then entire transformer shall be considered defective, rejected and shall be replaced.

16. Filtering Procedure
   a. A blotter filter press and oven will be required for reconditioning the oil.
   b. Contaminated transformer oil shall be reconditioned by drawing oil from the bottom of the tank, passing it through the filter press, and pumping it back into the top of the transformer at the filter press connection.
   c. Check that the air vents are open when adding oil to a transformer to avoid trapping air inside the tank.

F. Grounding Tests
   1. Each ground strap shall be tested for proper grounding by applying a Ground Tester or equivalent instrument and using auxiliary ground rods. The resistance reading on any strap shall not exceed 1.0 ohms.
   2. On new installations all underground connections in the ground grid shall be given a visual inspection.
   3. Equipment grounds shall show a resistance of 0.5 ohms or less to the ground grid or ground bus.

G. Generator
   Note: Test shall not be performed unless Manufacturer’s Representative is present. The
test to be performed shall be furnished by Manufacturer.

1. The Contractor shall assist the Manufacturer’s Representative in performing all tests.

2. The Contractor shall furnish electricians (as required) to assist in performing all tests.

H. General Inspection Points

1. Inspect each circuit breaker for dust or foreign particles on the working surfaces; blow out with air or clean off with a suitable cleaning fluid.

2. Check all control and metering circuits for proper operation.

3. Check all switchgear and transformer nameplates against manufacturer's drawings.

4. Check to be sure all switchgear indicating pilot lights and meters function properly.

5. Check operation of all circuit breakers.

6. Contractor shall thoroughly check all installations for proper operation.

END OF SECTION
SECTION 16060 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes electrical demolition for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 RELATED DOCUMENTS


B. Division 16 Specification sections.

1.3 SALVAGED MATERIALS

A. The User Agency shall have priority for the selection of salvaged material and equipment.

B. Any equipment and material selected to remain the property of the User Agency shall be removed and delivered to a location on the site as designated by the User Agency.

C. Material and equipment not retained by the Owner shall become the property of the Contractor and shall be removed from the site by him.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observations and existing record documents. Report discrepancies to Designer before disturbing existing installation.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate electrical service outages with User Agency.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Contractor shall remove all electrical equipment, panelboards, conduit (above ground and underground), wire, etc., not reused, place where directed by Designer, and patch finish to match existing. The following is a list of major items to be performed but this list in no way limits the scope of work.

1. Remove abandoned wiring to source of supply. Abandoned material shall become the property of the Contractor and shall be removed from the facility by him.

2. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

3. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

4. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

5. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

6. Repair adjacent construction and finishes damaged during demolition and extension work.

END OF SECTION
SECTION 16100 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE

A. All items contained under Section 16100 shall apply to all sections in Division 16 Electrical.

B. Each item shall be new unless otherwise stated and shall bear the name of the manufacturer and shall be of the best quality obtainable, unless specified otherwise.

C. All duplicate equipment shall be of a single manufacturer to include all facilities for the Skilled Nursing Care / Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

D. Materials shall be of the type, design, and strength to satisfactorily accomplish the purpose intended.

E. Each item shall conform with performance requirements, rules, codes, etc., to the testing, ratings, and quality of such items and they shall bear the stamp or seal of such approval.

1.2 SALVAGED MATERIALS

A. There will be a considerable amount of removed material involved in the work. All material, equipment and other removal items shall be turned over and placed in User’s designated area. See Specification Section 16060.

1.3 WORKMANSHIP

A. All work shall be performed in accordance with the best standards of practice by workmen skilled and qualified in the work to be done.

B. Supervision and coordination of the work and the integration of all components into a complete, functioning system shall be the responsibility of the Contractor.

C. Location of existing utilities and/or approved relocation or rerouting of proposed facilities to prevent interferences shall be the responsibility of the Contractor to accomplish at no additional cost to the Owner. Similarly, any damage to existing underground facilities shall be the responsibility of the Contractor and shall be repaired and/or replaced at no additional cost to the Owner.

1.4 SITE PREPARATION:

A. The Contractor shall provide all clearing, grading and/or fill required to prepare the site as required for installation of the foundations required and shall be suitable for the purpose and be compacted as described further herein to the compaction of the surrounding undisturbed soil.

1.5 EXCAVATION AND BACKFILL:

A. The Contractor shall provide all excavation necessary for installation of the foundations, underground conduit stub-outs, etc. See Section 02200 for applicable related items.

B. Excavated earth shall be placed in locations so as not to endanger the excavation nor interfere with other work or required traffic.
C. Width of excavations shall be the minimum necessary for proper installation of the facilities, with depths conforming as closely as possible to the required depth.

D. The Contractor shall provide shoring, bracing, sheeting, etc., as required to provide stability for excavations and the remaining undisturbed soil, and/or as required to maintain integrity of adjacent structures or facilities. All such shoring, bracing, sheeting, etc., shall be removed upon backfilling.

E. Use of mechanical equipment for excavation shall be permitted. When in doubt as to existing underground facilities or at points where such utilities are known to exist, hand labor shall be used.

F. The Contractor shall request the User Agency to locate and mark all underground utilities. Whether by hand labor or machine, all marked utilities damaged shall be the responsibility of the Contractor, and he shall repair or replace same to the satisfaction of the Designer. All unmarked utilities damaged will be repaired by the User Agency.

G. Placing of fill and/or backfilling shall be accomplished in maximum 8-inch layers using power tampers to obtain compaction equivalent to the surrounding undisturbed soil. Layers shall be continued and tamped until desired grade is obtained.

H. Placing of fill and/or backfilling of all excavations shall be to the satisfaction of the Designer, utilizing, where possible, previously excavated earth for backfill. However, broken asphalt, rocks, stones, concrete fragments or other foreign objects, or any materials which will soften or decompose such as lumber, rubbish, roots, frozen earth, etc., shall be removed from the backfill prior to its placement.

I. Any excess fill material shall be placed as directed by the Designer. Foreign material removed from fill or backfill shall be disposed of as directed by the Designer. Any fill requirements over and above the available from excavations shall be provided by the Contractor and shall be suitable for said purpose.

J. Sufficient pumping equipment shall be maintained to keep all excavations free of water.

1.6 CONCRETE WORK:

A. Except as noted otherwise in the Drawings and/or Specifications, all concrete used shall be 3,000 psi at 28 days concrete.

B. Concrete used as conduit or cable protection shall be 1,500 psi at 28 days concrete with an integral red dye added.

C. Forming of foundations, etc., shall be straight and true, with reinforcing and dimensions as called for on the Drawings.

D. All exposed concrete shall be carefully and expertly finished with equipment foundations or pads sloped to drain with no pockets or low areas.

E. Concrete shall be allowed to properly cure prior to being submitted to loading.

1.7 OPENING, CUTTING AND PATCHING:

A. Cut all openings as required for the work under this Contract. Patching shall be done by the various crafts whose work is involved.
B. Furnish and install all necessary sleeves, thimbles, hangers, inserts, etc., at such times and in such a manner as not to delay or interfere with the work of other trades.

C. Caulk, flash or otherwise make weatherproof, as directed by the Designer, all roof and exterior wall penetrations.

D. Adequate protection shall be provided to avoid damage to existing surfaces. Should damage occur, the surface shall be restored by patching, refinishing, repainting, reconstructing, or whatever process is necessary to restore the surface to its original condition. The Contractor shall be responsible for all required patchwork whether occasioned by his employees, Subcontractors, or material suppliers.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Wiring devices shall be as listed (or prior approved equal) in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Slater</th>
<th>Leviton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pole Toggle Switch</td>
<td>720-AG-IV</td>
<td>1221-I</td>
</tr>
<tr>
<td>Key Type Toggle Switch</td>
<td>720-AG-L-LH</td>
<td>1221-IL</td>
</tr>
<tr>
<td>Duplex Receptacle</td>
<td>5362-AG-IV</td>
<td>5362-1</td>
</tr>
<tr>
<td>Single Receptacle</td>
<td>5361-AG-IV</td>
<td>5361-1</td>
</tr>
<tr>
<td>Special Receptacles</td>
<td>RE: DRAWINGS</td>
<td></td>
</tr>
<tr>
<td>Three-way Toggle Switch</td>
<td>723-AG-IV</td>
<td>1223-I</td>
</tr>
<tr>
<td>Single Pole Switch with Pilot Light</td>
<td>720-AG-LH</td>
<td>5226-I</td>
</tr>
</tbody>
</table>

2.2 MULTI-OUTLET SYSTEM

A. Contractor shall furnish and install a system of multi-outlets as shown on the Drawings and described further herein.

B. Outlets shall be 1'-0" minimum on centers unless shown otherwise with circuits as shown on the Drawings.

C. Multi-outlet system shall be Walkerduct 4GW2C612, Wiremold Plugmold 2000-GA series or Porter RCF4 series all with separate grounding conductors and two circuits.
2.3 FLOOR BOX

A. The Contractor shall furnish and install floor boxes for all devices to be mounted in floor. This shall include all receptacles, mike outlets, controls, etc.

B. Floor boxes shall be cast iron construction and furnished with enough accessories to ensure bonding and waterproofing between box body and top assembly. A grounding set screw shall also be provided to assure continuity.

C. All floor flanges shall be brass and be compatible with floor covering.

D. Duplex receptacles shall have a gasketed brass flush flip-top cover plate. Other device covers described further herein.

E. The floor box shall be fully adjustable and water-tight.

F. Floor boxes shall be Walkerduct Products Cat. #853, Hubbell Catalog #B2537 w/S3925, or Steel City Catalog #600-Al w/Duplex Plug.

2.4 DEVICE PLATES

A. General purpose and specialty device plates as required shall be stainless steel. Where more than one switch or receptacle is ganged, the proper number of gangs on a one-piece ganged plate shall be used. All devices plates shall be attached with stainless steel security hardware (rejection pin torx fastener). Device plates shall be as listed (or prior approved equal) in the following table unless specially called for otherwise:

<table>
<thead>
<tr>
<th>Stainless Steel</th>
<th>Slater</th>
<th>Leviton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pole Toggle Switch</td>
<td>SSA-071</td>
<td>84001-40</td>
</tr>
<tr>
<td>Duplex Receptacle (120V)</td>
<td>SSA-101</td>
<td>84003-40</td>
</tr>
<tr>
<td>Single Receptacle (120V, 208V)</td>
<td>SSA-091</td>
<td>84004-40</td>
</tr>
<tr>
<td>Single Receptacle (208V, 1 Ph.)</td>
<td>SSA-381</td>
<td>84020-40</td>
</tr>
<tr>
<td>Weatherproof Receptacle (120V)</td>
<td>3780-SC</td>
<td>4929</td>
</tr>
</tbody>
</table>

B. Mount switches on strike side of doors as finally hung. Grouped switches shall be installed in one box and covered with a one-piece ganged plate.

2.5 DIMMING CONTROL

A. Fluorescent dimming control shall be rated for a minimum of 20 – 40 W lamps and shall be capable of mounting to a one-gang outlet box. Fluorescent dimmer shall be Lutron Nova Series or Hunt AF Series.

2.6 DRY TRANSFORMERS

A. Contractor shall furnish and install dry type transformers, indoor wall hung or floor mounted, as shown on Drawings.

B. Dry transformers shall be sized as shown on the Drawings, and in addition shall contain a minimum of two 2-1/2 percent taps below normal primary voltage.
C. Transformers shall have a minimum temperature rise of 115° C and have a minimum of K=4 rating with copper windings.

D. Dry transformers shall be Sorgel Square D Catalog Number T3HFISCUNL Series or General Electric Type 9T23Q Series or approved equal.

2.7 PUSH BUTTONS WITH PILOT LIGHTS

A. All remote mounted pushbuttons shall be individual heavy-duty oiltight watertight devices.

B. Start pushbuttons shall be with legend plates titled "ON". Stop push buttons shall be same style as start buttons and legend titled "OFF".

C. Push buttons shall be Square D Type K or Cutler Hammer Type T.

D. Pilot light shall be green when device controlled by push button is energized. Pilot light shall be oiltight Square D Type K or Cutler Hammer Type E24.

E. All devices shall be suitable for exposed outdoor applications and shall be provided with all appropriate boots, gaskets, etc., to provide a watertight installation at each device and at junction of device cover plate and cast switch box as defined further herein.

2.8 FLEXIBLE CONNECTIONS:

A. Provide plastic-coated liquid tight flexible metal conduit with grounding type fitting for this purpose.

B. 18 inches maximum shall provided between motors or equipment and stationary conduit systems.

2.9 SAFETY SWITCHES:

A. Indoor Safety switches, TO BE FURNISHED UNDER DIVISION 16, shall be without knockouts Type "Heavy Duty" fusible or non-fusible as required on Drawings. All indoor switches shall be NEMA Type 12 enclosures as listed (or prior approved equal) in the following table:
Fusible | Square D | Cutler Hammer
--- | --- | ---
30A 3 wire S/N | H221NAWK | TH3221J
30A 3 wire | H321AWK | TH3321J
30A 4 wire S/N | H321NAWK | TH4321J

Non-fusible

30A 2 pole | HU261AWK | THN2261JDC
30A 3 pole | HU361AWK | THN3361J

B. Outdoor Safety switches TO BE FURNISHED UNDER DIVISION 16, shall be without knockouts Type "Heavy-Duty" fusible or non-fusible as required on drawings. All outdoor switches shall be NEMA 4X stainless steel enclosures as listed (or prior approved equal) in the following table:

Fusible | Square D | Cutler Hammer
--- | --- | ---
30A 3 wire S/N | H221NDS | TH3221SS
30A 3 wire | H321DS | TH3321SS
30A 4 wire S/N | H321NDS | TH4321SS

Non-fusible

30A 2 pole | HU261DS | THN2261SSDC
30A 3 pole | HU361DS | THN3361SS

The above are minimum sizes to be used. Disconnects shown are for 120/208 and 240 volt services. Utilize same quality construction for 480-volt services. Size disconnects according to load served or as shown on Drawings.

2.10 MAGNETIC MOTOR STARTERS

A. Contractor shall furnish and install full voltage reversing or non-reversing motor starters, quantity and size as shown on Drawings.

B. Starter shall be a combination circuit breaker type, size as required, in NEMA 12 (indoor baked enamel finish) and NEMA 4X stainless steel (outdoor), gasketed enclosure.

C. Starter shall contain circuit breaker (MCP; motor circuit protector) rated as required, a panel mounted reset button, control fuses, 120V transformer, door mounted pilot light and hand-off-automatic selector switch.

D. Starter shall be rated as required for motor.

E. Each starter shall be provided with three phase motor protection. Motor protection shall include, but not be limited to, loss of phase, phase unbalance and low voltage. Detection shall cause all phases serving a motor to open upon and not close until manually reset. This protection shall be in addition to MCP and starter overload elements.

F. Contractor shall provide heater overloads as required per motor nameplate data.
2.11 MANUAL MOTOR STARTERS:

A. Manual motor starters shall be sized as required with appropriate sized heaters for all motors as shown on the Drawings.

B. Manual motor starters shall contain a red "on" pilot light.

C. Manual motor starters shall be as listed below (or prior approved equal) in the following table:

<table>
<thead>
<tr>
<th>Unfinished Areas</th>
<th>General Electric</th>
<th>Square D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Mounted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toggle Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA 1 - 1 pole</td>
<td>CRI0I1Y11</td>
<td>FG-IP</td>
</tr>
<tr>
<td>Toggle Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA 1 - 2 pole</td>
<td>CRI0IH11</td>
<td>FG-2P</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Finished Areas</th>
<th>General Electric</th>
<th>Square D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Mounted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toggle Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA 1 - 1 pole</td>
<td>CRI0I1Y11</td>
<td>FF-IP</td>
</tr>
<tr>
<td>Toggle Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA 1 - 2 pole</td>
<td>CRI0IH11</td>
<td>FF-2P</td>
</tr>
</tbody>
</table>

2.12 LABELING

A. For all motor starters, manual or magnetic, Contractor shall furnish laminated labels fastened to starter with tamperproof stainless steel hardware.

B. Labels shall be black letters on a white field. See Drawings for details.

C. Contractor shall also furnish appropriate sized heaters for all motors based on their full load ampere nameplate rating.

2.13 FUSES

A. Fuseholders shall be provided with dual-element, timelag fuses, Bussmann FRN-R Series or Chase Shawmut AT-DE Series, sized as required according to manufacturers recommendations unless shown otherwise on Drawings.

B. Fuses shall have a minimum of 200,000 amperes interrupting capacity.

C. Provide to the User Agency a 10% spare fuse supply for each different fuse type and size used, but in no case less than 3 fuses for each size and type.

2.14 GROUNDING

A. Conduit work, motors, panelboard and the other electrical equipment shall be effectively grounded as required by all governing codes.
B. Refer to grounding section of these Specifications (Section 16450).

2.15 START-STOP PUSH-BUTTON STATIONS

A. Stand alone push button station shall be as follows unless shown otherwise on drawings.

<table>
<thead>
<tr>
<th></th>
<th>Miniature</th>
<th>Square D</th>
<th>General Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push Button Type</td>
<td>LRR-IU Series</td>
<td>CR104 Guarded Series</td>
<td></td>
</tr>
<tr>
<td>Pilot Light Type</td>
<td>LRT Series</td>
<td>CR104 Push to Test</td>
<td></td>
</tr>
<tr>
<td>Selector Switch</td>
<td>LR5D Series</td>
<td>CR104 H.O.A. Series</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy-Duty</td>
<td>Square D</td>
<td>General Electric</td>
</tr>
<tr>
<td>Push Button</td>
<td>TR-51 Series</td>
<td>BG 91 Series</td>
<td></td>
</tr>
<tr>
<td>Pilot Light</td>
<td>TP-32 Series</td>
<td>LT 22 Series</td>
<td></td>
</tr>
<tr>
<td>Selector Switch</td>
<td>TS-3 Series</td>
<td>SG 21 Series</td>
<td></td>
</tr>
</tbody>
</table>

2.16 CONDUIT ITEMS

A. MATERIAL SPECIFICATIONS

1. Schedule 40 PVC conduit shall be used for all branch circuits, control wiring, branch runs for telephone locations and similar runs entirely encased in the floor slab, or underground.

2. Rigid galvanized steel conduit shall be used for runs exposed unless shown otherwise.

3. EMT conduit shall be used in concealed spaces above accessible ceilings only.

4. All underground 90-degree bends and risers for panel feeders, risers for receptacles, switches, etc., shall be rigid galvanized steel conduit.

5. See Drawings for details.

B. FLEXIBLE CONDUIT

1. Short lengths of flexible metal conduit, 18 inches maximum, shall be used for connections such as to motors on sliding baseplates, extensions from wireways or continuous rigid cable supports.

2. Flexible conduit for all locations shall have a liquid tight thermosetting or thermoplastic outer jacket unless shown otherwise.

3. Flexible metallic conduit for connections to lighting fixtures from junction box will be acceptable provided maximum length of flexible metallic conduit is limited to 6 ft.

4. Use of prewired flexible "BX" type conduit shall not be allowed.

C. NONMETALLIC CONDUIT
1. For underground or encased conduit Type 40 heavywall PVC conduit and fittings may be used, but all penetrations through slab, etc., shall be rigid galvanized steel elbows.

2. See Conduit Items: Materials Specifications for allowable uses of PVC conduit and Drawings for details.

2.17 CONTINUOUS RIGID CABLE SUPPORT SYSTEMS

A. Continuous rigid cable support systems, consisting of ventilated cable trays or ladders shall be used in indoor locations, where shown on Drawings.

B. Trays, ladders, separators and their supports and other fittings shall be as described in other sections.

C. Trays shall have open tops except removable covers shall be provided in locations where shown on Drawings.

D. Arrangement of cables shall be as noted on Drawings.

E. Cables shall be tied down individually at 4'-6" on horizontal intervals using outdoor class ties and tied down individually on 24" centers for vertical routing.

2.18 RIGID CABLE SUPPORT SYSTEM HANGERS

A. One and 5/8-inch square galvanized support channel and threaded galvanized rods shall be utilized for support of conduit and cable tray systems. See drawings for details.

B. All hardware shall be stainless steel, unless otherwise noted on Drawings.

2.19 WIREWAY SYSTEMS

A. Wireways shall be Circle AW GRT Series, Square D RD Series or shop fabricated in accordance with the following:

1. They shall be fabricated from sheet steel of not less than .0897 inches (No. 13 USS gauge) or aluminum alloy sheet of not less than 0.125 inch thickness.

2. All surfaces shall have a corrosion resistant enamel finish.

3. Wireways shall be suitable for exterior installation.

4. Section of wireways may be joined together and supported by any means which insures continued rigidity and alignment without sacrificing ease of cable installation or cable replacement.

5. They shall have provisions for future cable entrances at least every 3 feet along their length.

B. Wires and cables shall be run in one length. Where required, splices and taps shall be located within the wireway in an accessible location.

C. Cables shall be loosely laid in the wireway with a minimum number of crossovers. The sum of the cross-sectional areas of all contained conductors at any cross-section of a wireway shall not exceed 20 percent of the interior cross-sectional area of the wireway.
2.20 EXPANSION CONDUIT FITTINGS

A. Furnish and install conduit expansion fittings on all conduit crossing building expansion joints. Fittings shall be metal construction with bonding jumper for rigid galvanized conduit and plastic construction for PVC conduit.

2.21 SWITCH/OUTLET BOXES

A. Outlet boxes for receptacles, switches, manual motor starters, etc., on concealed system shall be flush mounted.

B. Boxes shall be galvanized steel of sufficient size and required number of gangs to accommodate devices and shall have raised covers required to meet requirements of NEC Article 370-16.

C. Boxes for lighting fixtures shall be 4-inch octagon, not less than 4 inches deep with fixture stud fastened through from back of box if required.

D. Where boxes are installed in a concrete slab, boxes designed for this application shall be used.

E. Outlet boxes for receptacle, switches, manual motor starters, etc., for use in masonry work shall be standard galvanized masonry boxes of the required number of gangs.

F. Receptacles, switchboxes, manual motor starters, etc., on exposed conduit shall be cast aluminum Type FS, FD or equivalent. Universal cast boxes with extra knockouts closed with plug shall not be acceptable. Cover plates shall cover box with no overlap. Galvanized handy boxes, with or without pre-punched conduit entrances, etc., shall not be used.

G. All exterior boxes shall be cast aluminum as described above and be provided with suitable neoprene gaskets to prevent entrance of water or other contaminants into the box.

2.22 PULL BOXES

A. Furnish and install pull boxes as required.

B. Boxes shall be code gauge galvanized with screw attached access panels in top, side or bottom, as required.

C. Boxes shall be large enough to comply with code requirements.

D. All pull boxes shall be fully accessible after installation of entire project.

2.23 INSULATED WIRE AND CABLE

A. For conduit installations, wires and cables shall be pulled into conduit in one piece between termination or splice points.

B. Wire and cables shall be liberally coated with a pulling lubricant compatible with the type insulation used. Grease shall not be used as lubricant for wires and cables having neoprene or other nonmetallic exterior jackets.

C. The pulling tension on cables shall be limited to the maximum tension recommended by the cable manufacturer.
D. No wire shall be pulled into conduit until all work of a nature which would cause damage has been completed.

E. Joints or splices in 120/240/208-volt conductors shall be made with acceptable nonmetallic body, metallic spring, screw on type fittings unless shown otherwise on drawings. Joints or splices in 480/277-volt conductors shall be made with acceptable compression type fittings fully insulated unless shown otherwise on drawings.

F. Connectors of the nonmetallic body, metallic spring, screw-on type shall be Ideal Cat. No. 451 or 454, Buchanan Cat. No. Bl or B2, or Scotch Cat. No. Y or R. At outlet for fixtures, pig tails of building wire shall be left for splicing to fixture wire after all other connections have been made up and fitting into the box.

G. Mains and feeders shall be run their entire length without joints or splices.

H. Connectors of the acceptable compression type shall be Panduit “JN” Series or Scotch S-II and S-31 Series.

I. Joints other than self-insulating types shall be carefully taped after inspection to the full insulation class of the wire with plastic tape; Scotch 33+ or Plymouth 4240.

J. Wire and cable terminations at motors shall be made with lug type compression connectors. These shall be connected to lug connectors on the motor terminal leads (or to terminal studs) with corrosion resistant bolts, nuts, washers or lock washers.

K. Wire used this project must be of soft drawn annealed copper having a conductivity of no less than 98 percent of that of pure copper.

L. Unless otherwise specified or noted, conductors shall be stranded Type THWN 600 volt for sizes through No. 8 for general use and use in damp locations.

M. Wire No. 6 and larger shall be stranded RHW/USE 600 volt for general use and use in damp locations.

N. Interlocked armor cable (IAC) shall be Type MC suitable for indoor or outdoor installation. Cable shall consist of four (4) EPR insulated stranded conductors with four (4) copper ground wires of appropriate size cabled together with binder tape and protected by an aluminum armor with PVC jacket overall. IAC cable shall be suitable for use as tray cable.

O. Wire shall be constructed with insulating properties, surface marking, etc., according to applicable Standards and Codes listed in Section 16010 and further herein.

P. Fixture wire shall be heat-resistant Type SFF, PFF, HFF or ZFF size as required. Type THWN conductors may be connected directly to fixtures only when the fixtures are equipped with outlet boxes approved by Underwriter's Laboratories, Inc. for use with wire having insulation rated for maximum operation temperature of 60°C (140°F). Otherwise, conductors with Type AF insulation shall be run from fixture terminal connections to an outlet box placed at least one foot from the fixture in flexible metal conduit. This applies for concealed conduit only.

Q. No wire shall be smaller than No. 12 for power or lighting service, or smaller than No. 14 for controls. Wire for branch circuits shall be the same from the panelboard to the last outlet on the circuit. All wire shall be stranded.
R. In lighting system, conductors shall be identified by color coding, and green grounded conductor shall be connected to screw shell of lamp sockets and shall be uniform through this installation. The color-coding shall be continuous the full length of wire No. 8 or smaller, and on larger wire permanent paint bands or tags at outlets will be accepted.

S. No wire shall be drawn into a conduit until all work of which may cause damage is complete.

PART 3 - EXECUTION

3.1 MOTOR AND CONTROL WIRING

A. Equipment furnished under Division 2 and Division 15 shall be installed and wired ready for operation under this section.

B. Motors, starters, push buttons, pilot lights, level switches, etc., furnished under Division 2 and Division 15 (except as noted) shall be installed and wired under this section.

C. Motor and control wiring shall be installed in general as indicated, but modified to conform to diagrams furnished by Contractor responsible for correct functioning of equipment.

D. Install all conduit and conductors needed for control systems.

3.2 OTHER CONNECTIONS:

A. Provide complete electrical connection for equipment indicated for installation under other sections or by User Agency.

B. Where required, provide or change cords and plug. Cords shall be heavy neoprene sheathed "SO" types with grounding conductor.

C. Connect and provide grounding plug to fit receptacles where required.

D. Conductor size shall be per manufacturer's recommendations.

3.3 MOUNTING HEIGHTS

A. Unless otherwise noted on the Drawings or directed by the Designer, the following mounting heights shall apply above finished floor.

B. Devices shall not cross a mortar joint. If crossing mortar joints is unavoidable, the device shall be mounted flush, with grouting added as required to fill all voids.

Outdoor Lighting: As shown on the Drawings
Toggle Switches: 4’ AFF or as required to coordinate with block work and ADDAG (See Architectural)
Receptacles: 18” AFF or as required to coordinate with block work
Receptacles over Counters: 6” above countertops (Coordinate w/counter installer and/or manufacturer) before rough-in.
Panelboards: 6'6” AFF to top or 6” AFF for larger panels
Telephone Outlets: 18” AFF
Motor Control Equipment: 5'0” AFF or as required to coordinate with blockwork and ADDAG (See Architectural)
Fire Alarm Station: 4'6” AFF or as required to coordinate with blockwork and ADDAG (See Architectural)
Fire Alarm Horn/ Strobe: Ceiling mounted as shown or if necessary 90° Min AFF or
3.4 CONDUIT INSTALLATION

A. All feeders, branch circuits, etc., which are installed in the slab or underground shall be Schedule 40 PVC, except for the 90 degree bend and the first ten feet in the slab or underground which shall be rigid galvanized steel conduit. See Drawings for details.

B. All 90-degree bends and risers for panel feeders, risers for receptacles, switches, etc., shall be rigid galvanized steel conduit. See Drawings for details.

C. 3/4" conduit shall be the minimum size conduit accepted on project.

D. Where rigid steel conduit is specified, it shall be galvanized heavy wall steel conduit or intermediate metal conduit with galvanized fittings as required.

E. Where the use of existing RGS conduit systems is feasible with the use of Type THHN or THWN insulated wire, this method of wiring is permissible and is recommended.

F. There is a considerable amount of existing conduit runs in Building Three. The Contractor may use these existing runs if the conduit is RGS and in excellent condition showing no signs of rust, corrosion or breakage.

G. Any existing conduit reused must be continuous and meet Specification requirements.

H. Any connections to these existing conduits shall be made with rigid steel with approved connections.

I. All abandoned and unusable conduits are to be cut off 4 inches away from entrances to slabs or walls where space allows.

J. Any existing conduit remaining shall be cut flush with structure and filled with grout.

K. All cable shall be liberally coated with cable pulling lubricant, compatible with the type of insulation used, prior to pulling any conductors.

L. All wires and terminals shall be identified and tagged with sleeve type tags.

M. Nametags shall be installed on all equipment as specified on the Drawings.

N. All conduits shall be swabbed clean before wire or cable is installed. In addition, before cable installation, a test mandrel having a diametrical clearance of not more than ½-inch compared to the conduit interior diameter shall be drawn through all conduits to be used for main distribution feeders.

O. All exposed conduit runs shall be adequately supported. The spacing between conduit clamps or other supports shall be kept short enough to prevent sagging in horizontal conduit runs. Conduit shall be supported at no greater than 6 feet on centers and no more than 2 feet from electrical appliances.
P. A minimum spacing of 1 inch shall be maintained between the outside surfaces of underground conduits 1-1/2 inches and smaller, and 2 inches shall be maintained between conduits 2 inches and larger.

Q. The bottom of trenches for underground duct banks shall be level. If soil cannot support the duct bank without settling, a concrete mat, reinforced if necessary, shall be provided along the trench bottom.

R. Underground conduits shall be installed a minimum of 18 inches below grade.

S. Furnish and install inserts and hangers required to support conduit, cables, pull boxes, etc. If any of these items are improperly installed, Contractor, at his own expense, shall do all necessary cutting, patching to rectify the errors.

T. Flashing for electrical conduit projecting through or mounted on roof provided under this section. All flashing to conform to details and requirements of National Roofing Contractors' Association and as directed by Designer.

U. Conduit stub-ups through paved surfaces and foundations shall be adequately braced to prevent shifting during pouring of the concrete.

V. All underground conduit runs shall be encased in RED concrete. Concrete shall have a minimum strength of 1,500 pounds and shall be colored red with a permanent coloring additive integrally mixed with the concrete. The minimum thickness encasement shall be 3 inches on top, sides, and bottom. If conduits rise above ground, the encasement shall extend 6 inches above ground. If conduits run through equipment foundations or building floor slabs, the encasement shall butt the underside of foundation or slab. The top of the concrete encasement shall be a minimum of 18 inches below grade. At road crossings the top of the encasement shall be a minimum of 30 inches below the road surface or rail base, unless shown on Drawings.

W. All underground conduits shall be securely tied to PVC or concrete spacers to prevent shifting, and shall be weighted or anchored as necessary to prevent floating when the concrete encasement is poured. Spacers shall not be left exposed or protruding through concrete encasement. Concrete encasement shall be poured so as to be monolithic insofar as possible. If joints in the encasement are necessary, the surface of the concrete at the joint shall be treated to insure a good bond before the next section is poured.

X. All conduit shall be concealed. Where impossible to conceal the exposed conduit, due to structural requirements or building construction, the conduit shall be securely attached as possible. Notify Designer before any structural member is chased or cut and obtain approval before proceeding. Location of all exposed conduit shall be subject to Designer's approval.

Y. Because of the nature and use of the building, all equipment, conduit, etc., that in the Designer's judgement constitutes a security violation shall be removed and relocated to a suitable place as directed by the Designer and at no extra expense to the Owner.

Z. All conduits shall bear the inspection label of the Underwriters Laboratories, Inc.

3.5 INSTALLATION REQUIREMENTS FOR RIGID CONDUIT SYSTEMS

A. Conduits shall not be run close to parallel hot lines or large high temperature surfaces.

B. Conduit shall not be run nearer to covering of steam or hot water pipes than 3 inches except where crossing is unavoidable.
C. Conduit shall be kept at least 1 inch from covering of pipe crossed.

D. Exposed conduit shall be installed with runs parallel or perpendicular to walls with uniform and symmetrical elbows, offsets and bends.

E. All conduit entering and leaving a pull point, switchrack, or any other particular congregation of conduits leaving or entering as a group shall be "fanned-in" or "fanned-out" using the largest practical bending radius. "Factory" bends shall not be used.

F. Conduit shall be held securely in place by approved hangers and fastenings, of appropriate design and dimensions for the particular application.

G. Acceptable supporting and clamping material for exposed conduit includes malleable iron one hole clamps with clamp backs, suspension pipe rings with 3/8 inch hanger rods, and standard galvanized steel 1-5/8 inch square supporting material.

H. All exposed hardware shall be of stainless steel, tamperproof design.

I. Perforated steel tape, wire hangers, stamped steel straps and similar materials shall not be used in exposed locations.

J. Hangers and other fastenings shall be supported on solid masonry with inserts or expansion sleeves and bolts; wood with wood screws; hollow masonry and cement wall panels with toggle bolts and steel with machine screws or welded threaded studs.

K. Unless specified otherwise, rigid conduit shall be supported at no greater than 6 feet on centers.

L. All exposed conduit shall be fastened as securely as possible with appropriate stainless steel, tamperproof hardware.

M. Where they enter boxes or cabinets, conduits that do not have threaded hubs shall be secured in place with galvanized locknuts inside and outside and shall have galvanized bushings inside except that conduits 1-1/4 inches and larger shall have galvanized locknuts and insulating bushings.

N. All locknuts shall be of the bonding type which penetrates the enclosure surface when tightened. Set screw type conduit connectors shall not be allowed.

O. All exterior conduits shall enter boxes or cabinets through a gasketed threaded hub sized as required. Hubs shall include all locknuts and seals to assure weather tightness. Do not enter exterior cabinets, boxes, devices, etc., from the top.

P. Conduit larger than 1 inch shall not be run in concrete floor slab.

Q. Conduit larger than 1 inch shown under floor slab shall be run under slab. Conduit run under floor slab which occurs on grade or fill shall be 12 inches under slab. Conduit run underground but not under floor slab shall be 18 inches minimum below grade, unless otherwise specified, encased in 3 inches of RED concrete all around.

R. Conduit penetration through floor shall be galvanized rigid elbows at all locations. See Drawings for details.

S. Leave a #12 AWG pull wire in each empty conduit.
BASIC MATERIALS AND METHODS

T. Conduit bends shall be reasonably free of flat surfaces and kinks or dents. Bends in conduit 1-1/2 inches in diameter and larger shall be made with a bending machine. Bending radii shall be 18 inches for 1-1/2 inch conduits and 24 inches for 3-inch and 4-inch conduits unless specified otherwise on the Drawings. Note this is the radius of the bend, not the bend size.

U. All rigid metal conduit joints and connections shall be made up using a suitable conducting sealing compound or thread lubricant to insure a tight joint and to prevent steel conduit threads from rusting. Rigid metal conduit joints and connections shall be screwed up tight using wrenches to insure good conductivity.

V. All conduits shall be clean before erection. Cut ends shall be reamed free of burrs. During construction all installed conduit shall be capped with malleable iron pipe caps to prevent entrance of water or other foreign matter. Conduits designated as "spare" shall be left capped, containing a #12 AWG pull wire.

3.6 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 Volt).

3.7 PHASE SEQUENCE

A. Connections shall be made at switchgear and motor control equipment to maintain the same physical arrangement of phases throughout the system. All feeder cables shall be phase sequence marked permanently.

END OF SECTION
SECTION 16115 – 600V CABLE BUS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the 600V cable bus for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

B. A complete metal enclosed bus system shall be provided; including all necessary fittings, tap boxes, enclosure connectors, entrance fittings, insulated conductors, electrical connectors, terminating kits and other accessories as required.

C. The bus system shall be suitable for indoor or outdoor use; with conductor spacing and ventilation maintained throughout the system.

D. All elements of the bus enclosure shall be so designed to eliminate any sharp edges or projections that may injure personnel or conductor insulations.

E. The bus system shall be as manufactured by MPHusky, or Calvert Company.

F. Cable bus shall be rated for 600V application at the ampacity shown on the drawings.

1.2 RELATED WORK

A. Section 16010: General Provisions – Electrical

B. Section 16100: Basic Material And Methods

PART 2 - PRODUCTS

2.1 CONSTRUCTION

A. All load carrying members of the bus shall be fabricated from extrusions of aluminum alloy 6063-T6. The maximum allowable stress used in design shall be 10,000 PSI.

B. Bus enclosure fittings shall have a radius of 24 inches unless the minimum bending radius of the conductor requires a larger fitting radius.

C. The top and bottom enclosure sections shall be corrugated to provide mechanical strength and slotted for ventilation. The top cover shall be fastened to the enclosure with self tapping screws spaced approximately 2 feet on centers and shall be removed for inspection. The bottom section shall be factory installed by welding.

D. Splice joints between sections of the bus enclosure shall be high pressure splined bolted type of a design which avoids any structural weakness at the connection and does not exceed the electrical resistance specified under Section 2.2.D of this specification.

E. Conductor support blocks shall be designed in segments to maintain a minimum of one conductor diameter in both the horizontal and vertical planes as required for free air conductor rating. Horizontal runs shall have blocks spaced every 36 inches and vertical runs every 18 inches.
2.2 ELECTRICAL

A. All current carrying conductors shall be copper and have insulation rated for 90 degrees Celsius operating temperature in accordance with ICEA publication #P-46-426 and interim STD #1 & 2 to ICEA publications #S-66-524 for the ampacity and voltage specified.

B. The conductors shall be phased and supported to maintain low impedance and assure the mechanical strength necessary to prevent cable movement or damage under short circuit currents up to 100,000 RMS symmetrical amps.

C. Conductors shall be of continuous length and be pulled in after the bus enclosure is in place. Electrical connectors shall be used only at the termination of conductor runs. All electrical connectors shall be provided by the manufacturer.

D. The bus enclosure shall have a continuous current rating of not less than 1000 and 1200 amperes (50 degree Celsius Rise) and the resistance across the enclosure section splice shall not exceed 50 microhms.

E. The bus enclosure shall be grounded at sufficient intervals for the purpose of preventing a potential above ground on the bus enclosure in the event of fault.

F. The conductors shall be arranged in a phasing pattern which exhibits minimal interphase and intra-phase unbalance.

G. Conductor temperature rise calculations and current balance calculations shall be provided in support of Section 2.2.F for this specification.

PART 3 - EXECUTION

3.1 APPLICATION

A. Do not fabricate cable bus until shop drawings are approved.

B. Provide cable bus supports as required by the Manufacturer. Modify typical cable bus support detail as required to meet manufacture’s requirements.

3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

END OF SECTION
SECTION 16120 - 15KV POWER CABLE

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the requirements for the 15KV power cable for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

B. The intent of this Specification is to cover 15KV Ethylene Propylene Rubber Shielded Power Cable (MV-105) requirements.

C. Cables shall be suitable for installation underground in a conduit system and cable shall be manufactured to afford long and dependable service under these conditions.

D. Acceptable cable manufacturers shall be Okonite, Kerite or prior approved equal.

1.2 STANDARDS REFERENCE

A. All cable herein specified shall be manufactured and tested in accordance with all applicable sections of the latest listed Standards and Publications.

I.C.E.A Insulated Cable Engineers Association
A.N.S.I. American National Standards Institute, Inc.
N.E.M.A. National Electrical Manufacturer's Association
U.L. Underwriters Laboratories, Inc.
A.S.T.M. American Society for Testing Materials
I.E.E.E. Institute of Electrical and Electronic Engineers

B. It shall be the Contractor's responsibility to be (or to become) knowledgeable of the requirements of these Standards and Publications. Any replacement of cable necessary to meet requirements of the Specification shall be at the expense of the Contractor.

1.3 QUALITY ASSURANCE

A. Cable shall be manufactured and tested in accordance with requirements of AEIC CS6-82 and ICEA S-68-516, and carry a UL listing as Type MV-105 cable.

B. Manufacturer shall submit satisfactory evidence to establish at least five (5) years successful operating experience with 15,000 Volt Ethylene Propylene Rubber Insulated Shield Power Cable, by providing experience records covering at least ten (10) different major installations of cable types specified.

C. The conductor screen, insulation and insulation screen shall be manufactured by means of the triple-tandem extrusion process.

D. Three (3) copies of certified qualification test reports, as required by Paragraph B of AEIC CS6-82 shall be submitted with each bid proposal.
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E.  Cable supplied must have been manufactured within the last year.

PART 2 - PRODUCTS

2.1 CONDUCTOR

A.  The conductor shall be stranded, annealed copper in accordance with ASTM B3 and ASTM B-8, conductor stranding shall be Class B. Conductor size shall be as shown on Drawings.

2.2 CONDUCTOR SCREEN

A.  The conductor screen shall consist of an extruded thermosetting compound applied over the conductor.

B.  It shall be of material compatible with the conductor metal, shall be uniformly and firmly bonded to the insulation and free stripping from the conductor.

C.  The minimum average and minimum point thickness shall be not less than the values shown in Table I below:

        TABLE I

<table>
<thead>
<tr>
<th>Conductor Screen Thickness (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor Size</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>AWG or KCML</td>
</tr>
<tr>
<td>2-4/0</td>
</tr>
<tr>
<td>250-500</td>
</tr>
<tr>
<td>600-1000</td>
</tr>
</tbody>
</table>

2.3 INSULATION

A.  The insulation shall be Ethylene Propylene Rubber per ICEAS-68-516, AEICC56 and UL 1072.

B.  Conductor shall be a high quality heat, moisture, ozone and corona-resistant compound of high dielectric strength.

C.  It shall be contrasting in color from the extruded conductor and insulation screens.

D.  The average insulation thickness shall be 220 mils 133% level. The minimum thickness of the insulation at any point shall not be less than 90 percent of the specified average thickness.

2.4 INSULATION SCREEN

A.  The insulation screen shall consist of an extruded, semi-conducting thermosetting compound applied over the insulation.

B.  It shall be of a material compatible with the insulation and the and maximum points shall be as shown in Table II below:
TABLE II

<table>
<thead>
<tr>
<th>Conductor Size</th>
<th>Insulation Screen Thickness (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td><strong>AWG or KCMIL</strong></td>
<td><strong>Average</strong></td>
</tr>
<tr>
<td>2-4/0</td>
<td>30</td>
</tr>
<tr>
<td>250-750</td>
<td>40</td>
</tr>
<tr>
<td>1000 &amp; Larger</td>
<td>50</td>
</tr>
</tbody>
</table>

C. The insulation screen shall be free stripping from the insulation, and the tension necessary to remove the extruded insulation screen shall be 8 to 24 pounds when tested in accordance with Paragraph H.1 of AEIC CS6-82.

2.5 METALLIC SHIELD

A. The metallic shield shall consist of a non-magnetic uncoated copper tape of .005 mils in thickness helically applied with a minimum overlap of 12.5 percent over the extruded semi-conducting screen insulation.

2.6 JACKET

A. A Polyvinyl Chloride Jacket shall be extruded over the underlying core.

B. The jacket shall comply with the UL 1072 and ICEA S-68-516 physical and aging requirements.

C. The average thickness of the jacket shall not be less than those shown in Table III.

D. The minimum thickness of the jacket at any point shall be not less than 80 percent of the specified minimum average thickness.

TABLE III

<table>
<thead>
<tr>
<th>Conductor Size</th>
<th>Minimum Average Thickness of Jacket (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AWG or KCMIL</strong></td>
<td></td>
</tr>
<tr>
<td>2-600</td>
<td>80</td>
</tr>
<tr>
<td>750-1000</td>
<td>110</td>
</tr>
</tbody>
</table>

E. The jacket shall withstand an alternating current spark test voltage, between an electrode at the surface of the jacket and the metallic shield, for not less than 15 seconds at the following voltage: 7.0 KV for 80 mils thickness and 10.0 KV for 110 mils thickness. This test shall insure jacket integrity.

2.7 TEMPERATURE RATINGS

A. The cable capabilities shall not be exceeded when it is operated under the following excess load conditions:

1. Short Circuit Load Condition - Heavy current flow for periods up to 1.67 seconds. The highest conductor temperature attained by any part of the cable under this condition shall be 130°C.
2. Emergency Overload Conditions - Above normal current flows for a time period of from 1.67 seconds to 100 hours. The highest conductor temperature attained by any part of the cable during this overload condition shall be 95°C.

3. The highest conductor temperature attained by any part of the cable under operating current load shall be 90°C.


2.8 IDENTIFICATION

A. The overall jacket of each conductor shall be printed at intervals not exceeding 24 inches with the following information:

1. Manufacturer's Name
2. Plant of Manufacture (Designation Code)
3. Trade Name
4. Insulation Type and Thickness
5. Conductor Size and Type
6. Maximum Working Voltage and Insulation Level
7. UL Identification and Designation of Cable (mv-105)
8. Year of Manufacture

2.9 CONSTRUCTION

A. Factory Tests on Completed Cable

1. Each reel of completed cable shall be tested and comply with UL-1072, ICEA S-68-516 and AEIC CS-682 as applicable.

2. Three (3) copies of certified test reports shall be forwarded to the User Agency prior to cable being proof tested at the job site.

2.10 PREPARATION FOR SHIPMENT

A. Unless otherwise specified, the cable shall be furnished in one continuous length per reel.

B. Watertight seals shall be applied to the ends of the cable to prevent entrance of moisture during transit or outdoor storage. Tails shall be brought out on each reel to permit field testing prior to installation.

C. Each reel shall be readily identifiable with appropriate markings which match the certified factory test reports.

D. Preparation for shipment shall be in accordance with the manufacturer's standards. Manufacturer shall be solely responsible for the adequacy of the preparation for shipment provisions employed, with respect to materials and their application, to insure that the cable reaches its designation in excellent condition when handled by commercial systems.
E. Reels shall be lagged with wood for shipment upon completion of all certified tests.

2.11 REEL IDENTIFICATION

A. Each reel shall have a weatherproof (metal or plastic) tag firmly attached indicating manufacturer, conductor size, length and manufacturer’s type.

2.12 WARRANTY

A. Manufacturer shall provide a minimum of a 40-year warranty, commencing on the date of final acceptance, for all medium voltage cable (5KV - 35KV) with EPR insulation provided this project.

1. The manufacturer shall warrant that the cable furnished conforms to this specification and is of first class material and workmanship throughout; that it is free from defects or inadequacy in design; that it has been tested in accordance with this specification and that the results of the tests comply with the requirements of this specification.

2. The manufacturer agrees to replace (i.e. supply new cable);

   a. Any length of cable found defective in material or workmanship during the installation of the cable.

   b. Any length of cable failing during normal and proper use, within 40 years of the date of final acceptance of the project, from defects of material or workmanship, provided in each case that written notice of such failure is given to the manufacturer, and the manufacturer is given all reasonable opportunity to inspect such failure.

3. If the cable fails electrically during the warranty period, the Owner shall notify the cable manufacturer within a reasonable time, five (5) days, of the discovery of such cable failure.

4. The Owner shall allow the cable manufacturer a reasonable time, within two (2) weeks of acknowledgement of the cable failure, to inspect and test the failed cable. If it is determined within the two (2) weeks that the cable failure is the result of defective material or workmanship, the cable manufacturer under this warranty shall provide a replacement cable free of charge to the Owner and extend the same warranty on the replacement cable. The replacement cable shall then be delivered within six (6) weeks, free of charge to the delivery point called for in the original order. If the replacement of a single conductor installed with two or more others in the same conduit is deemed necessary, then all three or more cables shall be furnished by the cable manufacturer to the Owner.

PART 3 - EXECUTION

3.1 APPLICATION

A. Do not manufacture 15 KV power cable until shop drawings are approved.

B. Install cable per manufactures recommendation regarding minimum bending radius and side wall pressure.
3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt)

- END OF SECTION -
SECTION 16163 - DISTRIBUTION PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE
A. This section includes the specifications of the distribution panelboards for the Skilled Nursing Care / Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 SECTION INCLUDES
A. 120/208V Three phase distribution panelboards.
B. 480/277V Three phase distribution panelboards.

1.3 RELATED WORK
A. Section 16010: General Provisions – Electrical
B. Section 16100: Basic Materials and Methods

1.4 STANDARDS AND CODES
U.L. Underwriters Laboratories, Inc.
N.F.P.A. National Fire Protection Association
N.E.C. National Electric Code (NFPA 70)
N.E.M.A. National Electrical Manufacturer’s Association

1.5 SUBMITTALS
A. Submit shop drawings under provisions of Section 16010.
B. Submit Operation and Maintenance data under provisions of Section 16010.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver products to site under provisions of Section 16010.
B. Store and protect products under provisions of Section 16010.

PART 2 - PRODUCTS

2.1 THREE PHASE DISTRIBUTION PANELBOARDS
A. Panelboards shall be circuit breaker type using quick make, quick break, trip-free, bolt-on type circuit breakers with minimum AIC interrupting ratings as shown on the Drawings or specified herein.
B. Two and three pole breakers shall be common trip.
C. Include ground fault circuit interrupters on all breakers feeding weatherproof receptacles and other areas as noted on Plans.
D. Panelboards shall be deadfront, safety with main breakers or main lugs, and number and size of breakers as shown on the Drawings.

E. Panelboards shall have single, feed through, or double lugs to accommodate feeder conductors as shown on the Plans.

F. Voltages and main circuit breaker or main lugs as specified on Plans.

G. Enclosures shall be suitably sized to accommodate both the main conductors and all feeder branch circuit conductors.

H. All circuit breakers shall be rated for switching duty.

I. All circuit breakers shall be rated for full interrupting values shown.

J. Series rating shall not be allowed.

K. Doors shall be fitted with flush cylinder locks, keys to which shall be all alike; 2 keys shall be furnished for each lock.

L. Cabinet fronts shall be furnished with baked enamel finish.

M. Provide with each panelboard a directory framed with transparent plastic window on inside of door and place therein a typewritten identification of all circuits.

N. All panelboards shall be labeled as shown on the drawings. Labels shall be constructed of laminated plastic 1/8” thick white letters on black field fastened with stainless steel screws.

O. Panelboards shall be completely factory assembled. All equipment purchased shall be of a single manufacturer.

P. Cabinet shall be galvanized steel with enameled trim, constructed in conformance with NEC, NEMA, and IEEE requirements and shall bear the Underwriter's Laboratories stamp of approval for the service intended.

Q. Main ampere capacity shall be as called for on the Plans.

R. All bus work shall be tin-plated copper.

S. All neutral bus shall be rated 200%.

T. Branch circuit breakers for 120/208 volt panelboards shall have a minimum 10,000 AIC.

U. Branch circuit breakers for 480/277 volt panelboards shall have a minimum 14,000 AIC.

2.2 MANUFACTURES

A. Panelboard shall be Square D Type I-Line, Siemens/ITE Type CDP, General Electric A Series, Cutler Hammer Type MP40 or Challenger Type LDP and BDP Series for 120/208 volts, 3 phase, 4 wire.

B. Panelboard shall be Square D Type I-Line, Siemens/ITE Type CDP, General Electric A Series, Cutler Hammer Type MP40 or Challenger Type LDP and BDP Series for 480/277 volts, 3 phase, 4 wire.
PART 3 - EXECUTION

3.1 APPLICATION

A. Do not purchase panelboards or cabinets until Shop Drawings have been approved.

B. Circuit numbering and phase connections shall be in accordance with the following:

1. In lighting and appliance branch panelboards having two vertical columns of devices, circuit numbering shall be such that, starting at the top, odd numbers shall be used in sequence down the left-hand side and even numbers shall be used in sequence down the right-hand side.

2. See schedule of panelboards on Drawings for circuit device sizes and number of poles.

3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

- END OF SECTION -
SECTION 16164 – BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. This work includes the following items for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center:

1. 120/208V Three phase distribution panelboards.
2. 480/277V Three phase distribution panelboards.

1.2 RELATED WORK

A. Section 16010: General Provisions – Electrical
B. Section 16100: Basic Materials and Methods

1.3 STANDARDS AND CODES

U.L. Underwriters Laboratories, Inc.
N.F.P.A. National Fire Protection Association
N.E.C. National Electric Code (NFPA 70)
N.E.M.A. National Electrical Manufacturer’s Association

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.
B. Submit Operation and Maintenance data under provisions of Section 16010.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 16010.
B. Store and protect products under provisions of Section 16010.

PART 2 - PRODUCTS

2.1 THREE PHASE BRANCH CIRCUIT PANELBOARD

A. Panelboards shall be circuit breaker type using quick make, quick break, bolt-on type trip-free circuit breakers with minimum AIC interrupting ratings as shown on the Drawings, or specified herein.

B. Two and three pole breakers shall be common trip.

C. Include ground fault circuit interrupters on all breakers feeding weatherproof receptacles and other areas as noted on Plans.
D. Panelboards shall be dead front, safety with main breakers or main lugs, and number and size of breakers as shown on the Drawings.

E. Panelboards shall have single, feed through, or double lugs to accommodate feeder conductors as shown on the Plans.

F. Voltages and main circuit breaker or main lugs as specified on Plans.

G. Enclosures shall be suitably sized to accommodate both the main conductors and all branch circuit conductors.

H. All circuit breakers shall be rated for switching duty.

I. All circuit breakers shall be rated for full interrupting values as shown.

J. Series rating shall not be allowed.

K. Door shall be fitted with flush cylinder locks, keys to which shall be all alike; 2 keys shall be furnished for each lock.

L. Cabinet fronts shall be furnished with baked enamel finish.

M. Provide with each panelboard a directory framed with transparent plastic window on inside of door and place therein a typewritten identification of all circuits.

N. All panelboards shall be labeled as shown on the drawings. Labels shall be constructed of laminated plastic 1/8" thick white letters on black field fastened with stainless steel screws.

O. Panelboards shall be completely factory assembled. All equipment purchased shall be of a single manufacturer.

P. Cabinet shall be galvanized steel with enameled trim, constructed in conformance with Standards and Code requirements as listed in Section 16010 and shall bear the Underwriter's Laboratories stamp of approval for the service intended.

Q. Main ampere capacity shall be as called for on Drawings.

R. All bus work shall be tin-plated copper.

S. All neutral bus shall be rated 200%.

2.2 MANUFACTURERS

A. Panelboard shall be Square D Type (NQOB), Siemens/ITE CDP Series, General Electric A Series, Cutler Hammer Type CHB, Challenger Type LP Series for 120/208 volts, 3 Phase, 4W. Branch breakers shall have a minimum 10,000 AIC interrupting rating (unless shown otherwise on drawings).

2.3 ENCLOSED CIRCUIT BREAKERS

A. Enclosed circuit breakers shall be of same construction as similar breakers described above.

B. Enclosures shall be NEMA 1 unless shown otherwise on Drawings.
C. Main ampere capacity shall be as called for on Drawings.

D. All bus work shall be tin-plated copper.

PART 3 - EXECUTION

3.1 APPLICATION

A. Do not purchase panelboards or cabinets Shop Drawings have been approved.

B. Circuit numbering and phase connections shall be in accordance with following.

   1. In lighting and appliance branch panelboards having two vertical columns of devices, circuit numbering shall be such that, starting at the top, odd numbers shall be used in sequence down the left-hand side and even numbers shall be used in sequence down the right-hand side.

   2. See schedule of panelboards on Drawings for circuit device sizes and number of poles.

3.2 ELECTRICAL CONNECTIONS

A. The contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14,C (2000 volt and below) and 110-40 (2001-35,000 volt).
SECTION 16200 – POWER GENERATION

PART 1 - GENERAL

1.1 SCOPE

A. Provide, install, and acceptance test a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for service for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

B. Equipment shall be new, factory tested, and delivered ready for installation.

1.2 RELATED WORK

A. Section 16010: General Provisions – Electrical

B. Section 16100: Basic Material and Methods

C. Section 16320: 15KV Switchgear

1.3 APPROVED MANUFACTURERS

A. Equipment, documentation, and services described in this specification and shown on the plans are as provided by Onan Corporation or Kohler.

B. Proposed substitutions shall include complete submittal data, as specified herein, clearly denoting any and all deviations and/or exceptions to the equipment specified. The complete proposal must be submitted to the engineer or architect for approval/disapproval not less than 7 days prior to the scheduled bid date. If approved, the Contractor is responsible for the charges for all necessary revisions.

C. Submit the following information with the proposal package for review and evaluation 7 days prior to scheduled bid date:

1. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.

2. Dimensions of the generator sets, paralleling equipment and accessory hardware, including plan and elevation drawings.

3. Sequence of operation if required to enhance the description included in this specification.

4. Indication of the nearest field service office staffed with factory trained technicians. Provide service organization data and manpower. Indicate typical response time for emergency calls. Provide typical scenario for an emergency service call.

D. To be classified as a manufacturer, the firm shall be regularly engaged in the manufacturing of the engine and/or generator and shall have been in production of engine-generator sets for not less than ten years. The manufacturer shall have produced engine-generator sets of the size specified for not less than five years and shall have essentially identical engine-generator sets to those specified in continuous, satisfactory operation. Manufacturer shall furnish proof, upon request. Manufacturer shall have a local (less than 150 miles) service firm that has been factory authorized, for not less than three years.
E. A Single manufacturer shall be responsible for complete engine-generator set and paralleling equipment including manufacturing of engine and/or the alternator, building of set, building of paralleling gear, factory test, factory warranty and shipping. Coordination between manufacturer, service firm and Contractor shall be mandatory.

F. The manufacturer shall have printed literature and brochures describing the standard series offered (not a one of a kind fabrication). The manufacturer shall furnish schematic and wiring diagrams for the engine alternator set.

G. The performance test of the generating set series shall be in accordance with procedures certified by an independent testing laboratory. The manufacturer shall have successfully tested a prototype of the generating set series offered, per NFPA110, which will include:

1. Maximum power level
2. Maximum motor starting capacity
3. Structural soundness
4. Torsigraph analysis
5. Fuel consumption
6. Engine alternator temperature rise
7. Single step load pick up
8. Harmonic analysis and voltage waveform deviation
9. 3 phase, short circuit test for mechanical and electrical strength.

1.4 SUBMITTALS

A. Within 10 days after award of contract, provide six sets of the following information for review:

1. Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturer's certification of prototype testing.
4. Manufacturer's published warranty documents.
5. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
6. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
7. Manufacturer's installation instructions.
1.5 WARRANTY

A. A no deductible warranty shall be provided for all products against defects in materials and workmanship for a five year or 1500 hour period from the of acceptance date. Warranty shall cover all costs of covered repairs, including parts, labor, mileage, travel time and travel expenses.

B. Standby electric generating system components, complete electric plant (engine & alternator) instrument panel, paralleling equipment, remote annunciator, etc., shall be warranted by the Manufacturer against defective materials and factory workmanship for a period of five years or 1500 hours, whichever first occurs.

C. Defective parts shall be repaired or replaced at Manufacturer’s option, free of charge for this period. This warranty shall commence when the standby power system is accepted at the project final acceptance.

1.6 SINGLE SUPPLIER

A. The supplier shall be the manufacturer's authorized distributor, who shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier shall have 24-hour service availability and factory-trained service technicians authorized to perform warranty service on all products provided.

1.7 RESPONSIBILITY

A. This system shall be built, tested and shipped by the manufacturer of the alternator, who has been regularly engaged in the production of the engine alternator sets and associated controls for a minimum of ten years, so there is one source of supply and responsibility. To be classified as a manufacturer, the builder of the generating set must manufacture at least the engine or the alternator, and the set shall be built at the Manufacturing Plant.

1.8 SUPPLIER QUALIFICATION

A. Firm must be engaged in supervising installation of and servicing engine-generator sets. Firm who is and has been for three years prior to bid date, a factory authorized service organization, in local area, of manufacturer whose set will be provided. Firm must be domiciled within 150 mile radius of project, maintain stock of standard spare parts, maintain staff of experienced technicians specifically trained in servicing engine-generator sets and have personnel available on 24 hour per day, 7 day per week call basis. Facilities open for inspection by Designer.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Three (3) sets of Operation and Maintenance Operators and Spare Parts Manuals shall be provided for all system equipment. The manuals shall include outline, interconnection, wiring, and control drawings accurately describing the equipment provided. Provide ladder logic for all programmable logic controllers in the system.

B. Comply with the provision of Section 16010.

1.10 START-UP & CHECK-OUT

A. Supplier of the electric generating plant and associated items covered herein shall provide factory-trained technicians to check out the completed installation and perform the initial start up of the unit.
B. They shall meet with the Contractor to discuss the installation prior to his beginning the installation and shall provide the Owner's personnel with operating and maintenance instructions at the time of start-up.

C. Generator system shall be capable of a single step pick-up of its nameplate rating of 800KW. A two-hour resistive full load bank test shall be performed at time of start-up and shall include a single step full load test. Include starting batteries, oil and antifreeze at time of start-up. Contractor shall fill fuel tank with diesel at completion of testing.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall furnish and install one (1) complete standby parallel electric generating system. The System shall be a pair of ONAN 400 DFCE Series or Kohler 400 ROZD Series or prior approved equal generators with associated paralleling equipment.

2.2 SYSTEM DESCRIPTION

A. The standby electric power system shall consist of two (2) 12 lead, broad range, reconnectable electric generating plans rated for continuous standby service at 400 KW, 500 KVA @ 0.8 power factor. Rating shall be based on an altitude of 500 feet and ambient temperatures up to 105 degrees F, connected for 3 phase, 4 wire, 480/277 volts and shall have a minimum capability of 2,208 KVA for motor starting at an instantaneous 25% voltage dip.

B. The system shall be a package of new and current equipment consisting of the following:

1. A pair of diesel engine driven electric generating sets to provide standby power.
2. An engine start-stop control system mounted on each generating set.
3. An automatic load transfer control to provide automatic starting and stopping of the engine and switching of the load.
4. A complete paralleling system as described further herein.
5. Mounted accessories as specified.

C. The system shall be built, tested as a system, and shipped by the manufacturer of the alternator so there is one source of supply and responsibility.

D. This standby electric power system, furnished completely by the electric plant manufacturer shall be warranted for a period of five years from the date of initial start up as described.

E. The entire electric generator system shall not be affected in any manner by operation of two-way business band radios in close proximity to the generator set. In addition, operation of the generator set shall not cause interference of any kind on nearby business band radios. The entire electric generator system shall comply with the applicable provisions of the latest additions of NFPA 37 and NFPA 110.
2.3 DIESEL ENGINE

A. The engine shall be four-cycle, diesel fueled with high ambient 122°F, 50°C cooling system including mounted radiator, pump and cooling fan.

B. Each engines shall have 6 cylinders and a minimum displacement of 855 cubic inches, with a minimum rating of 605 bhp at its operating speed of 1800 RPM.

C. Each engine shall be capable of a minimum of 400 KW output on diesel.

D. Intake and exhaust valves shall be heat resisting alloy steel, free rotating. Exhaust valve seat inserts shall be provided.

E. A positive displacement lube oil pump shall supply full pressure lubrication.

F. The engine shall have coolant and oil filters with replaceable elements.

G. Engine speed shall be governed by a gear driven mechanical governor to maintain alternator frequency within 3 hertz from no load to full load alternator output.

H. The engine shall have a minimum 45-amp battery charging DC alternator with transistorized voltage regulator.

I. Remote 2 wire starting shall be by a 24-volt solenoid shift electric starter.

J. Each shall be provided with a 4000-watt, 208 volt thermostatically controlled water jacket heater.

2.4 ENGINE INSTRUMENTS

A. Each engine instrument panel shall contain an oil pressure gauge, coolant temperature gauge, and battery charge rate ammeter.

2.5 ENGINE CONTROLS

A. Each generating set shall contain a complete engine start-stop control, which starts engine on closing contact and stops engine on opening contact.

B. A cranking limiter shall be provided to open the starting circuit in approximately 45 to 90 seconds if the engine is not started within that time.

C. The engine controls shall also include a 3 position selector switch with the following positions: RUN-STOP-REMOTE.

D. The engine shall have the following equipment: safety shutdown system.

1. Low oil pressure
2. High engine temperature
3. Overspeed
4. Overcrank
2.6 BRUSHLESS ALTERNATOR

A. Each alternator shall be a maximum 105°C rise, 4 pole, revolving field type design with temperature compensated solid state voltage regulator and brushless rotating rectifier exciter system. No brushes shall be allowed.

B. The stator shall be directly connected to the engine flywheel housing and the rotor shall be driven through a semi-flexible driving flange to insure permanent alignment.

C. The insulation system shall be Class H defined by NEMA MG1.65.

D. A 600-amp 100% rated plant mounted line circuit breaker shall be provided at each generator.

E. Each alternator shall be provided with a 250W, 120 volt rated heater (windings).

2.7 ALTERNATOR INSTRUMENT PANEL

A. The alternator instrument panel shall be wired, tested and shock mounted on the generating set by the manufacturer of the alternator.

B. It shall contain dual range separate voltmeter, ammeter with selector switch, frequency meter, panel lighting, manual-reset field circuit breaker, running time meter.

2.8 UNIT PERFORMANCE

A. Frequency regulation shall not exceed 3 hertz from no load to rated load.

B. Voltage regulation shall be within plus or minus 2 percent of rated voltage from no load to full rated load.

C. The instantaneous voltage dip shall be less than 20 percent of rated voltage when full 3-phase load and rated power factor is applied to the alternator. Recovery to stable operation shall occur within 2 seconds. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 1 percent of rated voltage. A rheostat shall be provided, a minimum of plus or minus 5 percent voltage adjustment from rated value.

D. Temperature rise shall be within NEMA MG1-22.40 definition.

E. The rating of the prime mover shall be such that any overloads, which occur during motor starting, even though they may exceed the steady-state capability of the prime mover, shall not cause stalling.

2.9 SAFETY SHUTDOWN MONITORING SYSTEM

A. The electric generating plant shall be provided with automatic safety shutdowns including individual alarm terminals plus individual indicating lights. This monitoring system shall include:

1. Run (green light)
2. Overcrank shutdown (red))
3. Overspeed shutdown (red)
4. High coolant temperature shutdown (red)
5. Low oil pressure shutdown (red)
6. Pre-warning for high coolant temp. (yellow)
7. Pre-warning for low oil pressure (yellow)
8. Low coolant temp (yellow light indicates inoperative coolant heater)
9. Switch off (flashing red indicates genset not in automatic start mode)
10. Two customer selected faults (red)

B. The low oil pressure & high engine temperature shall be pre-alarm types indicating danger is being approached prior to plant shutdown.

2.10 ELECTRIC PLANT MOUNTING

A. The electric plant shall have built-in vibration isolators and be mounted on welded steel base which shall permit suitable mounting to any level surface. Anchor generator steel base to foundation with minimum six (6) stainless steel anchors sized per manufacturer’s recommendations.

2.11 VIBRATION ISOLATORS

A. Six (6) pad type vibration isolators shall be provided for installation beneath electric plant skid and mounting surface, and shall be properly anchored to mounting surface.

2.12 EXHAUST SILENCER

A. A mounted critical exhaust silencer minimum attenuation of 26 dba, which shall be supplied along with an installed section of stainless steel exhaust flex, connected to the engine and muffler. The muffler shall be field installed and suitable for suspending.

2.13 BATTERIES

A. One 24-volt minimum, 225 cold cranking amp each, Group 4D, heavy-duty lead acid starting batteries with electrolyte shall be provided.

2.14 BATTERY RACKS

A. Battery rack shall be built into electric plant skid.

2.15 BATTERY FLOAT CHARGER

A. Two (2) 24 volt, 10 Amp SCR Float charger shall be remote mounted, one (1) for each generator set. Charger shall be fully automatic, constant voltage, current limiting, with equalize charge timer, voltmeter and ammeter. Charger shall be field wired to battery connections.
2.16 MISCELLANEOUS

2.16.1 GENERAL

A. Contractor shall install the complete electric generating plant including all fuel connections, in accordance with Manufacturer's recommendations as reviewed by the Designer. Contractor shall provide Owner's Operating personnel with detailed Operation & Maintenance Manuals including complete parts lists. Manuals shall include engine manufacturer's complete engine manual as well as alternator operation instructions.

2.16.2 SERVICE

A. Supplier of the electric plant and associated items shall have permanent service facilities within 150 miles of jobsite.

B. These facilities shall comprise a permanent force of factory trained service personnel on 24-hour call, experienced in servicing this type of equipment, providing warranty and/or routine maintenance service to afford the Owner maximum protection.

2.17 PARALLELING EQUIPMENT DESCRIPTION

2.17.1 EQUIPMENT RATINGS

A. The paralleling switchgear shall be rated for operation at voltage as shown on the contract drawings, with emergency bus rated and configured as shown on the contract drawings.

2.17.2 EQUIPMENT CONSTRUCTION

A. Switchgear shall be a rigid, free-standing, metal enclosed structure, designed for front and rear access, with generator and load connections entering the structure as shown on the project drawings. Each section of the switchgear shall be constructed with a minimum 12 gauge steel sheet metal framework.

B. Each section of the paralleling system shall be listed and labeled under the requirements of UL 891, including all covers, barriers, and supports. Breakers and individual control sections shall be isolated from each other by metal or insulating barriers.

C. All wiring shall be UL listed 105 degree C, 600 volt rated, and sized as required. Each wire, device or function shall be suitably identified by silk-screen or similar permanent identification.

D. The system emergency bus shall be silver plated copper with bolted joints for all three phases, with a full neutral, and a 1/4 x 2 inch ground bus extending through all sections and shall not exceed 1000 amps/square inch. Bus shall be braced for peak symmetrical amperage available from all generator sets plus motor contributions and utility (if utility paralleled system) to 50,000 amps RMS minimum. (See contract drawings for bus ratings.)

E. The framework and all other sheet metal components of the system shall be primed with a rust-inhibiting primer, and finished with two coats of satin finish ANSI 61 gray enamel.

F. All door mounted control devices shall be industrial type oil-tight with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Toggle switches and other light duty control devices are not acceptable. Indicator lamps shall be high intensity LED type devices. Indicator lamp condition (on or off) shall be easily visible in bright room lighting conditions.
G. AC control circuits in the switchboard shall be protected with properly sized fuses in safety fuse blocks, with fuse blown indication for each fuse. Potential transformers shall be protected on line and load side.

H. All field interconnecting wiring shall be sized as specified by system manufacturer (minimum 14 AWG copper) and shall be stranded.

2.17.3 CONTROL POWER

A. Control power for the system shall be derived from the generator set 24VDC starting batteries. A solid state, no break "best battery" selector system shall be provided so that control voltage is available as long as any battery bank in the system is available, and that all battery banks are isolated to prevent the failure of one battery from disabling the entire system. Generator set governing, voltage regulation, load sharing, synchronizing, protection, and control equipment shall be capable of proper operation with battery voltage levels down to 8VDC.

2.17.4 INDOOR ENCLOSURES

A. Note space available and access requirements for the paralleling equipment, and provide equipment, which will fit into the space allowed. Make all allowances prior to bidding.

2.18 GENERATOR SET PARALLELING CONTROL PANELS

A. Provide a paralleling control panel for each generator set in the emergency power system. The paralleling control functions may be integrated with the generator set control functions (with duplicate functions eliminated). Each paralleling control panel shall contain the components and devices as described in this section.

2.18.2 FRONT DISPLAY PANEL:

A. The front panel of the paralleling control shall contain the following analog or digital instruments and devices:

1. 1% accuracy generator set AC output instruments; Ammeter, Voltmeter, Frequency Meter, Wattmeter, KW-hour meter, Power Factor Meter. Selector switches to allow viewing of voltage and amperes for each phase shall be provided. For 3-phase/4-wire systems the voltmeter shall indicate line to line and line to neutral conditions. Voltmeter and frequency meter shall be analog instruments. Switches and/or other provisions shall be included to allow reading of bus voltage and frequency from this metering set.

2. Synchroscope and “generator set synchronized” indication. Indication may be synchronizing lamps, LED indication, or other provisions, but must be located on the paralleling control panel, adjacent to the paralleling breaker control switches.

3. Running Time Meter, Start Counter.

4. Generator Set Mode Selector Switch: Switch shall provide run, off, and automatic functions for control of the generator set.

5. Breaker trip/close switch with breaker status indicating lamps. The switch shall be interlocked with the control system such that breaker closure is not possible unless the mode select switch is in the run position and the generator set is synchronized with the system bus.
6. Control Reset push-button switch with indicating lamp. Lamp shall flash to indicate that generator set is locked out due to a fault condition.

7. Lamp test push-button switch. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.

8. The control panel shall be provided with a set of DC-powered lamps with a switch to allow viewing of all functions on the front panel when normal lighting systems are not available.

9. Emergency Stop switch. The emergency stop switch shall be a red, mushroom head switch which maintains its position until manually reset.

10. Precision voltage and frequency adjust raise/lower switches. Switches shall allow the generator set frequency and voltage to be adjusted plus or minus 5% when the generator set is operating independently of the system bus. Voltage and frequency adjustment switches shall be located adjacent to the generator set and bus metering, breaker control switches, synchroscope and manual paralleling panel, for ease of use by the operator.

11. Alarm and status indicating panel to indicate the following conditions (alarm horn shall be located on master control)

<table>
<thead>
<tr>
<th>Function</th>
<th>Lamp Color</th>
<th>Alarm Horn</th>
<th>Shutdown Unit</th>
</tr>
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<tbody>
<tr>
<td>Low DC Voltage</td>
<td>Amber</td>
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<td></td>
</tr>
<tr>
<td>High DC Voltage</td>
<td>Amber</td>
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</tr>
<tr>
<td>Weak Battery</td>
<td>Amber</td>
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<tr>
<td>Fail to Sync</td>
<td>Amber</td>
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<tr>
<td>Low Oil Pressure Alarm</td>
<td>Amber</td>
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<tr>
<td>Low Fuel - daytank</td>
<td>Amber</td>
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<tr>
<td>High Engine Temp Alarm</td>
<td>Amber</td>
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<tr>
<td>Ground Fault</td>
<td>Amber</td>
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<tr>
<td>Overcurrent Alarm</td>
<td>Amber</td>
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<td>Breaker Failure</td>
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<td>Breaker Tripped</td>
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<tr>
<td>Not in Auto</td>
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<tr>
<td>Breaker Closed</td>
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<td>Timing for Start</td>
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<tr>
<td>Timing for Shutdown</td>
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B. Provide all other components required, such as properly sized current transformers, transducers, terminal blocks, etc., for reliable system operation, as described herein under “SYSTEM OPERATION”.

2.18.3 PARALLELING CONTROL PANEL, INTERNAL COMPONENTS

A. Electrically operated power circuit breaker with electronic trip unit (long, and instantaneous trips) in drawout frame. Frame size and trip units shall be as shown on the project drawings.

B. Electronic isochronous kW load sharing control to operate the engine governors during synchronizing and to provide isochronous load sharing when paralleled. The control system shall allow sharing of real kW load between all generator sets in the system to within 5% of equal levels, without introduction of frequency droop into the system. The control system shall include all equipment required for kW load sharing with an infinite bus. (For future use.) The infinite bus governing controls shall allow the generator set to synchronize to an infinite bus, parallel, and ramp up to a preset load level on the generator set. Additional controls shall be provided to cause the generator set to ramp up to a kW load level signaled by the system PLC.

C. Load demand governing controls shall be provided to cause the generator set to ramp down to zero load when signaled to shut down in a load demand mode. On a signal to re-start, the load demand governing controls shall cause the generator set to synchronize to the system bus, close, and ramp up to its proportional share of the total bus load. The ramp rate of the generator set shall be operator-adjustable.

D. The isochronous load sharing module and engine governor shall be a coordinated system of a single manufacturer.

E. Electronic isochronous kVAR load sharing control to operate the alternator excitation system while the generator set is paralleled. The control system shall allow sharing of reactive load between all generator sets in the system to within 5% of equal levels, without introduction of voltage droop into the system. The control system shall include all equipment required for VAR load sharing with an infinite bus in either a constant VAR or constant power factor mode. (Mode and adjustments selectable by the operator)

F. Equipment shall be provided to monitor the generator set as it is starting, and verify that it has reached at least 90% of nominal voltage and frequency before closing to the bus. The equipment provided shall positively prevent out-of-phase paralleling if two or more engine-generator sets reach operating conditions simultaneously by providing a lockout signal to disable breaker closure for generator set(s) in the system which have not been selected to be the first units to close to the bus. Controls to recognize the failure of the first breaker signaled to close, and allow system operation to proceed in spite of this failure shall also be provided (breaker failure alarm). Systems using dead bus relay schemes without a disable signal to positively prevent out-of-phase paralleling shall not be acceptable under this specification.
G. Synchronizer to electronically adjust the engine governor to match the voltage, frequency and phase angle of the bus. Synchronizer shall maintain the engine-generator voltage within 1% of bus voltage and phase angle within 20 electrical degrees of the bus for 0.5 seconds before circuit breaker closing. Each unit shall have its own synchronizer; systems using a switching scheme to utilize a single system synchronizer will not be approved. Synchronizers and systems which utilize a motor driven pot for control of AC voltage during the synchronizing process will not be accepted. The system shall be provided with a fail to synchronize time delay which is adjustable from 10-120 seconds. Control logic for fail to synchronize function shall allow field adjustment of function for either alarm or shutdown of the generator set on failure condition.

H. Controls shall include a permissive relay function to assure that the generator set does not attempt to close out of phase with the bus, due to errant operation of the synchronizer.

I. Controls shall include a permissive (sync check) function, to be used with “generator synchronized” indicator during manual paralleling, to prevent accidental closure of the breaker with the generator set out of phase with the bus. Provisions to allow manual closure of the first generator set to a de-energized bus shall be included.

J. Control equipment shall contain a system of diagnostic LED’s to assist in analyzing proper system function.

K. Controls shall include three phase sensing reverse power equipment, to prevent sustained reverse power flow into the generator set. When the reverse power condition exceeds 10% of the generator set kW for 3 seconds, the paralleling circuit breaker shall be tripped open and the generator shut down.

L. Controls shall be provided to verify generator set and bus phase rotation match prior to closing the paralleling breaker.

M. Electronic alternator overcurrent alarm and shutdown protection. (This protection is required in addition to the overcurrent trip on the paralleling breaker.) The overcurrent alarm shall be indicated when the load current on the generator set is more than 110% of rated current for more than 60 seconds. The overcurrent shutdown shall match to the thermal damage curve of the generator set, and shall not have an instantaneous function.

N. Electronic alternator short circuit protection. (This protection is in addition to the overcurrent trip on the paralleling breaker.) The short circuit shall occur when the load current on the generator set is more than 175% of rated current and an aggregate time/current calculation indicates that the system is approaching the thermal damage point of the alternator. The equipment used shall not have an instantaneous function.

O. Controls shall be provided to sense loss of excitation of the alternator while paralleled to the system bus.

P. Generator set start contacts rated 10 amps at 32 VDC.

Q. Cooldown time delay, adjustable: 0-600 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for shutdown.

R. Start time delay, adjustable: 0300 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for start.
S. The control system shall monitor the paralleling breaker auxiliary contacts, and initiate a fault signal if the breaker fails to close within an adjustable time delay period after the control has signaled it to close. (0.5-15 seconds) Breaker failure alarm shall cause the paralleling breaker to trip open, and lock out until manually reset.

T. Controls shall be provided to initiate an alarm condition when generator set is at 90% of rated frequency for more than 20 seconds.

U. Controls shall be provided to shut down generator set and initiate alarm when the generator set is at less than 85% of nominal voltage for more than 15 seconds, more than 110% of nominal voltage for more than 10 seconds, or more than 130% of nominal.

2.19 MASTER CONTROL

A. Provide a master control to monitor and control the operation of the entire paralleling system. The master control panel shall contain the components described in this section.

2.19.2 MASTER CONTROL FRONT PANEL METERING

A. 1% accuracy RMS digital instruments to monitor total output of bus: Ammeter, Voltmeter, Frequency Meter, Wattmeter, Power Factor Meter, KVA, kVar kW-Hour Meter, kW demand, kVAR hours, kVA hours. Selector switches to allow viewing of voltage and amperes for each phase shall be provided. For 3-phase/4-wire systems the voltmeter shall indicate line to line and line to neutral conditions.

2.19.3 MASTER CONTROL FRONT PANEL SWITCHES AND CONTROLS

A. System Mode Select Switch. The switch shall be a two position rotary switch labeled TEST and AUTO. In the TEST position all generator sets in the system shall start, synchronize and parallel on the bus. In the AUTO position, the system shall be shut down, ready for a remote start signal.

B. Load Shed Overide Switch. The switch shall be three position rotary switch labeled SHED-NORMAL-RESTORE. Operation of the switch to the SHED position (momentary, spring return to NORMAL) shall cause designated loads to immediately be shed. Operation of the switch to the RESTORE position (momentary, spring return to NORMAL) shall cause designated loads to be returned to the system bus.

C. Load Add Overide Switch. The switch shall be a two position rotary switch labeled NORMAL-PRIORITY OVERIDE (Spring return to NORMAL). Operation of the control switch to PRIORITY OVERIDE position shall cause highest priority of loads which have not closed to the bus to automatically be powered by the available generator sets. One switch shall be provided for each load add priority level.

D. Alarm reset/horn silence Switch.

E. Load Demand Control Switch. Two position rotary switch labeled LOAD DEMAND OFF-LOAD DEMAND ON.

F. Load Demand Lead Unit Selector Switch. Switch shall be a flush mount thumbwheel switch. The lead unit selector switch shall give the operator the ability to select the shutdown sequence for the generator sets when the system is in the load demand mode. This is intended to allow equalization of operating hours on the generator sets in the system.
G. Load Demand Set Point Switch. Switch shall be a flush mounted thumbwheel switch labeled % PICK-UP AND % DROP OFF. Switch shall initiate shut down or start up of a generator set based on the % of available capacity of the next generator set in sequence to shut down or return to operation.

H. Provide a solid state Exerciser Clock to automatically start the paralleling system generators at regular intervals (verify with Owner; minimum once per week with load) and allow the system to run with or without load (key selectable) for a pre-set time period for exercise purposes. All associated 15KV switchgear and other components integral to the emergency system shall be operated during the exercise period. Exerciser clock shall be a minimum 7-day with unlimited field adjustable run time.

2.19.4 SYSTEM STATUS REMOTE ANNUNCIATION PANEL

A. A solid state system status remote panel shall be provided. It shall include the alarm and status indicators as described further herein and located as shown on the drawings.

B. The remote annunciator shall provide all the indications and audible alarms called for by NFPA Standard 110 and as provided on the engine-generator set control panel.

C. Annunciator shall be 24 volt alarm panel for remote installation with signals indicating condition & possible malfunction of the emergency generator system. Indication "signals" are as follows:

<table>
<thead>
<tr>
<th>Function</th>
<th>Color</th>
<th>Alarm Horn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator Set #1 Running</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Generator Set #2 Running</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Load Demand Mode</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Priority 1 Load On</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Priority 2 Load On</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Load Shed Level 1</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>Load Shed Level 2</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>System Test</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Remote System Start</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>Check Generator Set #1</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>Controller Malfunction</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>Check Station Battery</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>Check Generator Set #2</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>Bus Overload</td>
<td>red</td>
<td>*</td>
</tr>
<tr>
<td>System Not in Auto Mode</td>
<td>red</td>
<td>*</td>
</tr>
</tbody>
</table>

D. Panel shall have an alarm silence button on annunciator & will reset circuit for any subsequent fault condition whether or not initial fault has been cleared.

2.19.5 INTERNAL CONTROL COMPONENTS

A. The following internal controls shall be provided within the master control section:

B. Load pick-up output contacts, rated 10 A at 600 VAC (3 contacts per level). The system shall include load pick up contact sets for each generator set in the system, less one.

C. Load shed output contacts, rated 10 A at 600 VAC (3 contacts per level).
D. Provide all other components required, such as properly sized current transformers, transducers, terminal blocks, etc., for reliable system operation.

2.20 SYSTEM OPERATION:

2.20.1 LOSS OF NORMAL POWER:

A. System is given signal to start by receipt of start signal from the Master Control Panel described further herein. On receipt of this signal, the 15KV bus tie switch shall open and both generator sets shall automatically and independently start, accelerate to rated frequency and build up to rated voltage. The first start system shall monitor this process, and on finding a generator set at 90% of rated voltage and frequency and upon finding the 15KV bus tie open, shall automatically disable the other generator from closing to the bus, and shall close the ready unit to the bus. At this time, the first priority transfer switch shall begin the time delay transfer sequence, and on its completion shall close the generator breaker to transfer the load to the system bus.

B. The priority (load add) controls shall prevent overloading of the system bus by providing inhibit signals to prevent transfer of selected loads to the emergency system until sufficient generating capacity is available on the bus, or until the priority override switch on the touchscreen control is actuated.

C. After the first unit is closed to the bus, the control of the remaining unit is switched to the synchronizer in the generator paralleling control, which causes the generator set to synchronize with the system bus, and then close to it at the proper time.

D. As each unit closes to the bus, the unit shall assume its proportional share of the total load on the bus.

2.20.2 FAILURE OF A UNIT TO START OR SYNCHRONIZE

A. If a unit fails to start, after the overcrank time delay (in the generator set control) has expired, the unit shall be shut down, and an alarm will sound. The priority control will prevent the loads from being added to the system without manual intervention. If the operator determines that generator capacity is available to serve the load, the priority override controls on the touchscreen may be used to manually add load to the bus. Bus overload monitoring shall protect the loads in the event that the bus is inadvertently overloaded due to operator error.

B. If a unit fails to synchronize, after a preset time delay, an alarm will sound, but the unit will continue to attempt to synchronize until signaled to stop by manual operation of the control switches on the generator set.

2.20.3 BUS OVERLOAD

A. If a bus overload occurs for any reason, a load shed signal will be generated to initiate load shedding in the system.

B. If the bus does not return to proper frequency within a predetermined period of time, additional load shed signals will be generated.
2.20.4 LOAD DEMAND MODE:

A. When the system running in the emergency mode with the "load demand" switch on the touchscreen in the "on" position, controls shall continuously monitor the total load on the bus. If the total load on the bus falls below preset limits for a period of 10 minutes, the controller will automatically shut down generator sets in an operator predetermined order, until the minimum number of generators required to safely handle the load remain on the bus. The purpose of this function is to allow the generator sets to operate closer to their rated capacity, thereby decreasing fuel consumption, and reducing wear on the system.

B. On sensing that the available bus capacity is being approached, the standby units will automatically be restarted (in the reverse order of which they were shut down) and paralleled with the bus to assume their proportional share of system load.

2.20.5 RETURN OF NORMAL POWER

A. When all of the system start signals are removed from the generator sets, the generator set paralleling breakers shall all open, the 15KV bus tie shall close and the generator sets shall operate at no load for a cool down period. When the cool down period has been completed, the generator sets shall shut down.

B. If a system start signal is received during the cool down period, the 15KV bus tie will open and one generator set shall immediately close to the system bus and all other units shall synchronize to it, as described in “Loss of Normal Power” above.

2.21 DISTRIBUTION EQUIPMENT:

A. Provide emergency feeder distribution breakers of the number and size as shown on the project drawings.

B. The breakers shall be drawout power circuit breakers of the same manufacturer and model as the paralleling breakers. The breakers shall be provided with electronic trip units, with long, short, and instantaneous trips.

2.21.2 BREAKERS - ELECTRICALLY OPERATED

A. The breakers shall be electrically operated. Breakers shall be factory wired to provide operation sequence as described in sequence of operation, or as shown on the drawings.

2.22 ABOVE GROUND FUEL TANK

A. Provide a minimum 10,000 gallon (Seven (7) day supply) skid mounted, minimum 3/16" double wall steel above ground diesel fuel tank with openings for fill, vent and discharge.

B. Tank shall be sandblasted and coated with rust inhibiting prime coating and painted with a white epoxy finish.

C. Tank shall be a nominal six (6) feet diameter and 23 (twenty-three) feet long.

D. It shall be supported at a minimum of three (3) points with rolled flat bar saddles attached to a minimum seventeen (17) foot support on each side.

E. The fuel tank shall be factory tested to 5 psi air, and shall bear the Underwriter Listing UL-142.
F. Tank shall be provided with a minimum eighteen (18) inch manway opening with a watertight cover.

G. Lifting lugs (2 minimum) shall be provided on the top of the tank.

H. A minimum of five (5) 2" NPT openings on the top along with an 8" emergency vent and a 2-1/2" lockable fill cap shall be provided.

I. Tank shall be provided with two (2) each 1/2" openings with valves and sight gauge on the end of the tank.

J. Fuel tank shall be provided with a 1" NPT suction opening 3" from tank bottom on one end and a 3/4" NPT with plug, drain opening on the tank bottom.

K. Provide a galvanized steel, OSHA approved access ladder and platform with handrails as required to access the fill cap location. Ladder and platform shall be supported from the concrete foundation and not the fuel tank.

2.23 FUEL DAY TANK

A. Fuel Day Tank shall be UL listed for use with an overhead main fuel supply and shall be a double wall diesel tank with transfer pump and alarm float for outdoor application.

B. Provide one (1) 50 gallon day tank for each generator this project.

C. The tank shall be made of corrosion resistant steel.

D. Provide an automatic leak detection system in the space between the tank walls.

E. Provide inlet ballcock for above ground tank installation to prevent overflow.

F. Include a mounted critical high level contact and a low level alarm contact for connection to the remote annunciator.

G. Provide built in transfer pump sized for generator requirements.

H. Day tanks shall be finish coated in the same color as the generator set.

I. Provide a reverse pumping system for fuel return to the main tank as shown on the drawings.

PART 3 - EXECUTION

3.1 APPLICATION

A. Do not purchase emergency generator system until shop drawings are approved.

B. Space is a premium. Verify all generator system components shall fit in the space provided and make all allowances before bidding. Provide the minimum clearances as shown for maintenance, operation and code requirements.

C. Provide all fuel supply and return piping from the storage tank to the day tank and from the day tank to the engine as required by the Manufacturer. Adjust pipe sizes and routing and make all required allowances before bidding.
3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

3.3 TESTING

A. To provide proven reliability of the system, three series of tests shall be perform

1. Prototype Model Tests
2. Production Model Tests
3. Field Tests.

B. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results.

C. Generator sets that have not been prototype tested and factory tested at 0.8 PF shall not be acceptable.

3.4 PARALLELING EQUIPMENT PROTOTYPE TESTS

A. Prototype samples, representative of the production paralleling equipment supplied, shall have been tested as defined in UL 1008, including but not limited to: Overload, Temperature rise, Endurance, Dielectric voltage withstand, Withstand and closing tests with specific overcurrent devices.

B. The entire paralleling system shall be performance tested per the requirements of IEEE-587-1980, for voltage surge withstand capability.

3.5 FACTORY TESTS

A. Generator set and paralleling gear shall be tested as a system at the factory. These production tests, on the equipment to be shipped, shall be performed at rated load and 0.8 PF.

B. These tests shall include run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and safety shutdowns. Provide a factory certified test record of the production testing.

C. Paralleling equipment production model tests of the equipment supplied shall be factory tested before shipment. Factory tests shall include a complete functional test of the control system, including calibration of the voltage sensor potentiometers.

3.6 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the specification following completion of all site work.

B. Representatives of the manufacturer shall conduct testing, with required fuel supplied by the Contractor.

C. The Engineer shall be notified in advance and shall have the option to witness the tests.
D. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one step rated load pickup test in accordance with NFPA 110.

E. The Contractor shall provide a resistive load bank and temporary connections for full load test.

F. Contractor shall provide fuel for all testing and adjusting as required.

G. At completion of the testing and acceptance of the unit, the Contractor shall fill the above ground storage tank with diesel fuel.

3.7 SERVICE

A. Supplier of the electric plant and associated items shall have permanent service facilities within 150 miles of jobsite.

B. Service facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and/or routine maintenance service to afford the Owner maximum protection.

3.8 WARRANTY

A. Standby electric generating system components, complete electric plant (engine & alternator) instrument panel, paralleling switchgear, remote annunciator, day tank system, above ground fuel tank, etc. shall be warranted by the Manufacturer against defective materials and factory workmanship for a period of five years or 1500 hours, whichever first occurs.

B. Such defective parts shall be repaired or replaced at Manufacturer's option, free of charge, without deductible, for this period.

C. Coverage shall include parts, labor, and travel expenses, to remove and install any equipment found defective.

D. This warranty shall commence when the standby power system is accepted at the project final acceptance.

3.9 SUBMITTALS

A. Provide seven (7) sets of Engineering Submittals, for approval, prior to production release, showing all components, in addition to the engine generator set and load transfer controls.

B. Submittals shall include complete system interconnecting wiring diagrams, component specifications and Manufacturer's Published Warranty Form indicating compliance with these specifications.

3.10 START-UP & CHECK-OUT

A. Supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and perform the initial start up of the unit.

B. They shall meet with the Contractor to discuss the installation prior to his beginning the installation and shall provide the Owner's personnel with operating and maintenance instructions at the time of start up.
C. Each generator shall be capable of a single step pick up of its nameplate rating of 350KW.

D. A two-hour resistive load bank test of each generator shall be performed at time of start up and shall include a single step full load test in accordance with NFPA 110.

E. The Designer shall be notified in advance and shall have the option to witness the tests.

F. Contractor shall include starting batteries, oil, diesel fuel and antifreeze at time of start up.

- END OF SECTION -
SECTION 16310 - ELECTRICAL SUBSTATIONS

PART 1 - GENERAL

1.1 SCOPE
   A. This section describes the Electrical Substation installation for the Skilled Nursing Care/Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 SECTION INCLUDES
   A. 13.8kV – 480/277 volt, Three Phrase Pad Mount Transformer.

1.3 RELATED WORK
   A. Section 16010: General Provisions - Electrical
   B. Section 16100: Basic Materials and Methods
   C. Section 16030: Testing

1.4 STANDARDS AND CODES
   A. Where a referenced standard is indicated, the applicable standard shall be made a part of the specifications which refers it to the same extent as if written out in the specification in full.
   B. Meet the requirements and recommendations of applicable portions of standards listed below:
      - N.E.M.A National Electrical Manufacturer's Association
      - A.N.S.I. American National Standards Institute
      - N.E.C. National Electric Code

1.5 SUBMITTALS
   A. Submit Shop Drawing under provisions of Section 16010.
   B. Submit Operation and Maintenance data under provision of Section 16010.

1.6 DELIVERY, STORAGE AND HANDLING
   A. Deliver products to site under provision of Section 16010.
   B. Store and protect products under provision of Section 16010.

PART 2 - PRODUCTS

2.1 PAD MOUNTED TRANSFORMER
   A. Each transformer shall be padmount with KVA rating as shown on the drawings, 3 phase, 60 hertz, 13.8KV (V.O.J.) primary delta to wye grounded secondary.
B. Minimum transformer impedance (%) shall be as shown on the drawings.

C. All transformers primary compartments shall be sized to provide appropriate depth between the primary door and deadbreak elbow to allow for future addition of feed through inserts and deadbreak elbows.

D. The transformer shall be provided with a primary selective switch (rated minimum 600A) to permit energizing transformer from either or both of two primary loop conductors (see primary one line diagram on drawings for switch configuration). The switch shall consist of two internal, oil immersed, gang-operated, two positions (ON-OFF), manually-operated, loadbreak switches with internal connecting bus to provide the switching arrangement as shown on the primary system one line diagram. The switch shall be capable of switching transformer and overall system full load current.

E. The switch handles shall be located in the primary compartment and shall be hot stick operable.

F. Six primary bushing wells shall be provided.

G. The transformer shall be provided with a NO-LOAD Tap Changer with 2 - 2-1/2% full capacity taps above and below normal.

H. The primary shall be protected with a load break, current limiting fuse, drawout drywell assembly. Fuse size shown on Drawings.

I. Transformer shall be provided with selective primary loadbreak switches as shown on the one line diagram.

J. The transformer shall have dead front primary terminators, consisting of bushing wells and deadbreak inserts.

K. The secondary compartment shall include factory installed molded case circuit breakers, copper bus bar (not field installed conductors) connected to the secondary bushings. The compartment shall be able to accommodate breakers as indicated on the one line diagram, and a minimum of one (1) space for a future molded case circuit breaker. The frame size and breaker sizes shall be as shown on the Drawings. Provide closure panel to provide dead-front construction.

L. The transformer shall be a tamper-resistant safety design to prevent unauthorized entry into the high or low voltage compartment. The access door panel shall have a padlock type handle and the door shall also have an REA type recessed pentahead locking bolt.

M. The transformer shall be furnished with oil level gauge, thermometer, pressure vacuum gauge, pressure relief valve, and a drain valve with sampling device and manufacturer's standard outdoor color.

N. Contractor shall furnish and install locks for energized padmount transformer during the construction period. Upon final acceptance of project, he shall turn over to the Owner temporary key used for construction. All locks shall be brass and keyed alike.

O. Contractor shall furnish one (1) fuse handling hot stick tool, type as recommended by the manufacturer.

P. The Contractor shall furnish three (3) spare fuses for each padmount transformer primary.
2.2 HOT STICK

A. Contractor shall furnish to User Agency one (1) shotgun style telescoping, 5’ retracted to 8’ extended, electrical grade fiberglass hot stick with suitable adapters to operate the deadbreak elbows provided this project.

B. Hot stick shall be complete elbow pulling gripper adapter and water repellent storage case.

C. Hot stick shall be Hastings Fiber Glass Products, Inc. Catalog Number 81 Series, or A.B. Chance Catalog Number C-403 Series.

2.3 APPROVED MANUFACTURERS

A. General Electric Compad II, with accessories as shown above.

B. Square D 6330, with accessories as shown above.

PART 3 - EXECUTION

3.1 APPLICATION

A. Each transformer shall be provided with parking stands for each primary conductor.

B. Each transformer shall be provided with a primary fault indicator per Section 16402.

C. Contractor shall provide three spare fuses for each transformer primary. Fuse size shown on Drawings.

3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

END OF SECTION
SECTION 16312 UNDERGROUND DISTRIBUTION SYSTEM TERMINATION

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the Underground Distribution System Termination for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 SECTION INCLUDES

A. 15KV Deadbreak Elbows.
B. 15KV Deadbreak Plug insert.
C. Insulated Parking Bushing.

1.3 RELATED WORK

A. Section 16010: General Provisions – Electrical
B. Section 16100: Basic Materials and Methods
C. Section 16030: Testing

1.4 STANDARDS AND CODES

A. Where a referenced standard is indicated, the applicable standard shall be made a part of the specifications which refers to the same extent as if written out in the specification in full.
B. Meet the requirements and recommendations of applicable portions of standards listed below:
   - N.E.M.A National Electrical Manufacturer’s Association
   - A.N.S.I. American National Standards Institute
   - N.E.C. National Electric Code

1.5 SUBMITTALS

A. Submit Shop Drawing under provisions of Section 16010.
B. Submit Operation and Maintenance data under provision of Section 16010.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provision of Section 16010.
B. Store and protect products under provision of Section 16010.
PART 2 - PRODUCTS

A. Contractor shall provide deadbreak elbow terminations for primary conductor at padmount transformer.

B. Terminations shall consist of deadbreak elbow, deadbreak plug insert and bail assembly.

C. In addition, insulated parking bushings shall be provided as described further herein.

D. Acceptable manufacturers shall be Cooper Bol-T Series, Elastimold 600 Series or prior approved equal.

2.2 DEADBREAK ELBOW

A. Contractor shall furnish and install elbow connectors, sized as required to match the 15 kV underground distribution conductors.

B. Elbow connector shall be a fully shielded, fully submersible, hot-stick operable, separable insulated connector designed for energized operation.

C. Elbow shall be rated for a 600-ampere load and shall match the padmount transformers installed.

D. Installation shall not require the use of special tools or taping.

E. The elbow connector housing shall be made of compounds for functional reliability and long life. The outer jacket shall be 1/8 inch minimum molded conductive compound to provide a virtually indestructible ground shield for dead front construction.

F. A factory tested molded stress relief for terminating cable, and an inner shield or molded conductive material shall also be supplied.

G. Molded insulating compound shall be provided for an interference fit and to provide uniform concentric pressure on insulation of mating parts to provide the required creep-path length and waterseal.

H. A grounding eye shall be provided to connect a ground wire to the molded conductive shield to place the molded shield at ground potential.

I. Elbow connector shall be provided with a sized opening to engage the insulation shielding of the cable and provide ground shield continuity without taping.

J. A reinforced stainless steel pulling ring shall be provided for connector removal.

K. The crimp-type connector for the cable shall meet all requirements of TDJ-162 for Class “A” connectors.

L. The male contact copper pin shall incorporate Belleville washers at the engagement point with conductor contact for a result that the total connector system meets Class “A” connector requirements.

M. The elbow connector shall be furnished with an arc follower made on non-tracking material to quench the arc in switching operations.
N. The elbow connector shall be furnished with rubber locking ring seats in bushing plug groove for positive gripping force. The initial pulling action shall unseat the ring and produce a quick break action.

O. The elbow connector shall be provided with an insulating cuff to prevent re-strike to ground on switching operations and provide an additional waterseal. A white band shall indicate elbow is a deadbreak device.

P. A stainless steel hold-down bail shall be provided to mechanically lock the elbow connector with the busing or load break plug insert.

2.3 LOAD BREAK PLUG INSERT

A. Contractor shall furnish and install deadbreak bushing plug inserts sized as required to mate with deadbreak elbow connectors.

B. Deadbreak plug insert shall be fully shielded, fully submersible, separable insulated connector designed for energized operation.

C. Insert shall be rated for 600-ampere deadbreak operation.

D. Installation shall not require the use of special tools or the taping of any part of the product.

E. The insert shall be threaded onto the male stud of the universal bushing wells and tightened by hand.

F. Inserts shall be provided for all primary universal wells.

G. Future inserts not used with deadbreak elbows shall be closed with a suitable cap cover.

H. A deadbreak plug insert shall be constructed of compounds for functional reliability and long life.

I. A minimum 1/8 inch thick flange of molded conductive material shall provide ground shield continuity between the apparatus and the mating elbow connector for true dead front construction.

J. A molded insulating compound shall provide an interference fit and provide uniform concentric pressure on insulation of mating parts to provide required creep-path length and waterseal.

2.4 INSULATED PARKING BUSHING

A. Contractor shall furnish and install an insulated parking bushing for each conductor in transformer primary section. In addition, four (4) spare parking bushings shall be furnished for the project.

B. Parking bushings shall be fully compatible with deadbreak elbows and provide isolation and "dead-end" to the deadbreak elbows.

2.5 INSULATED CAP

A. Contractor shall furnish and install insulated caps for each parking bushing provided this project.
B. Insulated cap shall match the same ratings as the insulated parking bushing.

PART 3 - EXECUTION

3.1 APPLICATION

A. Each Transformer shall be provided with deadbreak plug inserts for each primary phase.
B. Each Transformer shall be provided with deadbreak elbows for each primary conductor.
C. Each Transformer shall be provided with six (6) insulated parking brushings.
D. Provided twelve (12) spare insulated caps for project and transmit to User Agency.

3.2 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

END OF SECTION
SECTION 16320 – 15KV SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

A. This specification describes the requirements for an indoor/outdoor lineup of 15KV switchgear at the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 RELATED WORK

A. Section 16010: General Provisions – Electrical
B. Section 16100: Basic Materials and Methods

1.3 STANDARDS AND CODES

U.L. Underwriters Laboratories, Inc.
N.F.P.A. National Fire Protection Association
N.E.C National Electric Code
N.E.M.A. National Electrical Manufacturer’s Association
I.E.E.E Institute of Electrical and Electronic Engineers
A.N.S.I. American National Standards Institute
O.S.H.A. Occupational Safety and Health Act

A. It shall be the Vendor’s and/or Manufacturer’s responsibility to be, or become knowledgeable of the requirements of these standards and codes. Any alterations or changes to the equipment to make it meet standards and code requirements shall be at the expense of the Vendor and/or Manufacturer.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.
B. Submit Operation and Maintenance data under provisions of Section 16010.

1.5 WORKMANSHIP AND MATERIALS

A. Materials and equipment shall be standard products of established manufacturers who have produced continuously the type of equipment specified.
B. All material and equipment shall be new.

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Manufacturer shall furnish instruction book on installation, operating and maintenance instructions no later than date of shipment of the equipment. Six (6) copies of this book shall be provided.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The metal-clad switchgear shall consist of a stationary housing and a draw out vacuum circuit breaker equipped with stored energy operating mechanism and primary and secondary disconnect devices assembled on a frame to form a self-contained and self-supporting mobile unit. The switchgear shall be suitable for service up to 15,000 volts and shall receive dielectric tests in accordance with ASA and NEMA standards. The switchgear shall be designed, manufactured and tested in accordance with the latest standards of IEEE and the NEMA. The metal-clad switchgear shall be as manufactured by S&C 15KV Series, Powercon 15KV Series or prior approved equal.

B. Provide metal-enclosed switchgear made of freestanding sections, factory engineered and coordinated to form a complete unit in a NEMA 3R outdoor enclosure.

C. Unit-type construction shall be used in the formation of the housing to provide a rigid self-supporting and self-contained enclosure for each switch unit (fused or non-fused).

D. Each stationary structure shall be built of at least 1/8-inch thick, formed, selected sheets of quality cold rolled steel and structural members, electrically welded and shall have a hinged steel panel suitable for mounting of instruments, meters and control devices.

E. Each compartment shall have a separate cover for individual servicing without exposing circuits in adjacent compartments. A protective shutter shall automatically close the opening to the insulators for the primary disconnecting devices when the circuit breaker unit reaches the “Disconnect” position. The shutter shall be a simple, one-piece unit closed and raised automatically upon insertion of the circuit breaker.

F. The cable compartment in the rear of each housing shall be provided with wiring sleeves or supports for the cables. Compartments shall be arranged for the cables to enter from below the housings.

G. Terminal blocks shall be conveniently located for external connections.

H. The stationary structure and circuit breaker units shall be constructed so that each unit is interchangeable with every other unit of similar rating.

I. The switch unit, buses, instrument transformers, and outgoing cables shall be isolated within separate compartments formed by sheet steel barriers.

J. Porcelain or cycloaliphatic epoxy bus supports shall completely cover the bus openings to provide a noncombustible firewall between units.

K. Provide full-length bulkhead type doors with 3 point latching corrosion-resistant hardware.

L. Mount a prominent nameplate bearing equipment rating, manufacturer identification, and reference serial numbers on the front of the equipment.

M. Provide stainless steel nameplate on front door of each switch, engraved as specified.
N. Provide porcelain or cycloaliphatic epoxy supported busing with porcelain or cycloaliphatic epoxy sleeves where buses pass through barriers.

O. Provide an electric space heater in each bay with all heaters being controlled by a single thermostat and deriving power from a remote 120 volt AC source. Provide space heaters rated for 240V AC, to operate on 120V AC. Wire each heater to a clearly marked terminal block for connection to 120V AC power. Provide a manual disconnect near the terminal block to allow operators to disconnect power from heaters (500 watts required for each bay).

P. Provide large gasketed glass viewing panel and light switch for each switch cubicle.

Q. Provide 600A copper bus bars, insulated and taped, with silver or tin plated connections. Provide bare copper ground bus full length of switchgear. Brace busing for short circuit current ratings consistent with switch ratings.

R. Provide full height internal protective screen door, bolt closed to guard against inadvertent entry to bays containing high voltage component.

S. Surface preparation and finish shall be Manufacturers Standard. Finish shall be suitable for moderate corrosive environment. The steel work shall be bonderized as a unit after all welding is completed and painted with a rust-resisting primer coat, followed by a light gray interior coat and a dark gray weather-resistant external finish coat.

T. A ground bus shall extend and be bolted through the stationary structure. It shall have a momentary rating at least equal to the highest momentary rating of any switch in the structure assembly. Each stationary unit shall be grounded directly to the ground bus. The frame of each switch unit shall be grounded. A cable clamp shall be provided at a convenient location for making station ground connection.

U. Cleats shall be mounted on support members for securing outgoing cables.

V. All joints for buses, interconnections, and disconnecting devices shall have silver-to-silver high pressure contacts. Insulated bus supports shall be designed and tested to withstand the mechanical stress produced by fault currents of 40,000 amperes or more, as required.

W. The switchgear described herein shall be completely assembled and wired at the factory. Rigid inspections before and after assembly shall be made to assure correctness of design and workmanship. All groups of wires leaving the shipped-assembled equipment shall be provided with terminal blocks and suitable numbering strips.

X. Switchgear shall be provided with four lifting plates, having crane hook holes, attached to the bottom channel base.

Y. The switchgear shall be shipped assembled to facilitate handling and thereby reduce the time and expense of installation. It shall be shipped in sections only when the complete equipment is too large for transportation facilities to accommodate. The purchaser will specify any limitations to the size of shipping sections.

2.2 CONSTRUCTION DETAILS

A. The switchgear assembly shall consist of metal-enclosed, self-supporting, freestanding vertical, dead-front steel structures with power busses, fused and/or non-fused load interrupter switch, necessary auxiliary control devices, instrument transformers, meters and switches for meters. The enclosure shall be suitable for outdoor installation.
B. Grounded steel barriers shall be provided between the adjacent vertical units, and between control compartments and power compartments. A separate steel barrier shall be provided in front of bus and switch to protect operating personnel.

C. A continuous copper ground bus shall extend throughout the length of each switchgear assembly. Each vertical unit shall be grounded to this bus. The end of each ground bus shall be provided with solderless #4/0 cable connectors.

D. The switchgear assembly shall be designed to permit the future addition of matching vertical units of the same voltage rating and manufacture at each end of the assembly.

E. The switchgear bus shall be copper and shall have a continuous rating of 600A. The bus, bus connection and supports shall be capable of withstanding all mechanical stresses and heat due to 500 MVA short circuit. Bus shall be plated at each joint and connection.

F. Control switches, indicating lights, meter and meter switches shall be mounted on the front of the switchgear panel and arranged in an approved, logical symmetrical manner.

G. Engraved plastic nameplates shall be provided identifying each meter, instrument switch, control switch, indicating light, potential transformer compartment, and fused and non-fused load-interrupter switch compartment. Equipment within the compartment shall be suitably identified.

2.3 BUSES AND CONNECTIONS

A. The buses shall be made of flat copper bar having round edges and shall be completely insulated with preformed Micarata tubes or equivalent, and pre-molded epoxy insulation boots to permit access for inspection.

B. The contact surface at each main bus joint and each tap joint shall be silver-plated and tightly bolted to insure maximum conductivity.

2.4 SWITCH SECTION

A. Provide 3pole, 2position (open/closed), 600 amp continuous current rated load break air interrupter type switches with front mounted operating handle, suitable for interrupting 600 amps for 100 operations without maintenance or replacement of parts. Include as part of the switch a stored energy spring mechanism which provides quick opening and closing of the switch independent of the handle operating speed. Switch rated as follows:
B. Provide operating handle of each switch with a latch or other device to prevent accidental movement of the switch. Provide means for padlocking each switch in each position. Mechanically interlock all doors with each load break switch to prevent entrance with the switch closed, but allow door to be opened only with bypass key when switch is open or closed.

C. Provide full height internal protective screen doors.

D. Provide space for terminating cable such that the distance between the terminating studs and the wall of the terminating chamber through which the cable enters shall be not less than one (1) inch per KV, phase to phase, plus twelve (12) inches.

E. Provide cable lugs, one per phase unless shown otherwise, compression type NEMA 2 hole, complete with bolting hardware for 1/C, #4/0 AWG, 15KV EPR cables, bottom entry.

F. Provide switch enclosure with cable entrance and exit at bottom.

G. Provide high voltage switch that is completely visible through a safety glass window and easily accessible through a door interlocked with the high voltage switch.

H. Provide four single full-length interphase barriers that isolate the three phases of the fuses from each other and from the enclosure.

I. Provide fuse compartment separated by a barrier from switch compartments.

J. Provide switch operating handle position in conjunction with prominent nameplates that clearly indicate whether the switch is open or closed.

K. Provide power fuses, sized as shown on the drawing.

2.5 BUS TIE SECTION

A. Provide a bus tie section equal in all respects to the Switch Section except provide an electrical motor system to recharge the stored energy spring mechanism of the bus tie section.

B. Bus Tie Section shall be complete with normally open and/or normally closed switch position contacts as required to interlock with the emergency generator paralleling system to provide operation as described in Specification Section 16200.

C. Electric operator voltage shall be supplied by and coordinated with the emergency generator paralleling system.
2.6 AUXILIARY REQUIREMENTS

A. Fuses shall be provided as required for metering circuits and shall be mounted on the inside of panel to provide easy access for maintenance and inspection.

B. Nameplates shall be provided for each compartment. Engraving to be specified later by the User Agency. Nameplates shall also be provided for meters and switches.

C. After assembly of the equipment and just before packing, the exterior surfaces of the switchgear shall be cleaned with a cleaning fluid.

D. Hardware (bolts, nuts and screws) shall receive a bright zinc plating and chromate dip treatment before assembly.

2.7 INSTRUMENT TRANSFORMERS

A. CURRENT TRANSFORMERS

1. Current transformers shall have 5-ampere secondary and primary rating as necessary. The thermal, mechanical and voltage rating of current transformers shall be equal to that of the assembled switchgear.

2. Accuracy shall be in accordance with ANSI standards for the metering application shown on the applicable one-line diagram.

3. Each current transformer shall have a short circuiting device.

B. POTENTIAL TRANSFORMERS

1. Potential transformers shall be mounted in a separate compartment with a hinged door.

2. The transformers shall be mounted in the incoming compartment section.

3. Transformers shall be protected with current limiting primary fuses, and shall be designed to withstand the basic impulse level of the switchgear.

4. Transformers shall have 120V secondary and standard ANSI accuracy.

5. Each potential transformer compartment shall have door mounted warning sign reading "Potential Transformer Compartment. WARNING! - Opening This Door Disconnects Potential Transformers". The sign shall be laminated plastic, white letters on a red background.

C. METERS

1. Meter (type and quantity) shall be as described and as shown on the single line diagram.

2. All meters shall have expanded scale and shall be mounted semi-flush at the front of the compartments.
a. Indicating instruments shall be of the long scale switchboard type, 250° movement, 1% accuracy, 4" square, with convex glass which limits reflection. Zero adjustment external to the case shall be provided. Resistors, reactors, and other accessories to make the instrument complete shall be provided.

b. Switches for meters shall be of the rotary operated type with positive means of maintaining contact position. The contacts shall be silver-to-silver and enclosed in easily removable covers.

c. Current transformers shall be mounted to provide easy access for inspection and maintenance. Current transformers shall have 5-ampere secondary winding, unless otherwise specified.

d. Each set of potential transformers, and its protective fuses shall be assembled in the incoming compartment, and so arranged that the unit can be readily disconnected from the operating position. In the disconnected position, potential transformers and fuses shall be completely disconnected from service and all exposed parts visibly grounded.

e. The primary and secondary of potential transformers shall be fused.

3. Each fused switch compartment shall be provided with an ammeter with ammeter switch. The incoming section shall be provided with a voltmeter with voltmeter switch and totalizing KWH meter.

D. CONTROL AND METER SWITCHES

1. Control switches shall be rotary, enclosed rear mounting type, with positive means for maintaining contact position and with readily removable protective covers over contacts and/or terminal blocks.

2. Voltmeter and ammeter switches shall be of the non-spring return type with knurled handles.

2.8 WIRING

A. All switchgear control wiring shall be Type SIS or TA stranded copper, Class B, single conductor, No. 14 AWG minimum. Wiring shall be complete for all control and metering circuits. All unused terminals and auxiliary contacts shall be brought to conveniently located terminal blocks. Terminal blocks shall be accessible from the front of the cubicle only. The terminal blocks shall have screw type connectors and dust covers.

2.9 TESTS

A. Switchgear assembly shall be given standard commercial factory test to assure operational performance, correctness of all control and meter circuits.

B. All meters shall be given operational tests to obtain satisfactory performance of the meters, wiring, and instrument transformers as a unit.

C. The Owner reserves the right of inspection in the manufacturer's shop during testing.
D. Manufacturer shall, if requested, provide the services of a field engineer to supervise any field tests and to make necessary adjustments or alterations required for operation of the equipment in accordance with this specification.

2.10 PAINTING

A. Surface preparation and finish shall be manufacturer's standard.

B. Manufacturer shall supply one gallon of matching paint for field touch-up after installation.

PART 3 - EXECUTION

3.1 PACKING AND SHIPPING

A. Manufacturer shall prepare all equipment covered by this Specification for shipment in such manner as to protect it from damage in transit, and shall be responsible for and make good at his own expense any and all damage to improper preparation.

B. All equipment not bolted to the structure and made a part thereof shall be packed in separate boxes. Removable units may be packed separately if too heavy for safe shipment when assembled within the stationary structure.

C. All boxes and crates shall be plainly marked with equipment numbers and purchaser's order number. Partial shipments shall not be accepted.

D. Each shipping section of switchgear assembly shall be provided with removable lifting angles and/or plates suitable for crane hooks or slings.

E. Meters shall be shipped, installed in the switchgear assembly and shall be blocked or braced to prevent damage during shipment.

F. Each shipping section or switchgear assembly shall be provided with proper identification.

3.2 SPARE PARTS LIST

A. Six (6) Spare Parts Lists shall be provided. This list shall include all parts or units, which are practical for the user to replace. It shall not be restricted to those parts which the vendor considers are parts subject to wear. The list shall include a description of the part, the ordering reference, the numbers of the part which are used in the equipment supplied and a recommended stock level.

B. Two spare power-fuse refill units shall be furnished for each size power fuse used. A fuse-handling tool as recommended by the fuse manufacturer shall be furnished.

- END OF SECTION -
SECTION 16350 – PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the precast concrete manholes for the electrical service for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 SECTION INCLUDES

A. Precast concrete manholes.
B. Acceptable precast manhole manufacturers shall be Brooks Products, Inc., Louisiana Concrete, Inc., or prior approved equal.

1.3 RELATED WORK

A. SECTION 16010: General Provisions. Electrical
B. SECTION 16100: Basic Materials and Methods

1.4 STANDARDS AND CODES

A. Meet the requirements and recommendations of applicable portions of standards listed below:
   A.S.T.M. American Society for Testing Materials
   N.E.C. National Electric Code (NFPA 70)

1.5 SUBMITTALS

A. Submit Shop drawings under provisions of Section 16010.
B. Submit Operational and Maintenance date under provision of Section 16010.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provision of Section 16010.
B. Store and protect products under provision of Section 16010.

1.7 QUALITY ASSURANCE

A. Precast concrete manholes shall be manufactured and tested in accordance with requirements as defined in the AASHTO and ASTM standards.
PART 2 - PRODUCTS

2.1 PRODUCTS

A. Precast concrete manholes shall consist of a two-piece (top and bottom section) system of reinforced concrete modules which field combine to yield an electrical manhole suitable for direct burial underground.

B. The top section of the manhole shall contain a 36" diameter traffic rated manhole cover with the wording "Electric" embossed on the top.

C. The bottom section shall provide a 4" deep, 9" diameter sump located at the center of the bottom section. Manhole signs is shown on drawings.

D. Manholes shall be complete with duct openings, suitable for 4" PVC conduit.

E. In addition, manhole shall be provided with pulling irons with pocket and closed bottom threaded inserts.

F. Manholes shall be designed with concrete compressive strength of 4000 PSI minimum at 28 days. The lateral load design of the manhole shall be based on AASHTO load factor design method, with a 30% impact factor used for traffic loads per AASHTO.

G. Structure shall be designed for HS 20-44 traffic wheel loads per AASHTO as last revised, and design shall assume the lateral soil pressure includes a 2_-0" live load surcharge per ASTM C857-92.

H. Reinforcing steel shall have a minimum yield strength of 60,000 PSI grade 60 and shall be in accordance with ASTM A-615. Structure shall be designed in accordance with ACI 318-89, and AASHTO fifteenth edition and ASTM C 857-92 where applicable.

2.2 IDENTIFICATION

A. Manholes shall be labeled to identify the top and bottom sections and also to identify the different sizes and/or configurations.

PART 3 - EXECUTION

3.1 APPLICATION

A. Manholes shall be installed per manufacturer’s recommendations.

B. Manholes shall be installed parallel or perpendicular to buildings or roadways.

3.2 PREPARATION FOR SHIPMENT

A. Preparation for shipment shall be in accordance with the manufacturer's standards. Manufacturer shall be solely responsible for the adequacy of the preparation for shipment provisions employed, with respect to materials and their application, to insure that the precast concrete manhole reaches its designation in excellent condition when handled by commercial systems.

- END OF SECTION -
SECTION 16401 - OVERHEAD ELECTRIC SERVICE

PART 1 - GENERAL

1.1 SCOPE
A. The scope of this project shall include the furnishing of all labor, materials, tools and appurtenances to install overhead electric service as indicated on the Contract Drawings at the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 GUARANTEE
A. The Contractor shall guarantee that he shall keep the work as installed by him in repair and perfect working order for one year from date of completion and acceptance of final certificate of payment; said guarantee to be based upon defective materials and workmanship.

1.3 WORKMANSHIP
A. All work called for in these Plans and Specifications shall be executed in a thorough, substantial and workmanlike manner, and shall be executed by competent workmen. The applicable rules of the latest edition of the National Bureau of Standards Handbook H43 shall apply as a minimum standard for work performed under this Contract.

1.4 MANUFACTURERS OR TRADE NAMES
A. Wherever manufacturers or trade names appear in these Specifications, the words "and equal" or "approved equal" or similar words shall be assumed to follow such manufacturers or trade names, whether they actually do appear there or not. It is the intention to set a definite standard as to the class of material. However, substitutions shall not be made without the written approval of the Designer.

1.5 EXCAVATING
A. Wherever excavations are to be made as per Plan designations, the Contractor shall make all necessary excavations and do all backfilling for the proper execution of this work. Backfill shall be well tamped and shall be free of debris.

1.6 LAWS, PERMITS AND INSPECTIONS
A. This Contractor shall comply with all State building and safety laws, ordinances and regulations relating to building and public health and safety laws, ordinances, and regulations relating to building and public health and safety.

B. A final inspection certificate from the inspection authorities shall be furnished to the Designer as appropriate.

C. Applicable rules of the latest edition of the National Electrical Code and the National Electrical Safety Code shall apply as minimum standards for work performed under this Subcontract.

1.7 PROTECTION OF APPARATUS
A. At all times, this Contractor shall take precautions necessary to properly protect his apparatus from damage.
B. Failure on the part of this Contractor to comply with the above to the Designer's satisfaction will be sufficient cause for the rejection of the particular piece of apparatus in question.

PART 2 - PRODUCTS

2.1 POLE LINE SPECIFICATIONS FOR MATERIALS THIS PROJECT

A. Insulation levels shall be designed to a BIL level of 95KV.

B. Primary voltage is 13.8/7.62KV grounded Wye (Verify on Job).

2.2 INSULATORS:

A. Static, Pole Top - Rated 5KV

   Neck Type C or F
   Thread Dia. 1"
   Leakage 5"
   Dry Arc 3-3/8"
   Min. Pin Ht. 4"
   ANSI Cantilever Str. 2500#
   Low Freq. Dry Flash 50KV; Wet Flash 25KV
   Max. Radio Interference Voltage Microvolts
   @ 1 MHZ 50 MV, ANSI 55-2
   Victor Cat. No. 8R or Porcelain Products Cat. No. 253S

B. Line Pin Type - Rated 15KV

   Neck Type Thread Dia. 1"
   Leakage 9" Dry Arc 5"
   Min. Pin Ht. 5" ANSI Cantilever Str. 3000#
   Low Freq. Dry Flash 70KV; Wet Flash 40KV
   Max. Radio Interference Voltage Microvolts
   @ 1 MHZ 50 MV, ANSI 55-4
   Victor Cat. No. 6R or Porcelain Products Cat. No. 366S

C. Line Post Type - Rated 15KV

   Neck Type F Stud Size 5/8" x 1-3/4"
   ANSI Class 57-IS, Cantilever Str. 2000#
   Leakage 14" Dry Arc 6-1/2"
   60 Cycle Dry Flash 40KV; Wet Flash 23KV

D. Spool Type - White or Brown

   ANSI Transverse Strength 3000#
   Low Freq. Dry Flash 25KV; Wet Flash 12KV
   ANSI 53-2, Victor Cat. No. 2012 or Porcelain Products Cat. No. 5101

E. Large Guy Strain - Brown

   NEMA Class 54-4 Leakage Dist. 3"
   Ultimate Strength 20000# - Compression
60 Cycle Dry Flash  40KV; Wet Flash  23KV
Victor Cat. No. 556 or Porcelain Products Cat. No. 708

2.3 WIRE AND CONDUCTORS

A. Guy wire - High Strength Steel, Class A coating (extra galvanizing), preformed seven (7) strands and conforming to ASTM Spec. A475-78, ultimate strength 8000# - acceptable alternate shall be 7/16” EHS with ultimate strength of 14,500# with all other factors being equal.

B. Bare conductors - primary, static and neutrals
4. Triple AC conductors shall conform to ASTM Spec. B399-72, latest edition, alloy 6201-781, class AA.
5. ACAR conductors shall not be acceptable alternates.

2.4 HARDWARE

A. Pal nuts shall be installed to any nut end of a bolt used on the pole line structure. All bolt/nuts shall be pulled up to the point where wood starts to depress and the pal nut then pulled up hard.

B. Normal industry practices for wood pole construction shall apply.

C. All line materials shall be handled and installed in such a manner so as not to cause damage to the item or its protective coating.

2.5 POLES AND CROSSARMS

A. Poles shall be in accordance with Section 16403.

B. Crossarms shall be made of fir and shall conform to Section 16403.

2.6 ANCHORS, ANCHOR RODS & GUYING

A. Anchors shall be installed by the power drive method. They shall be torqued in accordance with manufacturer's recommendation.

B. Anchor rod extensions shall be added in 3'-6” or 7'-0” increments as necessary until the recommended torque is reached.

C. The Contractor shall be responsible to assure that anchors do not damage other underground facilities.
D. Guy offsets of more than three feet shall be approved by the Engineers before installation.

2.7 CONNECTORS AND CLAMPS

A. Clamp bolts shall be torqued to manufacturer’s recommended torque.

B. Connectors shall be compression type suited to the conductor(s) upon which they are used. They shall be installed using compression tool and die specified by manufacturer of each specific connector.

C. The Contractor shall furnish and install connectors and clamps for Basic Structure Types and shall be installed to meet the specific needs of this project.

2.8 FUSE AND FUSE ELEMENTS

A. Fuse elements shall be furnished and installed as shown on the drawings.

2.9 POLE GROUNDING

A. Poles shall be independently grounded (not butt wrapped) with a 3/4” dia. X 10’-0” copper-clad ground rod driven into undisturbed earth adjacent to the pole being grounded.

B. Drive each ground rod sufficiently deep so that its top is 6” to 8” below finished grade.

C. A #4 cu BSD ground wire shall be connected to the ground rod, stapled to the pole (one plastic wire molding shall be installed over the wire from the ground line) in a straight vertical line (quartered to the pole line). The stapling process shall be determined by the pole type.

2.10 LIGHTNING ARRESTORS

A. Lightning Arrestors shall be installed on the line side of each cutout and at other locations as shown on the drawings.

B. Outdoor lightning arrestors shall be wood crossarm mounted, heavy-duty distribution class, 10KV, porcelain body MOV technology without a series gap. Lightning arrestor shall be Cooper Power Systems Catalog Number AZL series or Ohio Brass Catalog Number DV 217109 series, both with the appropriate brackets and hardware for crossarm mounting.

2.11 STIRRUPS

A. Stirrups - Bolted clamp stirrups are specified for this project; however, compression type stirrups may be applied.

2.12 15KV OUTDOOR DISTRIBUTION FUSED SWITCH

A. Outdoor distribution open power fuses shall be wood crossarm mounted, 400 amp rated, with removable fuseholder and blade. Power fuse shall be porcelain insulated with silicone bronze basic construction and stainless steel utilized for pins and springs. Cutouts shall be provided with the appropriate brackets and hardware for crossarm mounting.
2.13 15KV CABLE TERMINATORS

A. Outdoor cable terminators shall be wood crossarm mounted, porcelain terminators compatible with the 15KV tape shielded copper cable this project. Cable terminators shall be 3M Catalog Number 5904 Series or G&W Catalog Number E71 Series.

2.14 15KV CABLE SUPPORT BUSHINGS

A. Cable support bushings shall be constructed of malleable iron with hot dipped galvanized finish.

B. Bushings shall be suitable for use on threaded rigid conduit and shall be provided with a fiber compound wedging plug suitable for the outside diameter of the 15KV cable provided this project. Cable support bushings shall be OZ/GEDNEY Catalog Number R-4001-1 Series or Red Seal Electric Co. Catalog Number VCCA-16 high voltage (15KV) Series.

2.15 PINTYPE INSULATORS

A. Pintype insulators shall be wood crossarm mounted, 13.2KV application voltage, porcelain thread construction, ANSI Class No. 55-4. Pintype insulators shall be Victor Insulator, Inc. Catalog Number 6R Series or Chance Catalog Number C905-1304 Series, both with the appropriate pins and hardware for crossarm mounting.

2.16 SUSPENSION INSULATORS

A. Suspension insulators shall be deadend type, porcelain insulators, with 10,000 lb. mechanical and electrical strength, ANSI Class No. 52-9. Suspension insulators shall be Victor Insulator, Inc. Catalog Number 817 Series or Chance Catalog Number C907-1009 Series, both with the appropriate suspension brackets and hardware for crossarm mounting.

PART 3 - EXECUTION

3.1 CONSTRUCTION AND CONSTRUCTION ACTIVITIES

A. Work on this project shall be done in a safe and workmanlike manner. Contractor shall have in full force an active safety program to help assure that no injuries occur to Public or Contractor personnel or properties.

B. At all times, the Contractor shall take precautions necessary to properly protect his apparatus from damage. Failure on the part of the Contractor to comply with the above to the Designer's satisfaction will be sufficient cause for rejection of the particular piece of apparatus in question.

C. Designer reserves the right to require that Contractor correct any work which does not meet the industry construction standards or, in the Designer's opinion, is not acceptable. All corrective work shall be at Contractor's expense.

D. All conductor tie wire points shall be made in accordance with detail drawings as shown.

E. No electrical connection shall be made until the connecting surfaces are thoroughly cleaned by mechanical means (wire brushed).

F. "Penta-trox" or equal compound shall be applied where not provided with the connector and where necessary. Pad type connectors, on conductors, shall be aluminum type.
3.2 CONDUCTOR INSTALLATION

A. All bare conductors shall be tight line pulled-in over pulling blocks (running blocks) which are perfectly smooth, cushioned, free running and with their (pulling block) axles perpendicular to the direction of conductor travel. Conductors shall ride smoothly in the roller of the pulling block and shall suffer no nicks, scratching, burring, chafing or bird caging during handling, hauling or installing.

B. Any section of conductor which is damaged shall be replaced at contractor's expense.

C. Full Tension Splicing shall be kept to a minimum. When necessary, full tension compression splicing sleeves manufactured for the specific conductor to be spliced shall be used. Compression shall conform to manufacturer recommended method, tool and die(s). All full tension splices shall be capable of developing at least 95% of rated breaking strength of the wire on which installed.

D. Conductors of different sizes shall not be tension spliced.

E. All compression type connectors shall be purchased prefilled with inhibitor and capped at each end (or sealed in a plastic bag).

F. Bends in conductors shall be smooth and of sufficiently large radius to prevent any hint of bird caging. [NOTE: Any bend which results in a bird cage shall be cut out and the conductor section replaced at contractor expense.]

G. Jumpers and down leads shall be straight and smooth. Coiling or excessive bending of leads shall not be permitted.

3.3 CONDUCTOR SAGGING

A. Sagging of conductors shall be such that maximum tension at 60°F does not exceed 1,160 pounds per square inch and shall be in accordance with manufacturer's recommendations. Conductors shall be pulled to tension while still in stringing blocks and allowed to settle overnight before clipping in.

B. Conductors shall be cradled in the top groove of the insulator (except on angle structures where they shall be cradled in the offside groove) and tied in accordance with drawings.

3.4 SERVICE TRANSFER

A. Work on this project shall be coordinated in such fashion that transfer of electrical power and service shall be made in a smooth and orderly manner. Interruptions to User Agency shall be kept to a minimum. Contractor shall be responsible to coordinate with the User Agency and the Designer before any service interruption. Any interruptions shall be scheduled in writing at least one week prior to shutdown with User Agency.

3.5 CLEAN-UP AND ACCEPTANCE

A. Acceptance of Contractor's work shall not be done until Designer is assured by inspection that all work is complete and the work area has been cleaned of any trash, debris or rubbish for which Contractor is responsible.

B. Final acceptance shall be in accordance with the general contract for project.

- END OF SECTION -
SECTION 16402 - UNDERGROUND ELECTRIC SERVICE

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the underground electric service for the Skilled Nursing Care/Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 TRANSFORMER & UNDERGROUND 15KV FEEDING LABELING

A. Contractor shall furnish and install labels as shown on the Drawings for each pad mounted transformer. Labels shall be 2” high block letters and numerals and shall consist of decals, adhesive backed, or painted letters and numerals, subject to the Designer's approval. Submit sample with submittal data.

B. Contractor shall furnish and install labels as shown on the Drawings for all underground 15KV cables in each transformer, pull box or manhole. Labels shall be permanent in nature and constructed of embossed stainless steel and fastened permanently to each phase of each cable. Label shall list other designations as required.

C. For 15KV power cable specification, see Section 16120.

1.3 SUBMITTALS

A. Submit shop drawings under provision of Section 16010.

B. Submit Operational and Maintenance data under Section 16010.

PART 2 - PRODUCTS

2.1 15KV SPLICE KIT

A. Contractor shall furnish and install underground splice kits for the 15KV conductors as shown on the Drawings.

B. Splice kits shall mate with existing underground splices with no extra adapters.

C. Splice kits shall be Scotch/3m Cat. No. 5720 Series or Plymouth Cat. No. 2681 series.

D. Contractor shall provide fireproofing tape for each conductor within each manhole. Fireproofing tape shall be installed as detailed on the drawings. Fireproofing tape shall be Scotch/3m Cat. No. 77 series fastened with Cat. No. 27 series glass cloth tape or Plymouth Cat. No. Plyarc 30 series fastened with Cat. No. Plyglass series glass cloth tape.

2.2 FAULT INDICATORS

A. Contractor shall furnish and install, on primary cable, fault indicators as shown on the Drawings.
B. Fault indicators shall be magnetically operated, remote indicating, requiring no electrical connections, and automatically resets, if tripped, when line current of three amps or greater is restored in the conductor. It shall be designed to be installed on shielded cable systems.

C. The indicator control circuits and the sensing transformer, core–and–coil, shall be epoxy potted. Indicator shall be supplied with a six foot lead and adjustable mounting strap to be field mounted by the Contractor. Contractor shall mount the remote indicator in the low voltage compartment of padmount transformer.

D. Fault indicator shall utilize three current transformers with leads connected to one indicator to monitor all three lines of a three phase circuit. The three current transformers shall be designed such that the primary cable does not need to be disconnected for installation of current transformers. The fault indicators shall be three phase trip and three phase current reset with inrush constraint protection.

E. Fault indicators shall be Cooper catalog number 8137917BXXM or RTE catalog number CRRL3-3P Series or prior approved equal, both with appropriate mounting kits to mount the indicator in the secondary compartment.

2.3 OUTDOOR 15KV CABLE TERMINATIONS

A. Contractor shall furnish and install outdoor porcelain terminators for 15KV cable at dip pole.

B. Terminators shall be crossarm mounted with appropriate brackets to match utility company crossarm.

C. Terminators shall be sized as required and acceptable manufacturers shall be 3M Brand “Quick-Term” 5800 Series or G&W Electric “Eliminator Terminators” or prior approved equal.

PART 3 - EXECUTION

3.1 ELECTRICAL CONNECTIONS

A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001 – 35,000 volt).

3.2 MANHOLE IN-LINE SPlicing

A. In line splices shall be per manufacturer instruction with the 15kv splice kit.

B. Each phase of the 15kv conductor spliced in the manhole shall be individually supported per details shown on the drawings.

C. Each phase of the 15kv conductors in each manhole shall be protected with fireproofing tape.

- END OF SECTION -
SECTION 16403 - WOOD POLES, TIMBERS AND CROSSARMS

PART 1 - GENERAL

1.1 SCOPE

A. These specifications describe the size and quality of timber products and the treating process for full-length pressure treatment required of wood materials used for wood structure electrical power lines at the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 GENERAL

A. The Contractor shall provide receipts of material provided which will specify the shipping instructions, species of wood, length-class or size, quantity, type and pounds per cubic foot of preservative treatment for each wood item required, for verification by Engineer.

B. The Contractor shall reference on the material receipts to a drawing number, which shall give the supplier and Engineer complete details of the trimming, roofing, gaining, drilling and marking required.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.

B. Submit Operations and Maintenance data under provisions of Section 16010.

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. Pole shall be provided by Colfax Creosote or E. C. Smith Co. or prior approved equal.

B. All material supplied under these specifications shall be Southern Yellow Pine conforming to the American National Standard Specifications and Dimensions for WOOD POLES, ANSI 05.1-1987, or latest revision, except as herein modified. The poles shall be cut from live timber, cut above the ground swell, well proportioned from top to butt, and free from imperfections, deformities or crookedness, except as hereinafter set forth.

C. Poles shall be furnished in latest ANSI Classes or dimensions.

D. Density shall be measured on the butt of the pole to comply with ANSI 05.1-1987 (5.14). The average rate of growth shall not be less than 6 rings per inch measured 6 feet from the butt;

1. In the outer 2 inches of poles having a circumference of 37.5 inches or less or

2. In the outer 3 inches of poles having a circumference greater than 37.5 inches.

3. Poles with 4 and 5 rings per inch are acceptable if 50% or more summerwood (the darker, harder portion of the annual ring) is present.

4. No cores are allowed in making the above measurements.
E. Any localized deviation from straightness in a five-foot section, or less, shall be considered for Short Crook, and the deviation from straightness shall not exceed two (2) inches.

F. A pole may have sweep subject to the following limitations:

1. Where sweep is in one plane in one direction only, a straight line connecting the center of the top with the center of the butt shall not at any intermediate point pass through the external surface of the pole.

2. Where sweep is in two planes, or in two directions in one plane, a straight line connecting the center of top with the center of the butt shall not deviate from the centerline of the pole by more than one fourth (1/4) the diameter of the pole at the point of widest deviation.

G. Scars shall be permitted as defined in ANSI provided that the depth of the trimmed scar is not more than one inch if the diameter of the pole is ten (10) inches or less, or one-tenth (1/10) the pole diameter at the location of the scar, if the diameter is more than ten (10) inches.

H. Splits or through checks in the top shall be prohibited. Splits or cracks throughout or within the length of the wooden item shall be prohibited.

I. No pole shall have more than one complete twist of grain in any twenty (20) feet of length.

J. Whenever there is any sign of decay in untreated timber, and in all cases where the condition of the timber is doubtful, it shall be rejected.

K. Air-Seasoned stock - At least 1” shall be clipped from the top and butt of each pole so that the inspector can examine the condition of the material.

2.2 MANUFACTURING REQUIREMENTS

A. The manufacture, storage and handling of material supplied under these specifications shall conform to the ANSI Specifications except as modified herein. The supplier shall be equipped to manufacture and handle in accordance with the latest recognized standards.

B. The supplier shall fulfill the requirements of these specifications and shall use the utmost care in the rossing (pole peeling), roofing, gaining, drilling, marking and loading with the view of producing the best product consistent herewith.

C. The supplier shall place the poles for customer’s order on two or more ground level skids, separated from other material so as to facilitate accurate framing and inspection.

D. The supplier shall eliminate all material he considers defective according to these specifications before starting framing.

E. Poles 45 foot and shorter shall be machine trimmed. Poles 50 foot and longer may be either machine trimmed or hand trimmed. Machine trimming shall be smooth with the depth of the cut kept to a practical minimum. The circumference at any point between knot whorl shall not be reduced more than one (1) inch. When hand-trimmed, knots and knot whoils shall approximate the finish obtained in machine trimming.

F. All poles shall be branded at the location indicated on the drawing with the OWNER'S initials at least one (1) inch high immediately above the pertinent information specified in Section 6.5 of the ANSI Standard.
G. Numerals showing the pounds per cubic foot specified shall follow specie and preservative code letters, i.e.: SPC 9, DFC 12, or they can be at the bottom of the brand, as 9# and 12#, respectively.

H. An aluminum tag shall be put on the butt of all poles showing class, length and type framing. For poles 45 feet and under, the tag shall also show month and year of treatment.

2.3 CONDITIONING AND TREATING

A. All poles shall be conditioned prior to treatment in strict accordance with AWPA Standard M1. When conditioning by steam or heating in preservative is necessary, it shall be in strict accordance with AWPA C1 and C4.

B. When necessary to preclude warping and misshaping during the processing of steam-conditioned or "heating in preservative" conditioned charges, the poles shall be loaded on cushioned trams.

C. Poles fifty (50) foot and longer to be steam or "heating in preservative" conditioned shall be loaded on three (3) or more trams, equally spaced.

D. The volume of poles shall be computed in accordance with the appropriate pole cubic foot table in AWPA Standard F3.

E. The Southern Pine poles shall be treated to a Final Net Retention of 9# per cubic foot (by Assay) using the Rueping Empty Cell process in accordance with AWPA Standards C1 and C4 and the specific requirements of this specification. The retention shall be determined in accordance with AWPA Standard A6, latest revision.

2.4 PRESERVATIVE

A. Unless otherwise specified, the preservative shall be creosote in strict accordance with AWPA Standard P-1, latest revision.

2.5 INSPECTION

A. The inspection may be performed by a qualified representative designated by the Purchaser, but the inspection by the Owner or his representative, shall not release the supplier of the responsibility of furnishing material in accordance with these specifications, nor denies the Owner the right to reject.

B. After complete manufacture in the white, each piece shall be turned so that the inspection can be performed in strict accordance with the material requirements of this specification.

C. Treatment shall be inspected in strict accordance with AWPA M-2 and modifications within these specifications.

D. All increment borer penetration test holes shall be plugged and neatly circled with aluminum keel.

E. The inspector shall advise of any continuing chronic treating plant situation wherein only minimum standards can be maintained with regard to any of the following: Quality of materials, manufacturing, handling, processing, preservative, or equipment and efficiency.
2.6 LOADING FOR RAIL SHIPMENT

A. Railroad shipments shall be loaded on flat cars only, with at least three 2” x 4” or wider cross strips placed between the car floor and the load. No more than 75 poles shall be loaded on a car. All metal or debris that might injure the bottom layer of poles shall be removed before loading begins. The loading shall meet the requirements outlined in the Association of American Railroads’ Revised Rules effective February 1, 1960, or latest supplement, governing the Loading of Forest Products on Open Top Carts, and in such a manner that the bottom half of the load shall be held intact while the top half is being unloaded.

2.7 UNLOADING

A. Poles received at destination by either rail or truck shall be unloaded without drop, or free-roll, using hoist and/or slack-off lines in conjunction with skids.

B. Inspection shall be made by the purchaser of the materials F.O.B. cars, or trucks, at delivery point to determine that the poles carry the inspector’s stamp of approval and to determine that no damage has occurred in transit.

PART 3 - EXECUTION

3.1 POLE SETTING

A. The minimum depth for setting poles shall be as follows:

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<tr>
<th>Length of Pole (feet)</th>
<th>Setting in Soil (feet)</th>
<th>Setting in All Solid Rock (feet)</th>
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<tbody>
<tr>
<td>20</td>
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<tr>
<td>65</td>
<td>8.5</td>
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B. On sloping ground, the depth of the hole shall always be measured from the low side of the hole.

C. Poles shall be set so that alternate crossarm gains face in opposite directions, except at terminals and deadends where the gains of the last two poles shall be on the side facing the terminal or deadend. On unusually long spans, the poles shall be set so that the crossarm comes on the side of the pole away from the long span. Where pole top pins are used, they shall be on the opposite side of the pole from the gain, with the flat side against the pole.

D. Poles shall be set in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain so that the conductors shall be in line.

E. Poles shall be raked against the conductor strain not less than one inch for each ten feet of pole length nor more than two inches for each ten feet of pole length after conductors are installed at the required tension.
F. When using high pole to clear obstacles such as buildings, foreign wire crossings, railroads, etc., there shall be no upstrain on pin-type insulators in grading the line each way to lower poles.

G. Pole backfill shall be thoroughly tamped the full depth. Excess dirt shall be banked around the pole.

- END OF SECTION -
SECTION 16450 - GROUNDING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. This work includes the grounding system for the following items for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1. Electrical
2. Telephone
3. MATV
4. Computer
5. Structure

1.2 STANDARDS

A. The grounding system installation shall comply with the National Electrical Code.

B. Where a referred standard is indicated, the applicable standard shall be made a part of the specifications which refers to it to the same extent as if written out in the specification in full.

C. Deviations from this standard shall only be permitted with the approval of the Designer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Buried main grounding cables or loops where shown shall clear footings by at least 2'-0" and shall be run 1'-6" minimum below finished grade, except under roads where ground cable or loops shall be buried at least 3'-6" below top of road.

B. Exposed bare ground cables shall follow, and be securely supported to, the building construction surface contours to avoid mechanical injury.

C. Ground rods shall clear footings by a minimum of 3'-0" with adjacent rods spaced a minimum of 6'-0" apart or as specified. Top of ground rods shall be 1'-0" minimum below finished grade.

D. Ground cable runs and ground rods shall be located as indicated on Drawings.

E. All service equipment such as motor frames, wire mesh enclosures, metallic fences, large steel structures, starter frames, conduit, metal instruments, control, lighting or power panels and/or cabinets, etc., shall be securely and effectively grounded whether shown on Drawings or not.

F. Grounding wire or cable runs shall be as short and as straight as possible between points of connection to equipment and to ground bus, cable or rods.
G. Where grounding wires or cables rise through earth and/or concrete floor to electrical equipment, columns, etc., the wires or cables shall be protected by the use of non-ferrous conduit, or PVC conduit, as shown on the Drawings.

H. Motors grounded by separate wiring to their controllers shall have grounding wire sized in accordance with the National Electrical Code.

I. Grounding wires for main service protective devices shall be sized in accordance with their ampere rating as shown in the National Electrical Code and shall be green insulated conductors. See Drawings for details.

J. Main service equipment, conduit work, motors, panelboards, and other electrical equipment shall be effectively and permanently grounded to the cold water mains as a supplement to ground rods, loop and building steel, or as required by NEC. Grounding connections and conductor sizes shall be in accordance with requirements of the National Electric Code Article 250.

K. Where the continuity of the metallic conduit system is interrupted by a run of nonmetallic conduit, a separate grounding conductor (sized in accordance with NEC Table 250-95) shall be run in the conduit with the circuit conductors. The grounding conductor shall be insulated copper; and shall be finished to show a green color. Provide a grounding conductor where indicated on Plans.

2.2 GROUND RESISTANCE

A. Ground Resistance shall in no case exceed the value specified under Grounding Tests.

B. In the event that test readings give higher resistance values than the maximum specified, the resistance shall be lowered by one, or both, of the following methods:

C. Sufficient additional ground rods shall be driven where required and interconnected by means of the specified bare stranded cable to existing grounds.

D. Chemical treatment of the soil with magnesium or copper sulfate (90# minimum quality) placed in a trench around the ground rod. Dimensions of the trench shall be approximately 1'-6" I.D. by 3'-6" O.D. and 1'-6" in depth measured from the top of ground rod.

E. Subsurface metallic water piping may be used as a supplementary ground provided such piping is electrically continuous and electrically conductive to earth and/or is connected to equipment in direct contact with earth such as a well casing, etc. Grounding to water piping alone will not be accepted.

2.3 GROUNDING TESTS

A. Each ground strap shall be tested for proper grounding by applying a Biddle Ground Tester or equivalent instrument and using auxiliary ground rods. The resistance reading on any strap shall not exceed 1.0 ohms.

B. On new installations all underground connections in the ground grid shall be given a visual inspection.

C. Equipment grounds shall show a resistance of 0.5 ohms or less to the ground grid or ground bus.
PART 3 - EXECUTION

3.1 CONNECTIONS

A. All grounding shall be thermal welded connections unless shown otherwise.

B. All grounding connections shall be made between clean bare metal surfaces free from paint, corrosion, grease, oil, insulation or similar nonconductive coatings and as follows:

C. Copper to copper - use wire brush. No flux.

D. Copper to galvanized steel - use wire brush. No flux, but replace zinc with galvanizing bar.

E. Copper to aluminum - use wire brush. Tin copper with 100 percent pure tin (not solder). Apply flux to aluminum.

3.2 WIRING SYSTEMS

A. Metal enclosures for wire and cable such as conduits, cable trays, and raceways shall be grounded at their supply ends.

B. Connections shall be made to the switchgear or control center ground busses when such equipment is used.

C. The electrical continuity of metal enclosures for wire and cable shall be assured between terminations.

3.3 EQUIPMENT

A. As used herein, the term "equipment" applies to all electrical distribution, control and utilization components and includes such items as transformers, panelboards, lighting fixtures, receptacles, switching devices, and motors.

B. Metal enclosures of fixed equipment operating at 600 volts or less between conductors and supplied from solidly grounded systems are considered grounded through their ground return path and do not require further grounding.

C. Metal enclosures of portable equipment shall be connected to a grounding conductor located within the same cable assembly as the line conductors supplying the equipment. Grounding conductor shall be the same size as the line conductor. The grounding conductor shall be connected to the receptacle enclosure through separate contacts in the supply plug and receptacle, and shall be bonded to the plug enclosure. Plug and receptacle shall be polarized and arranged so that the ground connection makes first and breaks last.

3.4 GROUND RETURN PATHS

A. For solidly grounded systems, a metal ground return path shall be provided for each circuit supplying fixed equipment.

B. The return path shall be connected to the equipment metal enclosure at one end and to the system or system neutral ground at the other end.

C. A separate, green insulated, equipment grounding conductor shall be provided in each conduit run.
SECTION 16510 - INTERIOR AND EXTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. This work includes indoor and outdoor lighting fixtures and related items for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 RELATED WORK

A. SECTION 16010: General Provisions Electrical
B. SECTION 16100: Basic Material and Methods

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.
B. Submit Operations and Maintenance data under provisions of Section 16010.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 16010.
B. Store and protect products under provisions of Section 16010.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Furnish and install lighting fixture equipment and accessories shown on the Plans and/or specified herein.
B. Furnish and install lamps in lighting fixtures furnished and/or installed under this Contract. Thirty two-watt T8 fluorescent fixtures shall have electronic ballast except where otherwise specified or noted on the Drawings.
C. Fluorescent lamps shall be cool white, unless otherwise noted and shall be of the energy saving types. All lamps shall be “non-hazardous green label” approved by EPA.
D. Mounting shall be as detailed or as required to maintain equipment manufacturers’ guarantees.
E. Lighting fixtures shall be furnished and install as scheduled. Fixtures shall be completely factory assembled and ready for installation. Fixtures stored on job shall be in dry place above floor in crates or cartons and shall be clean and rust free when installed. Refer to Plans for lighting fixture schedules and acceptable manufacturers.
F. Contractor shall furnish and install lamps in all fixtures. Lamps shall be of size and type as scheduled, or as indicated herein. Fluorescent lamps rapid-start, standard cool white, bipin.
G. Exit Light Fixtures: Furnish and install as scheduled and shown on Plans. Fixtures shall be completely factory assembled and ready for installation. Fixtures shall be as indicated on the Plans. Fixture shall contain two (2) LED sources individually circuited to be operated on voltage indicated. Contractor shall furnish and install lamps in all fixtures. Refer to Plans for additional information.

H. All wiring for fixtures shall be totally concealed, unless specifically called for otherwise. Notify Designer when this is in conflict.

2.2 BALLASTS

A. Ballasts for operation of F32T8 rapid start fluorescent lamps shall be as follows:
   1. Operate lamps in instant start mode.
   2. Operate multiple lamps as parallel circuit, operating remaining lamp(s) at full light output upon failure of other lamp(s) connected to the same ballast.
   3. Individual ballasts specifically designed and UL Listed are to operate one, two, three, or four lamps as scheduled on the drawings.
   4. Operate lamps at a frequency higher than 20 kHz.
   5. Operate at rated circuit voltage (120 or 277 VAC) at an input frequency of 60 Hz, and tolerate +/-10% sustained voltage variation without damage to the ballast, and maintain light output at +/- 10% voltage variation.
   6. Comply with EMI and RFI limits set by the FCC (CRF 47 Part 18) for non-consumer applications and not interfere with normal electrical equipment.
   7. Power Factor shall be not less than 0.95.
   8. Total Harmonic Distortion shall be not less than 20 %.
   9. Lamp Crest Factor shall be 1.7 or less.
   10. Ballast factor shall be greater than 0.85.
   11. Sound rating shall be “A”.
   12. Withstand transients shall be as specified by ANSI C. 62.41 for location category A.
   13. Shall comply with applicable ANSI standards.
   14. Shall be provided with a three- (3) year replacement warranty.

2.3 LAMPS

A. Install lamps in all fixtures installed under this Contract in accordance with the Drawings.

B. All lamps shall be in working order at the time of final acceptance of the work. Replace all defective lamps with new lamps until the work is finally accepted.

C. All high-pressure sodium lamps shall be clear.
D. For each incandescent lamp installed a 10 percent spare capacity shall be furnished by the Contractor to the User Agency.

E. For each fluorescent lamp installed a 5 percent spare capacity shall be furnished by the Contractor to the User Agency.

F. For each HID lamp installed a 5 percent spare capacity shall be furnished by the Contractor to the User Agency.

2.4 PHOTOELECTRIC CONTROL

A. Contractor shall furnish and install photoelectric outdoor lighting control where shown on the Drawings and as described further herein.

B. The photocell shall be designed to operate with a supply voltage of 105-135 volts AC.

C. Relay contacts shall be single-pole, single-throw rated as 120 amps inrush, and incandescent lamp load of 1200W and a fluorescent load of 1800 volt amperes.

D. Photocell shall contain an adjustable shutter to be field adjusted for light level available.

E. Housing of photocell shall be weatherproof clear polycarbonate.

F. Chassis shall be molded phenolic with 3 locking blades and removable neoprene gasket.


2.5 LIGHTING CONTACTORS

A. Contractor shall furnish and install lighting contactors, quantity as shown on Drawings.

B. Contactors shall have a NEMA 12 enclosure, electrically held contacts, and shall be designed to withstand the large initial inrush currents of tungsten lamp loads without contact welding.

C. Contactors shall be full rated as shown on Drawings and shall not require derating to provide current ratings.

D. Contactors shall have voltage and current ratings as shown on Drawings, and shall contain control fuses, 120V control transformer, door mounted pilot light, and hand-off-auto selector switch.

E. Lighting contactors shall be as manufactured by Westinghouse Type A202, Square D Type S and Cutler Hammer Type C30.

F. Provide remote “on-off” pushbutton stations as described in Section 16100.

2.6 LIGHTING FIXTURE SCHEDULE

A. See drawings for lighting fixture schedule.
PART 3 - EXECUTION

A. The Electrical Contractor shall support each lighting fixture directly as shown on the drawing.

B. Unless otherwise specified, lighting fixtures shall be permanently installed and connected to the wiring system.

- END OF SECTION -
SECTION 16720 - FIRE ALARM NETWORK AND MONITORING SYSTEM

PART 1 – GENERAL

1:01 SCOPE

A. This specification provides the requirements for the installation, programming and configuration of complete, coordinated, intelligent Fire Alarm Systems for each of several remote building sets this project, including the RF communication to an existing Central Monitoring System located at the Building Three Administration Building for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center. This specification also describes the modifications necessary to the existing conventional Fire Alarm System for Building Three (Alternate No. 2).

B. The fire alarm system shall include, but not be limited to:

1. Software programming and hardware additions to the existing Central Monitoring Station (CMS) located at the Building Three Administration Building.

2. Remote Fire Alarm Panel (RFAP) to provide intelligent fire alarm systems at each remote building set with the interconnection to the Fire Alarm Radio.

3. Remote Communication Devices (Fire Alarm Radio) to interface each Fire Alarm network with the CMS via RF Communications.

5. Conduit, wire and accessories required to furnish a complete and operational Fire Alarm and Monitoring System, which is U.L. listed as a Proprietary Supervising Station System.

6. All equipment provided this project shall meet the requirements of NFPA 72 as a U.L. Listed Proprietary Supervising Station System.

1:02 MANUFACTURERS

A. Acceptable System manufacturer for the Fire Alarm System shall be Edwards EST-2/RF750 or Notifier NFS3030/RF750, to match the existing Keltron RF750 monitoring system currently in place in the Building Three Administration Building.

B. Acceptable manufacturer for the Fire Alarm Panels shall be the Edwards EST-2 Series or Notifier NFS 3030 which are U.L. Listed as a compatible networked fire alarm system with the Keltron RF750 Data Tap transceiver.

C. At the Contractor’s option, fire alarm panels manufactured by Notifier NFS3030 Series or prior approved equal shall be utilized. If this option is chosen the Contractor shall insure all fire alarm system components shall be the same brand as the standalone fire alarm panel and shall be U.L. Listed with the standalone fire alarm system panel. The standalone fire alarm system panel shall be U.L. Listed with the existing Keltron monitoring system as a Proprietary Supervising Station System.

C. One manufacturer shall supply all duplicate equipment furnished under this section.

D. The contractor shall be licensed by the State of Louisiana to perform fire alarm system installations and repairs and have fully factory-trained and authorized technicians to perform repairs, supervision of system installation and make all final connections at control panels.
E. The contractor shall demonstrate to the owner or his representative that the system is operable and meets specifications.

F. A letter of certification shall be issued by the contractor attesting Fire Alarm system conforms to these specifications with the shop drawing submittals.

G. Contractor shall provide a submittal package including brochures, plans and review application to the designer for Fire Marshal review as described further herein. System installation shall not commence until Fire Marshal approval has been received.

1:03 RELATED SECTIONS

A. Section 16000 – Electrical

1:04 REFERENCES

A. The equipment and installation shall comply with the current provisions of the following standards:


2. National Fire Protection Association Standards:
   a. NFPA72 National Fire Alarm Code
   c. Local Authorities Having Jurisdiction.
   d. Underwriters Laboratories Inc.

B. The fire alarm and monitoring system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

1. UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems.
2. UL 1481 Power Supplies for Fire Protective Signaling Systems.
3. Americans with Disabilities Act (ADA)
4. International Standards Organization (ISO)
   a. ISO-9000
   b. ISO-9001

C. Where a referenced standard is indicated, the applicable standard shall be made a part of the specifications which refers to it to the same extent as if written out in the specification in full.

1:05 CODES AND STANDARDS

A. Underwriters’ Laboratories shall list all equipment.

B. Each major component shall bear the manufacturer's name and catalog number.

C. The complete system shall conform to all local and national codes and shall provide an RF type communication between the RCD and the CMS.

D. Entire system shall meet all requirements of NFPA 72, NEC Article 760 and UL 864, and shall be classified as a Proprietary Supervising Station System per NFPA 72, 5-3.

1:06 SYSTEM DESCRIPTION
A. The Fire Alarm Monitoring System supplied under this specification shall be an RF radio polling system.

B. All Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as compatible to ensure that a fully functioning Fire Alarm Monitoring System is designed and installed.

1:07 SUBMITTALS

1:07.1 Product Data

A. The contractor shall submit six (6) complete sets of documentation within 30 calendar days after award of Contract.

B. Documentation shall indicate the type, size, rating, style, catalog number, manufacturers’ names, photos, and/or catalog data sheets for all items proposed to meet these specifications.

C. The proposed equipment shall be subject to the approval of the Designer and no equipment shall be ordered or installed on the premises without that approval.

D. Proof of that training and authorization of the servicing Engineered System Distributor (ESD) shall be included in the submittal.

1:07.2 Shop Drawings

A. A complete set of Shop Drawings, one for each unit sub-assembly, which requires that a field wire be connected to it, shall be supplied. The Shop Drawings shall be reproduced electronically from a Master Copy supplied by the manufacturer in digital format.

B. Submittal data shall be forwarded to the Designer within 30 days of award of Contract. Six copies of all data shall be required, unless specified otherwise elsewhere in this Specification. Initial submittal contents shall include the following:

1. Schematic showing the Fire Alarm Panels, Fire Alarm Radio, Remote Annunciator, and Central Monitoring System location and all interconnection to remote fire alarm panels and existing monitoring system.

2. Technical specification data sheets of each system component and device along with current UL listing sheets with testing laboratory numbers.

3. Complete drawings tailored specifically to this project indicating all point to point wiring to each device in the entire system.

4. Descriptive data and sequence of operation of each system shall be included in a complete Operator's Manual tailored to the individual buildings of the system.

1:07.3 Fire Marshal Submittals

A. The Contractor shall be aware that work shall not commence on the fire alarm system until shop drawings have been found to be in compliance with applicable codes of the Office of the State Fire Marshal, specifically LRS 40:1651.
B. As a minimum, the submittal shall include the State Fire Marshall review letter and in accordance with the June 24, 1993 memorandum distributed by the State Fire Marshal to all state licensed fire alarm contractors, specifically the shop drawing submittal shall specify the “Type of System” to be utilized.

C. The Contractor shall note on shop drawing submittals the following information:

1. Locations of all remote network fire alarm panels (RFAP), interconnections to any RCD this project.
2. Location of the CMS equipment interconnected to the RCD’s this project.
3. All equipment this project shall have Testing Laboratory numbers submitted with the submittal.
4. Manufacturers name and model number shall be submitted for each piece of equipment installed in each building this project.

1:07.4 Close-out Submittals

A. Six (6) copies of the following bound Operation and Maintenance Manual shall be delivered to the User Agency representative at the time of project acceptance. The close out submittals as a minimum shall include:

1. Operating manuals covering the installed Fire Alarm Monitoring System.
2. All data specified in the “Submittals” section of this Specification in its final as-built approved form.
3. As-built interconnection wiring diagrams or wire lists, of the complete field installed system with complete, properly identified, ordering number of each system component and device.
4. Point to Point diagrams of each Fire Alarm System as installed. This shall include all connected RFAP’s, RCD’s, Remote Annunciators, and any addressable field modules. All drawings shall be provided in CAD and supplied in standard DWG format.
5. The application program listing for the system as installed at the time of acceptance by the User Agency and/or Local AHJ (Disk and Hard copy printout).
6. Name, address and telephone of the authorized factory representative.

B. All drawings shall reflect device address and programmed characteristics as verified in the presence of the Designer and/or the User Agency unless device addressing is electronically generated, and graphically printed.

1:08 QUALITY ASSURANCE

1:08.1 Qualifications

A. The installing ESD shall provide proof of their qualifications as Factory Authorized and Factory Trained for the products specified herein. These qualification credentials shall not be more than two years old, to ensure up-to-date product and application knowledge on the part of the installing ESD.
1:08.2 Warranty

A. For a period of three (3) years following final date of notice of final acceptance of the project, the Contractor shall, at no additional cost to the Owner, warrant the entire remote network Fire Alarm Panels and interface to the Central Monitoring System provided this project including all appurtenances provided this section. Warranty shall correct any defects arising out of design faults, defective materials, inherent mechanical and electrical defects, installation and/or defective workmanship.

B. This warranty shall include all devices and components provided this section. When warranty repairs can not be made within 48 hours of a service request, the Contractor shall make available to the Owner loaner equipment that shall provide comparable service to that intended in this specification.

C. The Warranty shall include all transportation, equipment, labor and expenses required to maintain certification of the system.

D. Maximum time for on-site response shall be eight (8) hours from notification that service is required.

E. Warranty shall include Inspection, Testing and Maintenance of the complete Fire Alarm System provided this project including the Central Monitoring System including all Fire Alarm Panels, Fire Alarm Radio, Remote Annunciators, and Central Monitoring System.


F. Damage due to misuse, abuse, negligence, or other causes outside the control of the Contractor are excluded from warranty.

G. A copy of the manufacturers’ warranty shall be provided with closeout documentation and included with the operation and installation manuals.

1:09 SYSTEM STARTUP, OWNERS’ INSTRUCTIONS, COMMISSIONING

A. A Factory Trained and Authorized ESD shall perform system startup. A contractor under the direction of the Factory Trained and Authorized ESD may perform certain functions of the Systems Startup Procedure.

B. The Factory Trained and Authorized ESD shall supply Operation and Maintenance Manuals, specific for this project, to the User Agency as defined under “Close-out Submittals”. A “Generic” or “Typical” Operation and Maintenance Manual shall not be acceptable to fulfill this requirement.

C. The Factory Trained and Authorized ESD, in the presence of the Designer, Local AHJ, the Using Agency’s Representative, and a Representative of the General Contractor, shall perform commissioning of the installed system.

1:10 MAINTENANCE

A. The Factory Trained and Authorized ESD, who designed and installed this system, shall provide as part of the warranty, maintenance on the system for a period of three (3) years from the date of project acceptance.

B. As a minimum, the maintenance shall provide periodic inspections as required by NFPA.
1:11 SERVICE FACILITIES

A. Contractor shall make available to the purchaser a local service department of a duly authorized distributor of the equipment manufacturer which is to stock the manufacturer's standard spare parts.

1:12 STANDARD PRODUCTS

A. The equipment furnished under this specification shall be the standard product of one manufacturer.

B. All items of equipment including wire and cable shall be designed by the Contractor to operate as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

C. Notwithstanding the equipment described herein, the Contractor shall supply the latest, most recent version of the equipment available as of the bid opening. All equipment furnished shall be new and unused.

1:13 EQUIPMENT COMPATIBILITY AND COMPLETENESS

A. The Contractor shall insure that the system shall be designed so that the combination of equipment actually employed does not produce any undesirable effects such as signal distortion, transients, RFI, EMI, etc.

B. All such equipment required for compatibility and completeness, whether or not specified, shall be furnished and installed.

C. The system shall also be tolerable of portable business band radios being operated in close proximity with no effects to any components of the system. All transceivers provided this project shall not interfere with any existing RF transceivers at this facility. In addition, the Network Fire Alarm and Monitoring System, provided this project, including all of its components, shall be tolerant of any existing RF transceivers.

1:14 OPERATOR INSTRUCTION

A. The Contractor shall conduct operator training on the Fire Alarm Central Monitoring System provided at a time to be established by the Using Agency. Training shall be performed with a minimum of 10 hours total on site, dedicated instructor time. An additional 8 hours of instructor time shall be devoted to training two User Agency employed certified fire alarm inspectors in troubleshooting and emergency repair.

1:15 SERVICE AND INSTRUCTION MANUALS

A. For each piece of equipment or accessory installed or repaired, the Contractor shall deliver to the Designer six (6) copies of installation and/or operating instructions together with parts list indicating the parts by name, number and diagram.

B. These manuals shall cover troubleshooting, calibration, adjustment with both block and schematic diagrams.

C. The operation instructions and parts lists, together with Shop Drawings, shall be neatly bound in a suitable hardback binder permanently identified on the spine with the caption "SERVICE MANUALS - FIRE ALARM SYSTEM".

D. Individual Fire Alarm Panels, Fire Alarm Radios, and Remote Annunciators fire alarm
systems shall be tabbed by building.

1.16 ACCEPTANCE PROCEDURE

A. Acceptance procedure applies to all items included under this section.

B. Upon successful completion of system, the Designer shall be requested, in writing, to inspect and approve the satisfactory operation of the system, and accessories.

C. The contractor shall certify that each individual RFAP, RCD, and Remote Annunciator provides an individual point alarm and common trouble indication at the CMS and all components have been verified for correct operation.

D. The designer will randomly inspect components for proper operation.

F. Contractor shall provide labor, materials, personnel, etc., as required for complete check out of system operation and each device therein.

G. The Contractor shall invite the Owner, User, Fire Marshal and Designer to the final acceptance tests.

PART 2 - PRODUCT

2:01 GENERAL

A. Equipment incorporated into the system shall be products designed and coordinated to function, one part with another, as a complete system for continuous operation without overheating or any other detrimental effect.

B. Each major component shall have manufacturer's name and identifying number attached thereon.

C. All products shall be UL-listed.

D. Provide handheld programmer compatible with the existing Keltron monitoring system.

2:02 INTENT OF NETWORK AND FIRE ALARM MONITORING SYSTEM

A. It is the intent of these specifications to provide the User Agency with complete, addressable Fire Alarm Systems in each of the remote buildings indicated and notification to the existing CMS in Building Three, Administration Building. In addition each remote Fire Alarm System this project shall provide individual addressable point notification to the existing Central Monitoring System that shall, upon receipt of an alarm, instantly indicate to the operator the name, address, type of alarm, identification number of the alarm, date and time of receipt of the alarm. Information shall be provided on the existing screen in such a manner to enable the dispatcher to read and immediately broadcast or retransmit information to a remote location without requiring numerical list of names. The existing Building Three system shall report general alarm and trouble only by zone per building to match existing system configuration.

B. As a minimum the existing Central Monitoring System shall provide an individual point alarm and trouble signals from each of the Fire Alarm Panel locations. Each alarm and trouble signal shall be annunciated on the CMS in Building Three, Administration. The existing Administration Building shall provide general alarm and trouble only.
C. As a minimum, the Central Monitoring System shall maintain a redundant duplicate type system to insure a UL listed Proprietary Supervising Station System. The existing system shall continue to operate as an on-line system and the other unit shall transfer to the backup unit manually in the event of the failure of the on-line unit.

D. Additional pages of information shall be available.

E. A hardcopy printout shall simultaneously be created on the existing printer, indicating in plain English the type of alarm, identification number, exact time and date of receipt of alarm.

2:03 GENERAL TERMS AND CONDITIONS

A. The equipment to be supplied shall comply with the limits set for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of the FCC Rules and Regulations which are designed to minimize radio frequency interference in residential installations.

B. Contractor shall make all allowances before bidding for all dimensions, ventilation requirements, input power requirements, wiring requirements as well as all other specifications required.

C. ESD shall be the qualified representative of the manufacturer of the equipment specified and shall have technical knowledge of the proposed equipment.

D. Equipment shall be warranted against defects in both materials and workmanship as defined in 1:08.2.

2:04 CENTRAL MONITORING SYSTEM (CMS/RCD) EQUIPMENT

A. GENERAL

1. The system and all peripherals shall continue to be U.L. listed as a NFPA 72, Proprietary Supervising Station system. Make all allowances before bidding to provide for any additional equipment to insure all peripherals (annunciators, printers, software modifications, etc.) are connected to operate whether the primary or backup unit is in control.

2. Additional equipment that need not be accessible to operating personnel shall be located remotely within the console or remote mounted frame rack.

B. SYSTEM DESCRIPTION

1. The system shall be Underwriter’s Laboratories listed or FM approved as a Proprietary Supervising Station System.

2. Spare components of this system shall include as a minimum:

   a. One Fire Alarm Radio.

C. Multiplex Radio Fire Alarm Transceivers

   It is the intent of this section of the specification to provide a bi-directional, polling radio transceiver to be placed in each remote location for the transmission of fire and related alarms to the receiving center via radio signals.
1. Radio Alarm Transceiver portion of the RCD shall be capable of transmitting alarms by point to the CMS.

2. Any repaired break in the data link communication system shall indicate this to the operator at the CMS and shall resume normal operation.

3. During the period any RCD that has been placed “out of service” at the main console, the CMS system shall continue data signals to reestablish valid communications with the RCD.

4. If the CMS establishes valid data communications long enough to verify an alarm, it shall be reported to the operator even though RCD is “out of service.”

5. On power up the CMS shall send a reset signal to all RCD so that all Transceivers will retransmit all existing Alarm and Trouble conditions.

6. The CMS shall continuously poll all RCD’s to check for any change of status. A status change when found shall be reported to the operator and the type of status change shall be displayed on console and logged on printer.

7. The RCD shall keep a RAM image of the alarm status of all points. It shall maintain this image until the CMS advises the RCD that the status change has been processed. (i.e. the operator has pressed the acknowledge button on the CMS).

D. The Contractor shall include the following as a minimum:

1. Prepare submittals for Fire Marshal review indicating all fire alarm system components required this project. Submittals shall include all requirements as defined in the “Submittal” section described previously.

2. Furnish and install all features required, including but not limited to, connection to the fire alarm system (RFAP) for interface to the CMS described further herein.

3. All fire alarm system wiring.

4. Provide the RCD’s at the locations shown on the drawings. Provide an emergency branch circuit to serve each RFAP and RCD panels as required.

E. RF TRANSMISSION SYSTEM

1. Communication system for the Fire Alarm Monitoring System shall be an RF type of transmission medium.

2. All RCD locations and the CMS shall operate on the same existing assigned radio frequency.

3. FCC licensing is required and the Contractor shall be responsible for coordinating with the User Agency and shall obtain the appropriate FCC licensing in the User Agency’s name.

4. The Contractor shall make all required allowances before bidding to provide the necessary documentation to obtain the FCC licensing for the User Agency.

5. RF transmission system shall use active collision avoidance protocols to insure each transmission is transmitted without collision with other RCD locations.
6. All RF transmissions shall be acknowledged by the receiver that the message was received and decoded correctly. Retries and error checking shall be provided to insure reliable data delivery.

7. RF transmission system shall be UL Listed to operate as a Proprietary Supervising Station System per NFPA with all other components of the Fire Alarm Monitoring System and the network Fire Alarm Panels.

8. Outdoor antenna shall be provided for the RF transmission system chosen. The db gain of the antenna shall be chosen based on the required performance of the RF transmission system. Outdoor antenna shall be securely mounted on the building eave and coax shall be routed in appropriately sized RGS conduit fastened to surface with malleable iron one hole clamps and clamp backs and stainless steel hardware. All wall penetrations shall be sealed watertight. Roofs shall not be penetrated.

9. All transceivers provided this project shall not interfere with any existing RF transceivers at this facility. In addition, the Network Fire Alarm and Monitoring System, provided this project, including all of its components, shall be tolerant of any existing RF transceivers.

2:05 REMOTE FIRE ALARM PANELS (RFAP)

A. GENERAL

1. The Remote Fire Alarm Panel (RFAP) shall be installed where shown on the drawings and shall receive the inputs from the individual alarm and trouble points. The existing conduit serving the initiating and notification circuits shall be allowed to be reused if in good condition as described in Specification Section 16060. The RFAP shall provide outputs to the RCD.

2. The RFAP shall provide a minimum of one (1) NFPA 72, Style 4 (Class B) analog signaling line circuits. The RFAP shall also be capable of providing one (1) additional future NFPA 72, Style 4 (Class B) analog signaling line circuits without the need to alter the enclosure. Each circuit shall communicate with and receive alarms from a minimum of two hundred fifty (250) points, consisting of a maximum of one hundred twenty five (125) intelligent analog alarm initiating and one hundred twenty five (125) intelligent controllable output input/output modules.

3. System power supplies, including necessary transformers rectifiers, regulators, filters and surge protection required for system operation, with the capacity to power the system in a worst case condition with all devices in alarm and all local indicating appliances active without exceeding the listed ratings. All system devices shall display normal and alarm conditions consistently whether operating from normal power or reserve (standby) power.

   a. System primary power: Primary power for the RFAP and the secondary power battery chargers shall be obtained from a dedicated branch power circuit. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm. Each circuit used for fire alarm purposes shall be permanently labeled for function.

   b. Secondary power supply: Provide sealed gelled electrolyte batteries as the secondary power supply for all fire alarm functions. The battery supply shall be calculated to operate loads in a supervisory mode for twenty four (24) hours for proprietary systems, with no primary power applied, and after that time,
operate in alarm mode for fifteen (15) minutes. Batteries shall be sized at 125% of the calculated size to compensate for deterioration and aging during the battery life cycle. Battery calculations shall be submitted to justify the battery size with shop drawing submittals.

4. Provide battery-charging circuitry for each standby battery bank in the system. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. All system battery charge rates and terminal voltages shall be read using the RFAP control panel LCD display in the service mode, indicating directly in volts and amps.

5. The system shall be provided with a minimum 16 bit core processor which shall incorporate an internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm reception, by system programming or by manual commands. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Digital communication capabilities required for the control panel to communicate with remote annunciators, input/output drivers and displays shall be provided as required.

6. Interface modules shall be intelligent and listed by Underwriters’ Laboratories, Inc. The unit shall incorporate a microprocessor based integrated circuit that provides communication with fire alarm panel. The interface module shall supervise and monitor normally open or normally closed dry contacts and report their status to the control panel. The intelligent interface module shall be used to uniquely identify field devices (contacts) such as water flow switches, tamper switches, OS&Y valves or as directed by these specifications and project drawings.

7. The intelligent interface module shall also be used when remote relays are required for system control functions, such as, but not limited to, exhaust fan activation, HVAC unit shut down, etc. Relay dry contacts shall be rated a minimum 2 AMP @ 24 VDC resistive or 0.5 AMP @ 120VAC resistive and shall be Form “C”. Where necessary Contractor shall provide a load relay as required rated a minimum 10A, 120VAC.

8. The RFAP addressable data communications circuits shall support one hundred percent (100%) of the addressable devices in alarm or operated at the same time, during both primary (AC) and secondary (battery) power conditions.

9. The RFAP shall provide NFPA 72, Style Y, two-wire (Class B), notification appliance circuits.

11. Software and firmware control:
   a. All software and firmware provided with each RFAP shall be listed for use with the control unit.
   b. A record of installed software and firmware version numbers shall be maintained at the location of the RFAP unit.
   c. All software and firmware shall be protected from unauthorized changes through the use of “access levels.”

B. SYSTEM ALARM OPERATION

1. Activation of any manual fire pull station, area smoke detector, heat detector, duct smoke detector, or alarm causing intelligent interface module shall result in, as a minimum, the following functions and indications:
   a. Activate “ALARM” notification to the RFAP.
   b. Activate “ALARM” notification to the CMS on site as shown on the drawings.
c. Activate emergency evacuation audible and visual through the fire alarm system.
d. Activate fire emergency HVAC operational shutdowns and exhaust fan activation through the fire alarm system.
e. Record all events at the system alarm printer via the CMS.
f. Close all magnetically held fire doors through the existing fire alarm system.
g. Record event in the non-volatile system historical log.

C. SYSTEM SUPERVISORY FUNCTIONS

1. Activation of any supervisory circuit, (i.e.; supervised fire sprinkler valve closure, fire suppression system air pressure abnormal, etc.) shall cause the following actions and indications:
   a. Activate “Supervisory Alarm” notification to the RFAP.
   b. Activate “Supervisory Alarm” notification to the CMS as shown on the drawings.
   c. Annunciate alarm notification on system remote alphanumeric annunciators.
   d. Record event in the non-volatile system historical log.
   e. Record all events at the system alarm printer via the CMS.

D. SYSTEM TROUBLE FUNCTIONS

1. Receipt of a system trouble alarm, shall cause the following actions and indications:
   a. Activate “Trouble Alarm” notification to the RFAP.
   b. Activate “Trouble Alarm” notification to the CMS.
   c. Record event in the non-volatile system historical log.
   d. Record all events at the system alarm printer via the CMS.

2. The RFAP panel shall initiate a system trouble condition when the following occurs:
   a. Primary 120/220 VAC power loss.
   b. Battery disconnect.
   c. Battery low voltage.
   d. RFAP, RCD or Remote Annunciator panel power loss.

3. Trouble conditions shall automatically activate an audible signal and flash the general system trouble LED indicator at the remote annunciator. Pressing the trouble acknowledge key on the annunciator shall silence the audible signal and continuously light the LED indicator, until the trouble condition is repaired. Subsequent trouble conditions shall re-sound the audible signal and again flash the LED. Each trouble condition shall be required to be individually acknowledged.

4. Removal of or failure of internal electronic circuitry of any addressable device shall initiate a system trouble condition.

2.06 SPARE PARTS

A. Contractor shall provide a two percent (2%) spare (one minimum) of each type of initiating device (pull station, smoke detector, duct smoke detector, heat detector, door hold open device and each type of audio/visual units). Percentage shall include all devices provided this project.
B. Provide programmer compatible with the existing CMS to the User. If alternate RF system is provided, furnish all tools and/or program utilities necessary to operate the complete system.

2.07 COMPONENTS

A. Intelligent Devices—General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.

2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.

B. Intelligent Detectors—General

1. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.

2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors which are not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds.

3. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.

4. The detector shall be capable of identifying up to a minimum of 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

5. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

6. Each detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient “Environmental Thresholds” approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminate as well as...
detector aging. The process shall employ digital compensation to adapt the
detector to both 24 hour long term and 4 hour short term environmental changes.
The microprocessor shall monitor the environmental compensation value and alert
the system operator when the detector approaches 80% and 100% of the allowable
environmental compensation value. Differential sensing algorithms shall maintain a
constant differential between selected detector sensitivity and the “learned” base
line sensitivity. The base line sensitivity information shall be updated and
permanently stored at the detector approximately once every hour.

7. The intelligent analog detectors shall be suitable for mounting on any detector
   mounting base.

8. Detectors located adjacent to high humidity areas (i.e. adjacent to showers, etc.)
   shall be tolerant of the application. Any detectors not tolerant of the application
   shall be replaced with FM approved rate of rise detector.

2.07.1 Multisensor Smoke Detector

1. Provide intelligent ionization-photoelectric-heat smoke detectors EST SIGA-4D
   Series or Notifier Acclimate Series. The analog detector shall utilize a ionization,
   photoelectric, thermal sensor to sense changes in air samples from its
   surroundings. The integral microprocessor shall dynamically examine values from
   the sensors and initiate an alarm based on the analysis of data. Systems using
   central intelligence for alarm decisions shall not be acceptable. The detector shall
   continually monitor any changes in sensitivity due to the environmental affects of
dirt, smoke, temperature, aging and humidity. The information shall be stored in
   the integral processor and transferred to the analog loop controller for retrieval using
   a laptop PC. The ion detector shall be rated for ceiling installation at a minimum of
   30 ft (9.1m) centers and be suitable for wall mount applications. The ion smoke
detector shall be rated for operation in constant air velocities from 0 to 500 ft/min.

2. The percent smoke obscuration per foot alarm set point shall be field selectable to
   any of five sensitivity settings ranging from 0.7% to 1.6%. The ion detector shall be
   suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F (0°C to 49°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Elevation: Up to 6,000 ft. (1828 m)

3. Standard Detector Mounting Bases

Provide standard detector mounting bases suitable for mounting on 3½” or 4”
octagon box. The base shall, contain no electronics, support all detector types
and have the following minimum requirements:

a. Removal of the respective detector shall not affect communications with other
detectors.
b. Terminal connections shall be made on the room side of the base.
c. Bases which must be removed to gain access to the terminals shall not be
   acceptable.
d. The base shall be capable of supporting one Remote Alarm LED Indicator.
e. Provide remote LED alarm indicators if duct smoke detector is located in
   remote location.

4. Relay Detector Mounting Bases

a. Provide relay detector mounting bases suitable for mounting on 3½ “ or 4”
octagon box. The relay base shall support all detector types and have the following minimum requirements:

1.) The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
2.) The position of the contact shall be supervised.
3.) The relay operation shall be exercised by the detector processor upon power up.
4.) The relay shall automatically de-energize when a detector is removed.
5.) The operation of the relay base shall be controlled by its respective detector processor. Detectors operating network mode shall operate the relay upon changing to alarm state. Relay bases not controlled by the detector microprocessor shall not be acceptable.
6.) Form “C” Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for “pilot duty”.
7.) Removal of the respective detector shall not affect communications with other detectors.
8.) Terminal connections shall be made on the room side of the base.
9.) Bases which must be removed to gain access to the terminals shall not be acceptable.

5. Detectors located adjacent to high humidity areas (i.e. adjacent to showers, etc.) shall be tolerant of the application. Any detectors not tolerant of the application shall be replaced with FM approved rate of rise detector.

2.07.2 INTELLIGENT MANUAL PULL STATION - GENERAL

A. It shall be possible to address each fire alarm pull station without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults.

B. The fire alarm pull station shall be suitable for operation in the following environment:

1) Temperature: 32°F to 120°F (0°C to 49°C)
2) Humidity: 0-93% RH, non-condensing

C. Provide intelligent single action, single stage fire alarm stations EST SIGA-270 or Notifier NBG-12LX. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” lettering. The manual station shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.

D. Each fire alarm station shall be provided with a protective plastic cover sized to protect the device from false activation, however not prevent activation of device. Lifting device shall sound a 24VDC Fire Alarm System powered, local alarm to alert personnel of attempted activation of fire alarm station.

2.07.3 NOTIFICATION APPLIANCES – GENERAL
A. All appliances shall be UL Listed for Fire Protective Service.

B. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessabilities Guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed.

C. All appliances provided for all shower areas shall be U.L. Listed for wet location service.

D. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers’ instructions.

E. Any appliances which do not meet the above requirements, and are submitted for use shall show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.

F. Self-Synchronized Strobes

1. Provide strobes manufactured by EST Gensis Series or Notifier Spectralert Series.

2. In - Out screw terminals shall be provided for wiring.

3. The strobes shall have a white plastic face plate.

4. They shall provide 15 cd, 30 cd, 75 cd, or 110 cd synchronized flash outputs.

5. Strobes shall mount in a North American 1-gang box. The strobe shall have lens markings oriented for wall or ceiling mounting.

6. Ceiling mounted strobes shall have lens markings with correctly oriented lettering.

7. Removal of an installed strobe to change the lens markings shall not be acceptable.

8. Provide weatherproof wall boxes for outdoor mounting.

F. TEMPORAL HORNS

1. Provide electronic horns manufactured by EST Genesis Series or Notifier Spectralert Series.

2. In - Out screw terminals shall be provided for wiring.

3. The horn shall have a white plastic housing.

4. Horns shall be provided with high dBA output rated a minimum 100dBA peak.

5. Selection of low or high output shall be reversible.

6. Horns shall be selectable for steady or temporal output.

7. Selection of steady or temporal output shall be reversible.
8. A synchronized temporal pattern sound output level of 100 dBA shall be provided.

9. Horns labeled weatherproof shall be U.L. listed for application and shall be placed where shown.

2.07.4 ANCILLARY DEVICES – GENERAL

A. Ancillary devices submitted for use shall have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

B. Multi-Voltage Remote Control Relays

1. Provide multi-voltage remote control relays manufactured by EST MR101/C or Notifier MR101/C.

2. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc.

3. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.

4. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac.

5. A red LED shall indicate the relay is energized.

6. A metal enclosure shall be provided.

C. Heavy Duty Power Relays

1. Provide heavy duty power relays manufactured by EST MR 199 Series or Notifier MR199 Series

2. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc.

3. Relay contact ratings shall be DPDT and rated for 30 amperes at 300 Vac or 2 HP motor load.

4. A single relay may be energized from a voltage source of 24 Vac or 115 Vac as required.

5. A metal enclosure shall be provided.

2.07.5 ELECTROMAGNETIC DOORHOLDERS – GENERAL

A. Electromagnetic doorholders submitted for use shall have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

B. Wall Mounted Electro Magnetic Doorholders
1. Provide wall mounted electromagnetic doorholders manufactured by EST 1504 AQ or Notifier FM Series.

2. Provide flush wall mounted electromagnetic doorholder/releases rated at 120 Vac.

3. Finish shall be brushed zinc.

C. Floor Mounted Electromagnetic Doorholders

1. Provide floor mounted electromagnetic doorholders manufactured by EST 1501 AQ or Notifier FM Series.

2. Provide floor (if required) mounted electromagnetic doorholder/releases rated at 120 Vac input.

3. Finish shall be brushed zinc.

2.07.6 GRAPHIC COMMAND WORKSTATION ANNUNCIATOR (CRT) – GENERAL

A. The command center shall function as the center point for all operation and administration functions required for the systems provided within the specifications for Building Five only. The command center shall be manufactured by EST Fireworks Series or Notifier Uninet 2000 Series. The command center shall contain a console that shall display and house any equipment necessary for system operation. Console space shall be provided under other sections of the specifications. A single graphical workstation shall be provided that shall enable primary control of the systems provided by this specification. An operator shall receive, view, process and record system events for system provided.

B. The graphical command workstations shall display a different color test for each message type and color graphic diagram/floor plan for Building Four. The graphical command workstation shall simultaneously display the following system event views; system event display, graphical diagram display, detailed event message/instructions, and user event log. The workstation shall be an IBM-compatible personal computer listed for UL Standards 864 (Control Units for Fire-Protective Signaling Systems) under categories UOJZ, APOU and UUKL. The workstation shall be capable of annunciation and control of all fire detection and smoke control points in Building Four.

C. The Computer shall be a minimum of a Pentium Grade Pentium Processor 2.4 Ghz with a 53 Mhz front side bus, 512 MB RAM, 80 GB Had Drive and an 18” LCD monitor. Installation of the computer or monitor shall be for desktop mounting.

D. The software shall provide multitasking type environment that allows the User to run several applications simultaneously. The operating program shall run within a 32-bit operating system such as Windows® XP. These Windows applications shall run simultaneously with other programs. The mouse or Alt-Tab keys shall be able to work in Microsoft Word, Excel and other Windows based software packages, while concurrently annunciating on-line alarms and monitoring functions.

E. Graphic Work Station display screen shall organize and structure system events for easy user comprehension. The workstation display shall use four (4) relational quadrants. When any event occurs: the “list of events area” shall display the address of the alarm or off-normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list area shall automatically cause the display of a graphical map and other three areas (described below) to display information relating to the highlighted event.
F. The “map area” shall display color graphical representation of the area location in which the alarm or off-normal device is located. It shall be possible for the operator to manually zoom down to any potion of a vector-based graphic without aliasing, artifacating or pixilation of the image. Preset zoom levels shall not be considered equal.

G. The “event action area” shall display a customized set of written operator instructions for every state (alarm, trouble, restore, etc.) of each point. An event log shall record all events and operator actions to history for future review. An operator’s log shall record operator’s comments for each event in system history with time and date.

H. The “image area” shall display a stored image of the device relating to the event highlighted in the event list area.

I. When processing fire alarm events the graphic workstation:
   1. Shall be capable of acknowledging, silencing and resetting all fire alarm functions.
   2. Shall be capable of manually activating, deactivating, enabling and disabling individual fire alarm points.
   3. Shall be capable of generating status, maintenance and sensitivity reports for fire alarm components.
   4. Receipt of a fire alarm shall activate an audio WAV file over the workstation speakers alerting the operator to a fire alarm.

PART 3 EXECUTION

3:01 GENERAL

A. The entire system shall be installed in a skillful manner in accordance with approved manufacturers’ manuals and wiring diagrams.

B. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation.

C. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.

D. All penetration of fire walls shall be fire stopped in accordance with all local fire codes.

E. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer.

F. All wiring shall be installed according to NEC standards per the drawings submitted by the authorized Engineered Systems Distributor (ESD), unless otherwise noted.

3:02 FIELD QUALITY CONTROL

A. The system shall be installed and fully tested under the supervision of trained manufacturer’s representative. The system shall be demonstrated to perform all the functions as specified.

3:03 ACCEPTABLE INSTALLERS

A. The Fire Alarm System specified herein shall be installed by a Factory Trained and Authorized Engineered Systems Distributor (ESD) or by a Louisiana licensed electrical contractor under the supervision of an authorized ESD.
B. Field Connected Devices and primary power shall be installed and wired by licensed contractors under the direct supervision of a Factory Trained and Authorized Engineered Systems Distributor.

3:04 EXAMINATION

A. Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm / Life Safety System and all associated components are to be installed shall be made.

B. Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3:05 DEMONSTRATION

A. Each of the intended operations of the installed Fire Alarm System shall be demonstrated to the User Agency Representative, Designer and the Local Authority Having Jurisdiction by the Installing ESD.

- END -
SECTION 16740 - TELEPHONE SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the telephone system requirements for the Skilled Nursing Care/Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 GENERAL

A. Telephone system is limited to provision of a system of empty conduits for future use by the User Agency.

B. User Agency will furnish and install under a separate contract the telephone system of conductors (trunk and interior) and the telephone system and instruments.

1.3 RELATED WORK

A. Section 16100: Basic Materials and Methods

B. Section 16450: Grounding Systems

PART 2 - PRODUCTS

2.1 TELEPHONE SYSTEM COMPONENTS

2.1.1 BACKBOARD

A. AC grade 3/4" plywood minimum 4' x 8' or sized as shown on Drawing.

B. Paint plywood with fire resistive paint, see Architectural.

2.1.2 JUNCTION BOX

A. Junction box shall be minimum 4-11/16" square for branch conduit.

B. Junction box shall be 24"W x 24"H x 12"D for trunk conduit.

C. All junction boxes shall have flat closed covers.

2.1.3 OUTLET BOX

A. Outlet box shall be 4-11/16" square with single gang, plaster ring extension.

B. Outlet box shall be provided with single gang, telephone outlet cover plate to match other outlet plates. See Specification section 16100 for description.

2.1.4 CONDUIT

A. PVC conduit shall be used for all telephone conduits concrete encased within the floor slab.

B. IMC conduit shall be used for all telephone conduits routed vertically within all walls.
C. RGS conduit shall be used for all exposed telephone conduits.

D. EMT conduit shall be used for all telephone conduits concealed behind an accessible ceiling.

E. RGS 90 degree factory bends shall be used for all telephone conduits.

2.1.5 GROUNDING

A. Provide each backboard with a grounding system as shown on the drawings.

B. Each backboard grounding system shall be interconnected to other building grounding systems to affect a common grounding point.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide necessary conduit and pull wires as shown on the drawings including conduit for trunk and/or for branch runs as required.

B. Provide a system of backboard, junction boxes, outlet boxes and empty conduit for a telephone system as shown on Drawings and specified herein to provide a complete telephone conduit system.

C. Provide a system of empty conduits for telephone system branch outlets.

1. Conduit runs shall not contain more than two 90-degree angle bends.

2. Bends shall be of standard radius for the size of the conduit.

3. No routing of branch conduit shall be continuous for more than 150 feet. For longer runs suitable junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each telephone conduit run.

D. Provide a system of empty conduits for telephone system trunk.

1. Conduit runs shall not contain more than two 90-degree angle bends.

2. Bends shall be long radius for the size of the conduit.

3. No routing of trunk conduit shall be continuous for more than 150 feet. For longer runs suitable concealed, accessible junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each telephone conduit run.

5. Trunk conduit shall be as shown and a minimum of 18 inches below grade and routed as shown on the drawings.

- END OF SECTION -
SECTION 16741 - COMPUTER NETWORK SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the computer network system requirements for the Skilled Nursing Care/ Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 GENERAL

A. Computer network system is limited to provision of a system of empty conduits for future use by the User Agency.

B. User Agency will furnish and install under a separate contract the computer network system of conductors (trunk and interior) and its related components.

1.3 RELATED WORK

A. Section 16100: Basic Materials and Methods

B. Section 16450: Grounding Systems

PART 2 - PRODUCTS

2.1 COMPUTER NETWORK SYSTEM COMPONENTS

2.1.1 BACKBOARD

A. AC grade 3/4" plywood minimum 4' x 8' or sized as shown on Drawing.

B. Paint plywood with fire resistive paint, see Architectural.

2.1.2 JUNCTION BOX

A. Junction box shall be minimum 4-11/16" square for branch conduit.

B. Junction box shall be 24"W x 24"H x 12"D for trunk conduit.

C. All junction boxes shall have flat closed covers.

2.1.3 OUTLET BOX

A. Outlet box shall be 4-11/16" square with single gang, plaster ring extension.

B. Outlet box shall be provided with single gang, blank outlet cover plate to match other outlet plates. See Specification section 16100 for description.

2.1.4 CONDUIT

A. PVC conduit shall be used for all computer network conduits concrete encased within the floor slab.
B. IMC conduit shall be used for all computer network conduits routed vertically within all walls.

C. RGS conduit shall be used for all exposed computer network conduits.

D. EMT conduit shall be used for all computer network conduits concealed behind an accessible ceiling.

E. RGS 90 degree factory bends shall be used for all computer network conduits.

2.1.5 GROUNDING

A. Provide each backboard with a grounding system as shown on the drawings.

B. Each backboard grounding system shall be interconnected to other building grounding systems to affect a common grounding point.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide necessary conduit and pull wires as shown on the drawings including conduit for trunk and/or for branch runs as required.

B. Provide a system of backboard, junction boxes, outlet boxes and empty conduit for a computer network system as shown on Drawings and specified herein to provide a complete computer network conduit system.

C. Provide a system of empty conduits for computer network system branch outlets.

1. Conduit runs shall contain no more than two 90-degree angle bends.

2. Bends shall be of standard radius for the size of the conduit.

3. No routing of branch conduit shall be continuous for more than 150 feet. For longer runs suitable junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each computer network conduit run.

D. Provide a system of empty conduits for computer network system trunk.

1. Conduit runs shall not contain more than two 90-degree angle bends.

2. Bends shall be long radius for the size of the conduit.

3. No routing of trunk conduit shall be continuous for more than 150 feet. For longer runs suitable concealed, accessible junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each computer network conduit run.

5. Trunk conduit shall be as shown and a minimum of 18 inches below grade and routed as shown on the drawings.

- END OF SECTION -
SECTION 16742 - MATV SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the MATV system requirements for the Skilled Nursing Care/Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

1.2 GENERAL

A. MATV system is limited to provision of a system of empty conduits for future use by the User Agency.

B. User Agency will furnish and install under a separate contract the MATV system of conductors (trunk and interior) and the MATV system and components.

1.3 RELATED WORK

A. Section 16100: Basic Materials and Methods

B. Section 16450: Grounding Systems

PART 2 - PRODUCTS

2.1 MATV SYSTEM COMPONENTS

2.1.1 BACKBOARD

A. AC grade 3/4" plywood minimum 4’ x 8’ or sized as shown on Drawing.

B. Paint plywood with fire resistive paint, see Architectural.

2.1.2 JUNCTION BOX

A. Junction box shall be minimum 4-11/16” square for branch conduit.

B. Junction box shall be 24”W x 24”H x 12”D for trunk conduit.

C. All junction boxes shall have flat closed covers.

2.1.3 OUTLET BOX

A. Outlet box shall be 4-11/16” square with single gang, plaster ring extension.

B. Outlet box shall be provided with single gang, MATV system outlet cover plate to match other outlet plates. See Specification section 16100 for description.

2.1.4 CONDUIT

A. PVC conduit shall be used for all MATV system conduits concrete encased within the floor slab.

B. IMC conduit shall be used for all MATV system conduits routed vertically within all walls.
C. RGS conduit shall be used for all exposed MATV system conduits.

D. EMT conduit shall be used for all MATV system conduits concealed behind an accessible ceiling.

E. RGS 90 degree factory bends shall be used for all MATV system conduits.

2.1.5 GROUNDING

A. Provide each backboard with a grounding system as shown on the drawings.

B. Each backboard grounding system shall be interconnected to other building grounding systems to affect a common grounding point.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide necessary conduit and pull wires as shown on the drawings including conduit for trunk and/or for branch runs as required.

B. Provide a system of backboard, junction boxes, outlet boxes and empty conduit for a MATV system as shown on Drawings and specified herein to provide a complete MATV system.

C. Provide a system of empty conduits for MATV system branch outlets.

1. Conduit runs shall contain no more than two 90-degree angle bends.

2. Bends shall be of standard radius for the size of the conduit.

3. No routing of branch conduit shall be continuous for more than 150 feet. For longer runs suitable junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each MATV system conduit run.

D. Provide a system of empty conduits for MATV system trunk.

1. Conduit runs shall not contain more than two 90-degree angle bends.

2. Bends shall be long radius for the size of the conduit.

3. No routing of trunk conduit shall be continuous for more than 150 feet. For longer runs suitable concealed, accessible junction boxes shall be provided.

4. One #12 THHN pull wire shall be provided in each MATV system conduit run.

5. Trunk conduit shall be as shown and a minimum of 18 inches below grade and routed as shown on the drawings.

- END OF SECTION -
SECTION 16920 - MOTOR CONTROL CENTER

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the Motor Control Center requirements at the Skilled Nursing Care / Mental Health / HIV-AIDS Unit & Renovation of Related Support Facilities for Elayn Hunt Correctional Center.

B. This Specification describes the Indoor Motor Control Center. It is not intended to state performance requirements that are adequately specified by applicable published standards.

C. Motor Control Center Data Sheets as shown on the Drawings are intended to cover specific Electrical requirements.

D. Acceptable manufacturers shall be Square D "Speed D", Allen Bradley "Centerline", General Electric "8000", Furnas Model 89, Siemens Type MARQ 21 or prior approved equal.

1.2 STANDARDS AND CODES

A. All electrical equipment shall be constructed, wired, and tested in accordance with all applicable section of the latest listed Standards and Codes as listed in section 16010.

B. It shall be the vendor's and/or manufacturer's responsibility to be, or become, knowledgeable of the requirements of these standards and codes. Any alterations or changes to the equipment to make it meet standards and code requirements shall be at the expense of the vendor.

C. Where a referenced standard is indicated, the applicable standard shall be made a part of the specifications which refers to it to the same extent as if written out in the specification in full.

1.3 SUBMITTALS

A. Submit Shop drawings under provision of Section 16010.

B. Manufacturer's Drawings

1. Seller shall furnish Drawings for approval in accordance with the following.

   a. Complete assembly Drawings showing elevation and typical section views.

   b. Foundation plan showing location of channel sills, foundation bolts and anchors.

   c. Complete wiring diagrams including terminal wiring designations.

   d. Floor plans.

   e. Structure Drawings which show available space for all Owner’s conduit connections. Schematic (elementary) control diagrams, both a-c and d-c breaker control, interlocks, relays and instruments. Vendor to coordinate control interlocking with mechanical control requirements.
f. Family of time current characteristic curves for all types and sizes of circuit breaker trip devices furnished in the switchgear.

g. Bill of Material schedule of all units, accessories and nameplates which includes a complete description, rating and location of equipment being furnished.

h. Outlined dimensional drawings and weight shall be furnished which show location and arrangements of external features.

i. Wiring diagrams shall be furnished showing all controls and alarms.

j. All revised drawings shall have identification of changes to previous issued.

k. The Owner reserves the right to reproduce any and all vendor drawings and prints necessary for construction and estimating purpose despite any notice to the contrary prohibiting the same.

C. Submit Operation and Maintenance data under provision of Section 16010.

1. Seller shall furnish instruction book on installation, operating and maintenance instructions no later than date of shipment of the equipment.

2. Instruction book shall include all drawings and literature on all instruments and devices furnished with the equipment. Four (4) sets of Instruction Books shall be furnished.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN

A. Each control center shall be totally enclosed, NEMA 1A, dead front, freestanding type designed for front access only with adequate space for maintenance.

B. Each motor control center shall consist of a number of vertical sections bolted or joined together.

C. Vertical sections shall be approximately 90 inches high, 20 inches wide and 20 inches deep with a maximum of six unit compartments per section.

D. Compartment locations shall be numbered from left to right when facing the gear and lettered from top to bottom. This identification shall be used by the manufacturer in preparation of Drawings in itemizing equipment and accessories required by data sheets.

E. Individual starter units shall be isolated and baffled from all other components including adjoining starter units and adjacent buses and cable troughs.

F. Compartment doors shall be rigid and shall be mounted on the vertical section with support independent of the removable unit. Air circuit breakers or disconnect switches shall be manually operated by handle located on the outside of unit door. Handle shall clearly indicate whether breaker or switch is open, closed, or tripped. Handle shall also have a padlock lockout mechanism to prevent unauthorized closing of the breaker device while work is being performed on that unit.
G. The compartment door shall be interlocked so it cannot be opened while the breaker or switch is in the closed position, but it shall be possible to close the door whether the breaker or switch is in the open and closed position. An attempt at opening the door of a compartment containing a closed breaker shall not cause tripping of the breaker or opening the switch. Provide a defeater mechanism which will allow authorized personnel to open the compartment door with the breaker or switch in the closed position.

H. A vertical wiring trough shall be provided in each section for power and control wiring. The wiring trough shall be isolated from the bus and shall have a cross section of at least 28 sq. inches.

I. A continuous horizontal wiring trough shall be provided the full length of the section at both top and bottom.

J. Structures shall be arranged so that additional sections may be readily added.

K. Steel channel sills full length of shipping section shall be provided to facilitate installation without special floor steel or inserts other than anchors for foundation bolts.

2.2 BUS

A. A main horizontal bus located at the top of the control center shall be provided with insulating supports in each structure. It shall be braced to withstand RMS symmetrical short circuit and continuous current rating as specified in the data sheets.

B. Each section shall be complete with a 300-ampere vertical bus to feed present and future units. This vertical bus shall be isolated from incoming power and control cables by means of a suitable barrier. Other equipment shall not be located in the bus enclosure.

C. Each motor control center shall have a ground bus in the bottom of the structure of minimum capacity at least equivalent to 1/4-inch by 1-inch copper bar extending the entire length of the structure and shall have clamp type terminals at each end for 2/0 AWG to 250 MCM copper grounding cable. The ground bus shall be bonded to the metal enclosure of each vertical structure.

D. All bus shall be tin-plated copper.

2.3 WIRING

A. Wiring shall be Class I Type B.

B. All current carrying components shall be copper.

C. Terminal blocks shall be readily accessible from the front. Terminal blocks for copper cables shall have a minimum of 14 points.

D. All internal control wiring shall be made with stranded tinned copper switchboard wire of size at least as large as No. 14 AWG with 80°C rate insulation which will not support combustion. All wiring shall have compression type lugs.

E. Power wiring connections between units shall be provided for special elements mounted in the assembly, such as between lighting panels and lighting transformers and also between common control transformers, where requested, and the corresponding starter units.

F. Solderless crimp type cable lugs shall be provided for all Owner's incoming main supply and motor loads.
2.4 \textbf{PLUG-IN DEVICES}

A. Standardized plug-in circuit breakers or combination circuit breaker motor starter units shall be designed in multiples of fixed dimension. Each unit shall have silvered, pressure type, free-floating line disconnecting stabs, or a proven positive equivalent method of providing consistent alignment and satisfactory contact.

B. NEMA Size 4 and smaller units shall be draw-out type with provision for latching in the disconnected position. The foregoing also applies to fused switch units up to a maximum practical size.

C. NEMA Size 5 and larger units need not be plug-in with latching provision, but shall be designed for front access only and for removal without de-energizing the main bus.

D. All associated equipment such as control transformers, auxiliary relays, etc., shall be located in the respective unit and shall not extend into the bus compartment nor into wiring troughs.

2.5 \textbf{CIRCUIT BREAKERS}

A. Each molded case circuit breaker shall act as a circuit protective device for the circuit controlled. The breaker shall afford overcurrent protection to the cable, and where used in combination with a motor starter the breaker shall afford short circuit protection for the starter.

B. Circuit breakers shall be rated not less than 42,000 rms symmetrical interrupting amperes and ampere frame size as shown on the Drawings. They shall be manually operated, trip free, and shall be complete with thermal-magnetic non-interchangeable trip elements calibrated at no less than 40 degrees C in open air. All circuit breakers furnished in outdoor units shall be ambient compensated to 50 degrees C.

2.6 \textbf{STARTERS}

A. Starters shall be full voltage, non-reversing combination circuit breaker type.

B. Ambient compensated thermal overcurrent devices shall be manually reset type and shall be furnished on basis of motor full load current, assuming motor and starter are subject to the same ambient temperature conditions. All thermal overcurrent devices shall be furnished with the control centers, installed ready for operation. Three overload devices are to be furnished with each starter.

C. All control circuits shall be fused and the fuses shall be furnished with the control centers. Miniature control circuit fuses shall be furnished for all motor starters similar to Bussman Type BBS5 amp or equal.

D. For outdoor units or units not in environmentally conditioned space, ambient compensated thermal magnetic devices shall be furnished.

E. Each starter shall be furnished with one auxiliary contact rated 10 amperes at 600 volts. These shall be in excess of starter requirements for cross electrical interlocking and holding circuits. Each contact shall be readily converted to an open or closed contact.

2.7 \textbf{CONTROL TRANSFORMERS}

A. Each 480-Volt starter shall be provided with 120-volt control power transformer with fuses in each primary leg, one fused secondary leg and the other side grounded.
2.8 PILOT DEVICES
   A. When required, pushbuttons or control switches will be specified and defined in detail in the data sheets.
   B. “Run” indicating lights shall be provided for each motor starter. Indicating lights shall be full voltage type for 110/125 volts AC/DC operating voltage.

2.9 ELECTRICAL CONNECTIONS
   A. The Contractor shall insure the temperature rating associated with the ampacity of a conductor shall be so selected and coordinated as to not exceed the lowest temperature rating of any connected termination, conductor or device as further described in NEC Article 110-14, C (2000 volt and below) and 110-40 (2001-35,000 volt).

2.10 NOMENCLATURE
   A. All compartments designated SPARE shall be furnished with complete units completely wired except nameplate shall be left blank.
   B. All compartments designated FUTURE shall be readily convertible to starter positions simply by the addition of plug-in starters, doors and associated hardware. No nameplates shall be provided.

2.11 NAMEPLATES
   A. A nameplate shall be provided for each compartment. Each nameplate shall be made of laminated plastic 1/8-inch thick, 1-inch high and 3 inches wide. The plate shall be black with 3/16 inch engraved white lettering.
   B. All four front edges shall have 1/16-inch bevel. Each nameplate shall be fastened to the compartment door with 2 stainless steel self-tapping screws. Nameplate inscriptions will be detailed in the data sheets.

2.12 PAINTING
   A. After fabrication, all metal work shall be thoroughly cleaned and a bonderizing or equivalent treatment applied followed immediately by a priming coat of rust resistant paint. The color finish for external surfaces shall be two coats of manufacturer’s standard color paint.

2.13 FACTORY ASSEMBLY
   A. The control centers shall be completely assembled at the factory and shipped in vertical sections with shipping splits as shown on the Motor Control Center Data Sheet and shall be assembled as a unit in the field.

2.14 TESTS
   A. Control centers shall be completely assembled at the factory and given inspection and wiring check to insure completeness and proper functioning of equipment.
   B. Each circuit shall be given a continuity test.
   C. All power and control wiring shall be given a voltage test at two and one-half times rated insulation value plus 1000 volts for one second.
D. Cost of equipment, instruments, tools, personnel, and all expenses incidental to tests, including replacements of damaged materials shall be borne by the seller.

2.15 PACKING AND SHIPPING

A. Seller shall prepare all equipment covered by this Specification for shipment in such manner as to protect it from damages in transit, and shall be responsible for and make good at his own expense any and all damage due to improper preparation.

B. All equipment not bolted to the structure and made a part thereof shall be packed in separate boxes. Removable units may be packed separately if too heavy for safe shipment when assembled within the stationary structure.

C. All boxes and crates shall be plainly marked with manufacturers order and items numbers.

- END OF SECTION -
GEOTECHNICAL ENGINEERING RECOMMENDATIONS
SKILLED NURSING CARE / MENTAL HEALTH UNIT
AIDS UNIT AND RENOVATION OF RELATED SUPPORT FACILITIES
ELAYN HUNT CORRECTIONAL CENTER
ST. GABRIEL, LOUISIANA

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS

FOR:
STATE OF LOUISIANA - FACILITY PLANNING AND CONTROL
COLEMAN & PARTNERS, ARCHITECTS, AIA
FORTE AND TABLADA, INC., CONSULTING ENGINEERS
MCKEE & DEVILLE, CONSULTING ENGINEERS

May 1999
State of Louisiana - Facility Planning and Control  
c/o Coleman & Partners, Architects, AIA  
3377 North Boulevard  
Baton Rouge, Louisiana  70806  

Attention: Mr. Dale M. Songy, AIA  

Re: Geotechnical Engineering Recommendations  
Skilled Nursing Care/Mental Health Unit  
Aids Unit and Renovation of Related Support Facilities  
Elayn Hunt Correctional Center  
St. Gabriel, Louisiana  
State Project No. 08-413-97B-1, Part 1  
G&G File: 99-30  

Gentlemen:  

We have completed the necessary geotechnical engineering analyses and are summarizing our findings. Supporting data are attached.  

On 12 March 1999, our Mr. Glynn P. Gautreau, P.E., met with Dr. Dean C. McKee, P.E. of McKee & Deville to discuss the project. On 12 April 1999, “Preliminary Treated Timber Pile Loadings” were faxed to Dr. Dean C. McKee. “Preliminary Foundation Design Data”, along with the Treated Timber Pile Loadings were faxed to Mr. Barry P. Gahagan, P.E. of Forte & Tablada, Inc. on 21 April 1999. On 13 May 1999, “Preliminary Pavement Sections” were faxed to Mr. Bobby Badeaux, P.E. of Forte & Tablada, Inc. Copies of these items are in an attached Appendix.  

DESCRIPTION OF PROJECT  

Your plans are to construct a total of 11 - one-story buildings, consisting of brick veneer, concrete block, metal roof and bar joists, ranging in size from 6,400 to 50,000 square feet. You will also have a 500,000 gallon elevated water tank about 400 feet northwest
of these facilities. About 500 feet east of these new buildings you will be adding a new clarifier, which will be 60 feet in diameter by about 15 feet high.

New roads and parking areas are anticipated. About 1 to 2 feet of fill is expected to raise the building pads to the required grade(s). Assistance by on-site personnel was required in locating existing underground utilities.

SOIL CONDITIONS

The Vicinity Map, Boring Plan and Soil Profiles through these borings are shown on Sheet 1. The soil consists of typical River bottom land, stiff desiccated clay overlying soft to medium clays and very loose to firm clayey silts with organics.

The Results of Laboratory Analyses are attached on Tables 1 through 5. The Unified Soil Classification System (USCS) symbols, for the soils having Atterberg limits conducted thereon, are shown on these Tables. The detailed Boring Logs are attached.

Most of the borings were advanced with a hollow stem auger. Borings 24 and 25 were advanced by "rotary-wash" drilling. The initial groundwater was encountered and measured between 4 and 13 feet below the surface during sampling operations. Groundwater is addressed in another section of this report.

Our First Visit Site Observations and a description of the Field and Laboratory Procedures are in attached Appendices.

GEOTECHNICAL ENGINEERING

This section describes the foundation types, which are available. Following this section, "Detailed Foundation Recommendations" are given for supporting specific units. "Miscellaneous Foundation Engineering Information" is found toward the end of this report.

FOUNDATION TYPES AVAILABLE

SHALLOW SPREAD AND CONTINUOUS FOOTINGS

The "net" allowable bearing pressures for shallow square isolated spread footings, and long or continuous wall footings, with a length to width (L:W) ratio greater than 2 to 1, are
tabulated below. The pressures for long footings can be used for a monolithically poured slab and grade beam foundation with turned down edges. These bearing pressures are applicable at any convenient depth below the ground surface or on or in "compacted backfill", monitored (tested), and placed in accordance with our recommendations under the heading "Site Preparation and Backfill Requirements".

<table>
<thead>
<tr>
<th>&quot;NET&quot; ALLOWABLE BEARING PRESSURES (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated Spot (Square)</td>
</tr>
<tr>
<td>Footings</td>
</tr>
<tr>
<td>On &quot;Natural Soil&quot;</td>
</tr>
<tr>
<td>(Existing Ground Surface) or</td>
</tr>
<tr>
<td>On or in the &quot;Compacted Fill&quot;</td>
</tr>
</tbody>
</table>

The minimum grade beam or strip footing width is 1.5 feet. Square footings shall have a minimum width of 3 feet.

Settlement for these footings loaded up to 100 Kips is estimated to be about \( \frac{3}{4} \) inch or less. One-half of this settlement will occur during construction. The differential settlement can be reduced by increasing the rigidity of the footing/mat or by utilizing a waffle type foundation or a ribbed slab (grade beams). These magnitudes and rates are based on the "sustained" pressures indicated above. Lesser pressures will result in proportionally less settlement and require longer time rates.

**BELL BOTTOMED FOOTINGS**

With no increase in strength within a reasonable depth, bell bottomed footings (under-reamed) are not suitable foundations at this site.

**DRILLED SHAFTS**

The allowable loadings in **KIPS** for various diameter Straight Sided Drilled Shafts, between 10 and 80 feet below the surface, are shown below. The horizontal loadings, which are based on passive pressures and a rigid body rotation, are not applicable for shaft lengths greater than 15 times the shaft diameter in feet. Linear interpolation of loadings between the depths shown is acceptable. Generalized Data applicable to the shafts and piles follow.
ALLOWABLE DOWNWARD (D), UPLIFT (U), AND HORIZONTAL (H) LOADINGS ON DRILLED SHAFTS (KIPS) - (Factor of Safety = 2)

<table>
<thead>
<tr>
<th>Shaft Diameter (Inches)</th>
<th>Tip Depth Below Surface</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 Feet</td>
<td>20 Feet</td>
<td>30 Feet</td>
<td>40 Feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>U</td>
<td>H</td>
<td>D</td>
<td>U</td>
<td>H</td>
<td>D</td>
<td>U</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>5</td>
<td>0.6</td>
<td>11</td>
<td>10</td>
<td>2.4</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>8</td>
<td>6</td>
<td>0.7</td>
<td>13</td>
<td>11</td>
<td>2.8</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td>9</td>
<td>7</td>
<td>0.8</td>
<td>15</td>
<td>13</td>
<td>3.2</td>
<td>21</td>
</tr>
<tr>
<td>18</td>
<td>11</td>
<td>8</td>
<td>0.9</td>
<td>18</td>
<td>14</td>
<td>3.6</td>
<td>24</td>
</tr>
<tr>
<td>24</td>
<td>16</td>
<td>10</td>
<td>1.2</td>
<td>25</td>
<td>19</td>
<td>4.8</td>
<td>33</td>
</tr>
<tr>
<td>30</td>
<td>22</td>
<td>13</td>
<td>1.5</td>
<td>33</td>
<td>24</td>
<td>6.0</td>
<td>43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shaft Diameter (Inches)</th>
<th>Tip Depth Below Surface</th>
<th>50 Feet</th>
<th>60 Feet</th>
<th>70 Feet</th>
<th>80 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 Feet</td>
<td>60 Feet</td>
<td>70 Feet</td>
<td>80 Feet</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>U</td>
<td>H</td>
<td>D</td>
<td>U</td>
<td>H</td>
</tr>
<tr>
<td>12</td>
<td>26</td>
<td>24</td>
<td>N/A</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>14</td>
<td>30</td>
<td>28</td>
<td>N/A</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>16</td>
<td>35</td>
<td>32</td>
<td>N/A</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>18</td>
<td>40</td>
<td>36</td>
<td>N/A</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>24</td>
<td>54</td>
<td>48</td>
<td>N/A</td>
<td>62</td>
<td>58</td>
</tr>
<tr>
<td>30</td>
<td>70</td>
<td>60</td>
<td>N/A</td>
<td>79</td>
<td>72</td>
</tr>
</tbody>
</table>

SOIL CRITERIA
This criteria was used to calculate the loadings for the shafts and the driven piles.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Ultimate Adhesion (KSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Neglect</td>
</tr>
<tr>
<td>2 - 10</td>
<td>C = 0.57</td>
</tr>
<tr>
<td>10 - 30</td>
<td>C = 0.41</td>
</tr>
<tr>
<td>30 - 40</td>
<td>C = 0.35</td>
</tr>
<tr>
<td>40 - 50</td>
<td>C = 0.36</td>
</tr>
<tr>
<td>50 - 60</td>
<td>C = 0.36</td>
</tr>
<tr>
<td>60 - 70</td>
<td>C = 0.34</td>
</tr>
<tr>
<td>70 - 80</td>
<td>C = 1.00</td>
</tr>
</tbody>
</table>
The minimum center to center spacing for these shafts shall be 2 diameters. The settlement under individual shafts will be ¼ inch or less.

Augered Cast-in-Place (pressure-grouted) Piles are not to be "confused" with or assumed to be the same as Drilled Shafts. Only with a load testing program at the contractor's expense, under our direction, and with our approval, will these piles be considered.

These shafts provide economical uplift resistance by extending the reinforcing steel from the shaft into the cap/foundation. Generally, with the high groundwater level and potentially caving/"running" soils, temporary casing or processing the excavations with a slurry will probably be required for installation.

TREATED TIMBER PILES

The allowable loadings for Treated Timber Piles are tabulated below. Please note that the shaft loads are given in KIPS and the pile loads are given in TONS.

Settlement of individual piles will be less than ¼ inch. The minimum center to center spacing between piles shall be 3 feet.

ALLOWABLE DOWNWARD AND UPLIFT LOADINGS ON TREATED TIMBER PILES (TONS)
(Factor of Safety = 2)

<table>
<thead>
<tr>
<th>Tip Embedment Below Surface (feet)</th>
<th>Dimensions (inches)</th>
<th>Downward (Compression)</th>
<th>Uplift (Tension)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>7 12</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>45</td>
<td>7 12</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>50</td>
<td>7 12</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>55</td>
<td>7 13</td>
<td>16.5</td>
<td>16</td>
</tr>
<tr>
<td>60</td>
<td>7 13</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>65</td>
<td>7 13</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>
SQUARE PRECAST PRESTRESSED CONCRETE PILES

The allowable Downward (Compressive) and Upward (Tension) loadings on these piles are given below.

ALLOWABLE DOWNWARD AND UPLIFT LOADINGS ON SQUARE PRECAST PRESTRESSED CONCRETE PILES (TONS) - (Factor of Safety = 2)

<table>
<thead>
<tr>
<th>Pile Diameter (Inches)</th>
<th>50 Feet</th>
<th>60 Feet</th>
<th>70 Feet</th>
<th>80 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>U</td>
<td>D</td>
<td>U</td>
</tr>
<tr>
<td>12</td>
<td>16</td>
<td>15</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>14</td>
<td>19</td>
<td>18</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>20</td>
<td>26</td>
<td>24</td>
</tr>
</tbody>
</table>

ALLOWABLE DOWNWARD AND UPLIFT LOADINGS ON CONCRETE FILLED OPEN-END OR CLOSED-END PIPE PILES (TONS) - (Factor of Safety = 2)

<table>
<thead>
<tr>
<th>Pile Diameter (Inches)</th>
<th>60 Feet</th>
<th>70 Feet</th>
<th>80 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>10 φ</td>
<td>12</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>12 ¾ φ</td>
<td>16</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>14 φ</td>
<td>18</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

The minimum center to center spacing between the concrete and pipe piles shall be 3 feet or 3 times the largest pile dimension, whichever is greater.

GENERALIZED DATA FOR SHAFTS AND PLIERS

For clusters of more than 4, the Group Efficiency shall be checked using the "Perimeter Shear" method. This is the ratio of the perimeter of the group to the perimeter of the
total number of individual shafts in the group. For groups in excess of 4, a detailed settlement analyses should be conducted.

Generally, full scale load testing can be economically justified by revealing higher capacities than those computed. With our experience at this site, load testing will not be required. These elements derive their loading from a combination of side friction and tip bearing. The side friction values have been conservatively estimated.

Any shafts/piles used to resist uplift loadings shall have structurally designed connections to transfer the load from the shaft/pile to the foundation.

These shafts/piles shall conform to the Specifications or Pile and Hammer Requirements in attached Appendices.

A listing of qualified Contractors and General Pile Driving Specifications are also in attached Appendices.

**HEAVE, VIBRATIONS, AND HARD DRIVING** - (If Applicable)

The butt elevation of each pile shall be determined immediately after it is driven, and again when driving of the group is completed. If any pile is found to have heaved more than ¼ inch, it shall be re-driven at least to its original butt elevation, without damaging the pile.

Preboring a pilot hole, as indicated in the “Pile and Hammer Requirements”, will minimize the heave, and assist in achieving the required penetration. This will also assist in proper alignment and plumbness.

For any piles driven within 30 feet of existing structures, we suggest preboring pilot holes a minimum of 30 feet deep prior to driving. This will reduce the driving time, noise, vibrations, and effects on the existing foundations supporting the existing facilities. Open-end pipe piles will lessen hard driving and vibrations. Predrilling will not be required for the open-end pipe piles.

**HORIZONTAL AND UPLIFT FORCES**

Horizontal loadings can be resisted either by battering the shafts or piles, or by developing passive pressure. Individual vertical piles can resist an allowable horizontal loading of 1 Ton per 12 inch projected width of pile. This assumes a maximum deflection of ¼ inch at the surface. If this is not adequate, the shafts or piles should be battered, and tied together by
struts and/or grade beams at the surface. The allowable passive soil pressure will be 500 psf. This can be increased by 33½% for wind. This passive pressure can also be used to determine the horizontal loadings on the shafts. A plot of Passive Pressure verses depth can be furnished upon request. The bending may require heavier than normal reinforcing.

LOAD AND STRESS INCREASES

All loadings and bearing pressures can be increased as specified below.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Increase in Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Testing</td>
<td>25</td>
</tr>
<tr>
<td>Wind</td>
<td>33½</td>
</tr>
<tr>
<td>Earthquake</td>
<td>50</td>
</tr>
</tbody>
</table>

FIELD INSTALLATION MONITORING

All shafts/piles shall be installed under the watchful eye of a qualified observer. Records of tip elevations, diameters, and other pertinent details should be recorded. Review of the records shall be conducted by a licensed professional engineer.

DETAILED FOUNDATION RECOMMENDATIONS

BUILDINGS - (Borings 1 through 23)

These buildings can be supported on Shallow Spread Footings with the bearing pressures given herein. Drilled Shafts or Treated Timber Piles, with the loadings furnished herein, could also be used to support these buildings depending upon the economics. The load data is furnished herein.

WATER TOWER - (Boring 24)

This tower can be supported on square precast prestressed concrete piles or concrete filled pipe piles with the loadings furnished earlier. Supporting data are in the attached Appendices.
CLARIFIER

This new 60 foot in diameter by 15 foot high steel clarifier will be constructed about 500 feet east of the new buildings. The soil pressure under operating conditions will be about 860 psf. This assumes a 62 foot diameter reinforced concrete mat foundation. A mat foundation at this site will be the most economical foundation. Less than 1½ inches of settlement will occur at the center of the mat, "dishing" upwards to less than half of that at the edges. Less than 1 year will be required for 50% of this settlement to occur. The remainder will occur in 5 years. This should not be a problem since adjustments to the moving equipment therein can be made.

MISCELLANEOUS FOUNDATION ENGINEERING INFORMATION

SITE PREPARATION AND BACKFILL REQUIREMENTS - (If Applicable)

The foundation and paving areas shall be first stripped of all surface vegetation (grass and roots), existing paving, foundations, existing utilities and unwanted trees. All existing below grade structures and demolition debris should be removed from the site. All stumps shall be completely removed. Grinding the stumps and leaving the roots in-place is not acceptable.

Any underground pipes or existing utilities shall be removed or grout plugged to prevent the loss of material.

These areas shall be proof rolled with a "sheep's foot" roller or a 7 cubic yard dump truck loaded with soil. This will indicate any soft spots/weak areas or poorly backfilled areas such as ditches, trenches, and stump holes, which will require further removal, reworking, and/or replacement. Heavy equipment, which destroys the natural integrity of the near surface soils, should be avoided.

A "CL" type low plasticity "clayey" material (Liquid Limit (L.L.) less than 45 and a Plasticity Index (P.I.) greater than 11), or a more granular material (maximum 10% passing the No. 100 Screen), placed in maximum 8 inch thick loose lifts and compacted to 90% modified Proctor density (ASTM D 1557) or 60% Relative density (ASTM D 4254), shall be used to raise the site to the required elevations. Monitoring of the fill placement operations shall be conducted to insure the required compaction has been achieved.

Care should be exercised not to overwork these soils which may become "jelly-like" and lose their supporting strength depending upon their natural moisture content. As an estimate, mixing, cutting-in, and compacting in about 3% to 4% of lime or fly ash by weight (or 8% to 10% by volume) to about 6 to 8 inches deep, or complete removal may be required to achieve compaction.
If less than 1 foot of fill is required under the floor slab, it can be compacted in maximum 8 inch thick loose lifts with 3 passes of a D-6 or larger dozer with standard width tracks.

Surface strippings containing grass and organics can be used for landscaping fill without any detailed compaction monitoring. Hauling equipment can be used for compaction. No foundations or pavements should be supported on this fill.

Additional items to consider relative to the hauling and compaction equipment, placing fill on slopes, weather factors, lift thickness and suggested compaction specifications are in attached Appendices.

SETTLEMENT DUE TO FILL

Some fill will be placed on the site. If not more than 2 feet of fill is placed on the site, the anticipated settlement will be negligible and tolerable. If properly compacted and monitored during placement, the effects from the fill should not be a factor on the proposed construction, whether these buildings are supported on shallow foundations or treated timber piles.

NEGATIVE SKIN FRICTION

The effects of downdrag and/or negative skin friction on shafts or piles will be minimal. No reduction in the loads will be needed.

FLOOR SLAB

The ground floor slab can be supported on or in the compacted fill, if placed as indicated herein.

All separately poured walkways shall be tied into the adjacent slabs with dowels to reduce separation. No. 6 deformed dowels, by 38 inches long, spaced on 18 inch centers, and placed mid-slab height, shall be used.

Consideration shall be given to making separate pours and/or installing metal keyed joints in the slab at narrow sections or re-entrant corners. For aesthetic reasons, these joints should be located under partitions or in carpeted areas, if applicable. In addition, the
placement of No. 5 deformed bars (mid-slab) by 5 feet long at 45° to these corners, will minimize normal shrinkage and temperature curing cracks which generally occur at these vulnerable areas. Similar bars shall also be added at all holes or block-outs in the slab. See Sheet 2.

**CAPILLARY BARRIER**

A 4 inch thick CAPILLARY barrier and a polyethylene vapor barrier will be required under the floor slab. The capillary barrier material shall consist of a *Washed Gravel* with less than 10% passing the No. 3 Screen (¼ inch), or #57 crushed limestone. Crushed limestone (#610) road base aggregate or river silt is NOT acceptable for use underneath the slab as a capillary barrier.

**GROUNDWATER**

Free water in the boreholes was initially encountered as indicated on the attached Boring Logs between 4 and 13 feet below the surface. The depth of groundwater shall be verified prior to conducting any excavations. *For design purposes, the groundwater level shall be assumed at the ground surface, or higher, if in flood prone areas.* The Mississippi River stage should be considered during high stages when performing uplift calculations.

**RETAINING WALLS – (DESIGN PRESSURES & BACKFILLING)**

Retaining walls shall be designed for an equivalent fluid pressure of 90 pcf below the ground surface, assuming the groundwater is at the surface, and 60 pcf above the ground surface. A horizontal pressure equal to one-half of the anticipated floor load or surcharge must be added to this horizontal design pressure.

Fill behind retaining walls within 1(H):1(V) slope from the wall can be a granular material. The type and compaction requirements are as indicated in the "Site Preparation and Backfill Requirements" section. This free draining granular material will reduce the lateral pressure against the wall and assist in achieving compaction. Weep holes covered with a Geotextile Filter Fabric (GFF) at the base of the walls shall also be provided. Routing these pipes away from the building by gravity may be required.

**DESIGN PARAMETERS/COEFFICIENTS**

The Modulus of Subgrade Reaction (k) for soils in the upper 25 to 30 feet should be limited to 25 psi per inch. This soil property can be used in computer programs for determining mat deflections, etc.
COEFFICIENT OF EARTH PRESSURE AT REST

The coefficient of Earth Pressure at rest can generally be taken as 0.7. For these "normally consolidated" River bottom soils, the value of $K_o = 0.95 - \sin \phi$, where $\phi$ is equal to $15^\circ \pm 5^\circ$.

RESISTING HORIZONTAL FORCES

A key under the center of the footings can be used to develop passive pressure to resist horizontal forces. The "allowable" passive pressure for continually applied loads on the face of a key under the center of the footing is 400 psf, which can be increased by 33$rac{1}{3}$% for wind. This value shall be used for concrete poured against undisturbed soil at least 3 feet below the ground surface.

If spread footings are used to resist horizontal forces, the "working" Coefficient of Friction between concrete and soil can be taken as 0.2. This includes a Safety Factor of 2 against sliding. The Coefficient of Friction can be used to analyze a footing in conjunction with the passive pressure stated above.

EXCAVATIONS

Temporary open-cut excavations about 5 to 10 feet deep shall have the side slopes no steeper than $1\frac{1}{2}(H):1(V)$. Localized sloughing may occur requiring flatter slopes. These excavations will be in Type C soils as per OSHA Requirements and Regulations, 29 CFR Part 1926, Subpart P. Regardless of these recommendations, OSHA safety guidelines relative to shoring or bracing excavations and protecting personnel must be followed.

For excavations greater than 10 feet deep, the excavated side slopes should be flattened. The amount of rainfall and season of the year, etc. will be factors in determining the stability of the side slopes. If space does not allow for these side slopes, temporary sheet piling and/or a braced excavation may be required. The design pressures are given elsewhere herein.

PITS, SUMPS, AND FLOTATION

A mat or spread footing foundation can be used to support sumps, since the excavated material will weigh more than the sump. Care should be taken not to disturb the adjacent/surrounding area for supporting shallow spread footings while installing sumps. Otherwise, a deeper foundation may be required.
Provisions should be made to prevent flotation of sumps with the groundwater level at the surface. This flotation can be prevented by several methods. The first is to provide sufficient “dead” weight through the concrete. The second is cantilevering the base slab beyond the walls with soil backfill thereon.

The submerged unit weights of concrete and soil of 80 and 50 psf, respectively, shall be used. If these loadings are not sufficient to provide the required uplift resistance, drilled shafts shall be used.

The shear strength (side friction) of the soil can also be utilized to resist uplift or flotation. An adhesion value of 300 psf can be utilized for the recompacted soil from the sump base to the surface.

Special care should be taken to prevent flotation of sumps during construction, generally the most critical time. Unless the sumps have sufficient “dead” weight of concrete to prevent flotation, the backfill can be placed the day after pouring the walls using internal bracing. As an alternate, the pits can be filled with water until the backfill is placed.

**SPREAD FOOTINGS OR MAT PREPARATION**

Depending upon the time of the year and the groundwater level, the pouring of footings can probably be performed without vertical forming for the sides. Open vertical cut excavations (neat cuts) where the concrete is poured directly against the soil can probably be used. The bottom of the footings shall be excavated to undisturbed soil or to compacted backfill. Any loose soil, water, and/or muck shall then be removed. For large footings or mats 3 feet or deeper, a 3 inch thick dry bottom (mud mat) of unreinforced concrete (2000 psi) or crushed limestone (SP #57) may be desirable to provide a clean working surface to set reinforcing steel and to protect the bottom.

**SWELL/SHRINK POTENTIALS**

About 1 out of 6 of the near surface soils has a moderate swell/shrink potential. The remainder of the surface soils are presently swollen. No special precautions are required to safeguard against the swelling soil on this site, since 1 to 2 feet of fill will be placed on the site. This will negate some of the swell potential since drying will be prevented.
FLEXIBILITY BETWEEN BUILDINGS - (If Applicable)

Expansion joints, flashing, and flexibility will be needed between the existing structures and the new buildings to accommodate the potential differential movements. Even the slightest differential movement or contraction of materials will appear as a separation between the new and existing construction.

ROADWAY DRAINAGE

The primarily problem of support for roadways is poor drainage. Ditches should be cut to carry away excess water, but difficulties may still be encountered in the lifetime of the roadway.

PAVEMENT RECOMMENDATIONS

After the required drainage and sewer appurtenances are installed, the base shall then be prepared as indicated above in the "Site Preparation and Backfill Requirements" section.

The application (mixing and compacting) of Fly Ash and/or lime may be required to provide strengthening of these soils, and provide a stable working platform to support the construction equipment. This will depend upon how soon after the rainy season the site preparation work is undertaken. You requested three separate pavement sections. These include an aggregate surface, an asphalt roadway, and a concrete parking lot. These typical sections were faxed to you on 13 May 1999 and are shown on Sheet 3. An Appendix entitled "Asphalt and Concrete Roads, Parking Lots and Drives" furnishing supporting data is attached.

Suggested "Reinforced Concrete Pavement Joint Details" are illustrated on Sheet 4.

All concrete paving should be installed in lanes a maximum of 12 feet wide, with reinforced contraction/expansion joints. Such measures will eliminate the majority of cracking and still allow transfer of load across the joints. After the concrete pavement is cured, care must be taken to seal the joints and prevent water from entering and softening the subgrade.

**SUMMARY** on next page.
SUMMARY

The soil consists primarily of typical River bottom land, stiff desiccated clay overlying soft to medium clays, and very loose to firm clayey silts with organics.

Foundation design information for selecting the most economical support for these new facilities has been provided. Design data for spread footings, and the loadings for drilled shafts, and driven piling are furnished herein.

Miscellaneous information relative to site preparation and backfill requirements, settlement due to fill, negative skin friction, floor slab, capillary barrier, groundwater, retaining walls, design parameter/coefficients, coefficient of earth pressure at rest, resisting horizontal forces, excavations, pits, sumps and flotation, spread footings or mat preparation, swell/shrink potential, flexibility between buildings, and pavement recommendations are also presented herein.

Specifications for compacting soils and installing the shafts and piles are enclosed. Other supporting data is attached.

Very truly yours,

GAUTREAU & GONZALEZ, INC.

Glynn P. Gautreau, P.E.
President

Gavin P. Gautreau, P.E.
Project Engineer
Enclosures:

Appendix: 12 April 1999, Treated Pile Loadings
21 April 1999, Preliminary Data - Clarifier
13 May 1999, Pavement Sections

Appendix, First Visit Site Observations
Appendix, Field and Laboratory Procedures
Appendix, Installation Specifications for Straight Sided Shafts
Appendix, Listing of Shaft Drilling Contractors
Appendix, Pile and Hammer Requirements (Treated Timber & Open and Closed Piles)
Appendix, Pile and Hammer Requirements (Precast Concrete)
Appendix, General Pile Driving Specifications
Appendix, Listing of Pile Driving Contractors
Appendix, Clay Compaction Specifications
Appendix, Granular Material Compaction Specifications
Appendix, Asphalt and Concrete Roads, Parking Lots and Drives
Sheet 1, Vicinity Map, Soil Boring Plan and Soil Profiles
Sheet 2, Slab Reinforcement Details
Sheet 3, Pavement Section
Sheet 4, Reinforced Concrete Pavement Joint Details
Tables 1 through 5, Laboratory Test Results
Logs of Borings 1 through 31
APPENDIX

- 12 April 1999 Treated Pile Loadings
- 21 April 1999 Preliminary Data - Clarifier
- 13 May 1999 Pavement Sections
ALLOWABLE DOWNWARD & UPLIFT LOADINGS ON TREATED TIMBER PILES (F.S. = 2) - TONS

<table>
<thead>
<tr>
<th>Tip Embedment Below Surface (ft)</th>
<th>Dimensions (in)</th>
<th>Down (Compression)</th>
<th>Up (Tension)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>7</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>45</td>
<td>7</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>50</td>
<td>7</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>55</td>
<td>7</td>
<td>13</td>
<td>16\frac{1}{2}</td>
</tr>
<tr>
<td>60</td>
<td>7</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>65</td>
<td>7</td>
<td>13</td>
<td>19</td>
</tr>
</tbody>
</table>
PRELIMINARY FOUNDATION DESIGN DATA

Re: New Clarifier
Hunt Correctional Facility
St Gabriel, Louisiana

I. DESCRIPTION OF PROJECT: A new 60 foot diameter, 18 feet tall clarifier will be constructed adjacent to the existing clarifier at the Hunt Correctional Facility and function as part of the Existing Wastewater Treatment facility on-site. The new clarifier will be located to the west of the existing clarifier, south of the existing canal, and north of the oxidation ponds. Existing grade at the site is approximately 12.3 feet MSL.

II. SOIL CONDITIONS: The soil consists primarily of stiff clay from the surface to about 6 feet below ground. From 6 feet to about 30 feet a soft clay exists, then from 30 to 35 feet medium clay undertain by a stiff clay from 35 to 40 feet below ground was found.

III. SHALLOW SPREAD FOOTINGS: "NET" ALLOWABLE BEARING PRESSURES (psf)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Allowable Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Existing Ground Surface</td>
<td>1000</td>
</tr>
<tr>
<td>On or in the &quot;Compacted Fill&quot;</td>
<td></td>
</tr>
</tbody>
</table>

IV. SETTLEMENT: These calculations are not complete at this time. Settlement information will be detailed in our final report. Information relative to the weight of the structure, base, and contents will assist in our calculations.

V. ALLOWABLE LOADS ON TREATED TIMBER PILES ON TIMBER PILES (TONS)

Sheet 1 presents Allowable Downward and Uplift Loadings on Treated Timber Piles with a Safety Factor equal to two (FS = 2) in tons

VI. SWELL/SHRINK POTENTIALS: The soil here has a low to moderate swell/shrink potential. Special precautions to safeguard against the swelling soil on this site will be detailed in our final report.

VII. FINAL GEOTECHNICAL REPORT: ... with the data outlined in our "Scope of Services" will be forthcoming.

GAUTREAU & GONZALEZ, INC.

Gavin P. Gautreau, P.E.
Project Engineer

21 April 1999
G & G File: 99-30
# PAVEMENT SECTIONS
Hunt Corrections Institute
St. Gabriel, Louisiana

<table>
<thead>
<tr>
<th>AGGREGATE SURFACED ROADWAY</th>
<th>ASPHALT ROADWAY</th>
<th>CONCRETE PARKING LOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 4&quot; Cr. L.S. (b)</td>
<td>3&quot; Asphalt</td>
<td>6&quot; Reinforced Concrete</td>
</tr>
<tr>
<td>6&quot; Base</td>
<td>8&quot; to 10&quot; Base (2 lifts may be required)</td>
<td>8&quot; Base (2 lifts may be required)</td>
</tr>
<tr>
<td></td>
<td>2&quot; Subbase (a)</td>
<td>6&quot; Subbase (a)</td>
</tr>
</tbody>
</table>

Note: Optional Base and Subbase materials listed below.

### Optional Materials
- Base Materials
  - Crushed Limestone (b)
  - Soil-Cement
  - Soil-Lime

- Subbase Materials (a)
  - Crushed Limestone (b)
  - Soil-Lime
  - Clean Sand (c)

- Embankment (f)
  - "CL" Type Clay Per ASTM D 2487 (d)
  - River Silt (e)

### Compaction
- 75% Relative Density
- 92% Modified Proctor
- 70% Relative Density
- 90% Modified Proctor

### Notes:
- (a) 6" thick subbase (minimum) unless more is required due to "bridging-up" at spongy/pumping areas.
- (b) Crushed Limestone - ASTM D 1241 Type I Gradation A (#610).
- (c) Clean Sand is material with less than 10% passing the No. 100 Sieve.
- (d) Maximum Liquid Limit of 45, minimum Plasticity Index of 11.
- (e) River Silt is material with more than 12% passing the No. 200 Sieve.
- (f) On imported or existing soil, varies from "as required" to zero at cut areas.

* Lime and Cement to be used only with soils specifically tested and approved for such use. Estimates of percentages are given in text. Monitoring agency should determine exact percentages.

Specifications - Modified Proctor ASTM D 1557.
Relative Density ASTM D 4254 or EM 1110-2-1906.
**FIRST VISIT SITE OBSERVATIONS**

**Job Name:** HUNT CORRECTIONAL CENTER  
**Date:** 8 March 99

**Location:** ST. GABRIEL, LOUISIANA  
**File No.:** 99-30

Mark an X where best describes the site and fill in the blanks if applicable. Use another sheet to make a site sketch. In addition, show nearby roads, railroads, TREES and approximate North.

1. **Topography**
   - [X] Level
   - [ ] Gently sloping
   - [ ] Terraced
   - [ ] Hillside
   - [ ] Valley
   - [ ] Cultivated
   - [ ] Pasture
   - [ ] Low spots w/standing H2O
   - [ ] Swamp
   - [ ] Rolling
   - [ ] Sink hole/depressions
   - [ ] Other

   Elevation between highest and lowest points (feet)
   ____________________________

2. **Ground Cover**
   - [ ] Cleared
   - [ ] Wooded
   - [X] Grass
   - [ ] Rubbish
   - [ ] Fill
   - [ ] Other
   - [ ] Buildings
   - [ ] Color/stain
   - [ ] Trees (sizes, no.)

3. **Surface Soil**
   - [ ] Soft
   - [X] Hard
   - [ ] Loose
   - [ ] Firm
   - [ ] Wet
   - [ ] Dry
   - [X] Clay
   - [ ] Silt
   - [ ] Sand
   - [ ] Gravel
   - [ ] Trash
   - [ ] Rubble
   - [ ] Concrete
   - [ ] Rubble/trash & type
   - [X] Cultivated
   - [X] Pasture
   - [ ] Burn pile
   - [ ] Other

4. **Filled-In-Area**
   - [ ] On-site
   - [ ] Type/depth
   - [ ] Nearby
   - [ ] Ditch side slope
   - [ ] Depth

5. **Surface Water**
   - [X] Ditches
   - [ ] Creek
   - [ ] Swamp
   - [ ] Lakes / Ponds
   - [ ] River
   - [X] Onsite

   LARGE DITCH NEAR BORING 25

6. **Groundwater**
   - [ ] Wells
   - [ ] Springs
   - [ ] Artesian wells
   - [ ] Other

7. **Rainfall Conditions**
   - [X] Previous Weather: DRY
   - [ ] Current: Wet
   - [X] Dry

8. **Nearby Structures:**
   - Type: [ ] Residence
   - [ ] Bldg
   - [ ] # Stories
   - Construction Type: [ ] Wood
   - [ ] Steel
   - [ ] Other:
   - Conditions: [ ] Cracks
   - [ ] Settlement
   - Parking Lot Type: [ ] Asphalt
   - [ ] Concrete
   - [ ] Gravel
   - Conditions: [ ] Cracks
   - [ ] Settlement

8. **Remarks:**
   ____________________________
   ____________________________

---

99-30 First Visit  
5/21/99

GAUTREAU & GONZALEZ, INC.  
GEOTEchnical ENGINEERS
FIELD AND LABORATORY PROCEDURES

Between 10 and 17 March 1999, thirty-one (31) borings were conducted at the locations shown on Sheet 1. High quality undisturbed samples, suitable for laboratory analyses, were obtained by hydraulically pushing a 3 inch O.D. thinwall sampler into the soil. The borings were advanced by dry augering, and sampled continuously in the top 10 feet. Continuous sampling means the bottom of one sample becomes the top of the next and a continuous core of soil is obtained. Additional samples were collected on 5 foot centers to the bottom of the borings. Borings 26 through 31, taken in the road and parking areas, were sampled to 4 feet deep.

The granular soils were obtained by performing the Standard Penetration Test. This consists of driving a 2 inch O.D. sampler into the soil with blows from a 140 pound hammer free-falling a distance of 30 inches. The penetration resistance is the number of blows required to drive the sampler 12 inches, or a portion thereof, after first seating it 6 inches. The number of blows required to drive the sampler each successive 6 inch distance is shown in parentheses on the Boring Logs.

The total lineal footage of borings taken was 609 feet, of which 250 feet were continuously sampled. The detailed Boring Logs are attached. Upon completion, the borings were backfilled as required by LA DOTD.

Penetrometer readings were conducted on the collected samples in the field to assist in the soil strength determination. All samples obtained from the boring were visually classified in the field and in the laboratory. Soil samples were then subjected to laboratory analyses. These consisted of: 187 Unconfined compression tests, 63 Atterberg limit determinations, and 16 moisture contents. For the compression tests, our standard procedure includes determining the natural moisture content and dry density.

The compression tests provide the strength of the soil from which the bearing pressure under footings or the side friction on shafts or piles can be determined. The Atterberg limit determinations assist in classifying the soil more accurately than by field methods, and provides information on the susceptibility of the soil to swell with changes in the moisture content. The results of these analyses are on Tables 1 through 5.
INSTALLATION SPECIFICATIONS FOR STRAIGHT SIDED SHAFTS

The sizes, depths, and spacing of the drilled straight sided shafts are shown on the drawing(s). The shafts shall be installed with a machine powered drilling rig.

The excavation may be done "in the dry" using an auger to remove the soil from the hole. If the soil conditions are such that an augered hole cannot be maintained or will not "stand-up", the contractor shall use whatever measures may be necessary. These measures may consist of, but not necessarily be limited to, casing the excavation, "wet" boring or processing the hole with drilling mud, pumping, hand excavation, or any other measures that may be required to achieve the desired construction.

The cost for any of these measures shall be included in the base bid for the project. No extra payment will be allowed for these measures or any others that may be required. No excavations for slush pits shall be made in the ground surface if the "wet" boring process is used. A portable mud pit shall be used.

The concrete shall have a 28 day minimum compressive strength of 3,000 psi and minimum slump of 5 inches. The excavation shall be filled with concrete immediately after completion. The holes advanced with an auger shall first be inspected to insure that no loose material is in the bottom. Holes excavated using a "wet" drilling process shall have the concrete installed with a tremie pipe which shall be kept below the surface of the concrete at all times during placement. No concrete shall be dropped through free water.

The shafts shall be installed to within 3 inches of the design locations. If any shafts vary more than 3 inches from the design locations, the entire installation shall be surveyed by a licensed surveyor and back charged to the contractor. The foundation will be analyzed using these installed locations. Any costs for the analyses, redesign, including any additional foundation construction shall be borne by the contractor.

Soil boring logs can be reviewed at the owner's office. The soil conditions can vary between boreholes.
SHAFT INSTALLATION CONTRACTORS

H. Beck Foundation
P.O. Box 16747
Lake Charles, Louisiana 70616
(318) 439-2788
1-800-527-5076
Fax (318) 439-2853

Gus Beck - President
Scott Sollay - General Manager

Baker Foundation Drilling, Inc.
Highway 90 West
P.O. Box 751
Jennings, Louisiana 70546
(318) 824-4621
1-800-736-2208
Fax (318) 824-4824

John Baker

Auger Services, Inc.
(mailing)
10330 S. Tiger Bend Road
Baton Rouge, Louisiana 70817

or

(physical)
14656 Airline Highway
Gonzales, Louisiana 70737
(504) 673-9233
(504) 297-0535 (pager)
Fax (504) 673-4698

Pat Patureau

R. R. Cassidy, Inc.
Airline Highway - Prairieville, LA
P.O. Box 80231
Baton Rouge, Louisiana 70898
(504) 346-0945
Fax (504) 673-5819

Randy Cassidy

May 1998
PILE AND HAMMER REQUIREMENTS

Scope. This specification includes the pile materials, installation procedures, and hammer requirements for treated timber piles, and concrete filled open or closed-end pipe piles.

Pile Materials. Treated Timber Piles shall conform to ASTM specification D-25, latest revision, seasoned yellow pine or Pacific Coast Douglas Fir, with a minimum tip diameter of 7 inches.

The treatment for timber piles shall correspond with the American Wood Preservers Association (AWPA) standard (C-3), latest revision, per section entitled "Foundation Piles".

Steel for pipe shall conform to ASTM specification A-252, grade 2 (minimum yield 35,000 psi). Pipes shall have a minimum wall thickness of 0.188 inches. The closure plate at the bottom of pipe piles shall be 1 inch thick and continuously welded to the pipe.

Piles joined in any fashion, except a full penetration butt weld, shall have approval of the engineer.

Preboring. For any piles within 30 feet of existing structures, and immediately prior to driving, the contractor shall drill a pilot hole, for a distance of 30 feet. The diameter of the pilot hole shall be no larger than 70% of the average cross sectional area of the pile, or 2 inches less than the least dimension of the Pile. The preboring shall be done in the "wet" by keeping the holes filled with water. Auger or drill type equipment, which removes the soil from the hole, shall be used. Jetting the hole will not be allowed nor will a steel mandrel, which displaces the soil laterally, be allowed.

The cost of any such preboring shall be included in the unit price for each pile. No extra payment will be allowed for such predrilling.

Pile Hammer. The hammer used shall be either a single or double acting air or steam or a diesel hammer having an energy rating between 15,000 and 19,500 foot pounds. A drop hammer will not be allowed.

Pile Driving. The piles shall be driven one at a time, into the ground in one continuous operation, except for the time required for splicing, if needed. Driving can be stopped only after achievement of the required penetration resistance, or embedment lengths.

Concreting Piles. As soon as practical after driving, all piles where needed shall be filled with concrete, after first being inspected to insure that there is no mud or water flowing into the pile from broken joints, collapsed pipes, etc. No pile driving shall be done within 20 feet of filled piles until 24 hours after the concrete has been placed.

Concrete used to fill all piles shall have a minimum slump of 5 inches. The concrete for filling corrugated shells shall have a compressive strength of 4000 psi in 28 days; for pipe piles the concrete strength shall be 3000 psi.

Soil Conditions. Soil borings have been taken at the site. The boring logs can be reviewed at the owner's or soil engineer's office.
PILE AND HAMMER REQUIREMENTS - SQUARE PRECAST CONCRETE PILES

Scope. This specification includes the pile materials, installation procedures, and hammer requirements for square precast-prestressed concrete piles, in accordance with LDOTD Standard Drawing CS 216, latest revision.

Preboring. To preclude hard driving, and immediately prior to driving, the contractor is allowed to drill a pilot hole for a distance no closer than 10 feet within the pile tip. The diameter of the pilot hole shall be no larger than 80% of the cross-sectional area of the pile, or 2 inches less than the least dimension of the pile. The preboring shall be done in the "wet" by keeping the holes filled with water. Auger or drill type equipment, which removes the soil from the hole, shall be used. Jetting the hole will not be allowed, nor will a steel mandrel which displaces the soil laterally be allowed. No extra payment will be allowed for such predrilling.

Pile Hammer. The hammer used shall be either a single or double acting air or steam hammer or diesel hammer having an energy rating of at least 24,000 foot-pounds. A drop hammer will not be allowed.

Pile Driving. The piles shall be driven one at a time into the ground in one continuous operation.

Pile Lengths. These piles shall be driven to the lengths or tip elevations specified.

Soil Conditions. Soil borings were taken on this site. The boring logs can be reviewed at the engineer's or owner's office.
GENERAL PILE DRIVING SPECIFICATIONS

The purpose of these specifications is to furnish requirements for the driving of piles for this project. This covers the general description of the pile driving equipment, the tolerances in driving, and the general performance of the work. Detailed information as to the type of pile and hammer to be used as well as the driving resistance and/or penetration of pile is contained in the heading "Pile and Hammer Requirements".

Energy Rating of Hammer. The energy rating of the hammer will be done by one of the following methods: For steam or air operated gravity hammers, the energy shall be the height of fall times the weight of ram. For double acting or differential hammers, the energy rating will be determined at the operating rate of the hammer in the field. If the hammer is not operated at a rate sufficient to make it meet the energy requirements, either its operating rate shall be increased to meet specifications or it shall be removed from the job and replaced. For a diesel hammer, the energy rating will be based on the weight of the ram and the actual height of the fall of the ram measured in the field, notwithstanding energy claims of the manufacturer to the contrary.

Leads. The pile hammer shall be held by firmly fixed supported leads extending down to the lowest point the hammer must reach. Leads suspended from a line and braced by lines will not be acceptable unless the piles are rigidly braced and held in alignment by suitable guide frames extending for one third of the pile length.

Driving Head and Cushions. A cast or structural steel driving head shall be used to fit the top of the pile. Suitable cushion blocks shall be used if required to prevent excessive upsetting of the tops of the piles under hard driving conditions. The use of cushion blocks under the hammer ram shall be kept to a minimum so as to achieve the maximum energy transfer to the pile.

Locations. The piles shall be driven where shown on the drawings with a maximum deviation of any pile of 3 inches from the exact location. The deviation of the top of any pile from its design vertical or battered slope shall not exceed 2%. For any footing where a pile is more than 3 inches out of position or 2% off slope, the contractor shall furnish the engineer with an as driven location of all piles in the footing. The engineer will then determine what, if any, corrections will be required. These corrective measures may consist of tie beams to adjacent footings or additional piling. The cost of any such corrective measures, as well as the cost of design of such corrective measures, shall be to the contractor's account.
Hard Driving. If hard driving conditions are encountered, the contractor may be granted permission to pre-bore for the installation of the piles.

Records. An accurate record shall be kept by the engineer showing the time of project, name of contractor, type of pile, type of hammer, date and time of starting and completing driving, penetration resistance of pile in blows per foot or inch as required by the penetration resistance described elsewhere, the operating speed of the hammer, height of drop of ram, and any unusual phenomena of the driving. The contractor shall cooperate with the engineer as is necessary for the engineer to obtain these records.

Miscellaneous. All driving shall be continuous from when the hammer is placed on the pile until the hammer is finally removed from the pile. If driving is interrupted before final penetration is reached, a record of blows for bearing capacity should not be taken until at least 12 inches of penetration has been obtained after driving has been resumed, or unless the engineer is present on the site and indicates otherwise. Care should be taken that the pile is not overdriven and possibly damaged or broken. Any pile which in the opinion of the engineer appears to be broken shall be replaced by a new pile. The cost of the new pile and any redesign and additional construction for the pile cap shall be to the contractor’s account. If any piles are found to have heaved, they shall be redriven to the required penetration resistance.

Any piles that are driven hollow to be later filled with concrete shall be checked for the following: The shell shall be whole and not collapsed or torn, there shall be no flow of water or mud into the pile. Piles which do not have a portion of the bottom plate visible shall be checked for obstructions and water or mud by lowering a probe to the bottom of the pile and then retrieving the probe. The probe shall have an outside diameter 1 inch less than the inside diameter of the pile.
PILE DRIVING CONTRACTORS

Boh Brothers Construction Co., LLC
P. O. Drawer 53266
New Orleans, Louisiana  70153
(504)821-2400

Phil Hoz
Ralph Junius

Gulf South Piling & Construction, Inc.
P. O. Box 10073
Jefferson, Louisiana  70181
(504)834-7791

Mike Kelly
Butch Casey

Coastal Contractors, Inc.
5842 Perkins Road
Baton Rouge, Louisiana  70808
(504)766-0244

Bobby Overall

P.C.S.
Professional Construction Services
14363 Highway 73
Prairieville, Louisiana  70769
(504)673-9013
or

Ronnie Hughes

P. O. Box 26245
New Orleans, Louisiana  70186
(504)241-8001

Ernie Kohler

Pile Contractors

June 1998
CLAY COMPACTION SPECIFICATIONS

After the subgrade has been proof rolled and approved by the engineer, the contractor can start his compaction operations. No fill shall be placed on any area of the subgrade, or subsequent lifts, which have not been accepted by the engineer. Any soft spots, or areas where the contractor believes he may have difficulty in obtaining the desired compaction, shall be removed and replaced with compacted backfill, as described herein.

Depending upon the current rainfall when the site preparation work is undertaken, drainage swales will probably be required. If excessive moisture is present, these upper silty soils could pump under the vibrations of the heavy compaction/construction equipment.

The borrow source shall be checked to insure the soil meets the specifications. Initial acceptance of the soil in the borrow pit does not mean general acceptance of the entire borrow pit, since the soil encountered in the pit can change.

Clay soils used for fill shall conform to ASTM Standard D 2487, latest revision, "CL" material. If the material is placed on the site within 2% of its optimum moisture content, minimum preparation effort will be required. The starting layers shall be placed in the deepest portion of the fill/excavation. Each layer shall be constructed parallel to the finished grade line. During construction of the fill, the contractor shall at all times, evenly route his equipment, both when loaded and when empty, over the layers as they are placed, and shall distribute the travel evenly over the entire width of the lift of fill being placed.

The thickness of lifts shall be no more than the teeth height of the sheep's foot roller. The determination of the thickness of a lift will be the capability of the contractor's equipment to achieve the required compaction throughout the entire lift thickness.

Some "sheep's foot" rollers have stubby/short prongs. If the lift to be compacted is 7 or more inches thick, and the teeth on the sheep's foot roller are only 4 inches long, it may be necessary to compact the material in two separate lifts. It has been our experience that large drums with short stubby teeth on the roller compact only the top 4 inches of material, and have little effect on compacting material below that depth.

Generally, sheep's foot rollers are the most suitable equipment for the compaction of clay soils. The contractor may use any compaction equipment that has sufficient mass to achieve compaction of the soil as specified. Generally, the drums of sheep's foot rollers should be filled with water, or for additional weight, with both water and sand. Smooth wheel rollers, to seal the working area, should be available on the site so rains will not saturate the soil and delay any work in progress. The contractor will be advised to modify, or remove from the site, any equipment not capable of compacting the fill to the required density.

When obtaining the density of a lift, if any density is more than 2% below the required average, that portion of the lift will be rejected.

The re-testing of rejected lifts will be to the contractor's account.

Any clearing, site preparation, or compaction work started between mid November and late March risks encountering delays and difficulties because of our rainy season. With only about 3 days between the passage of "fronts", drying on-site/in-place material will be difficult. Otherwise, lime or fly ash may be required to strengthen these saturated soils and allow equipment to achieve compaction. This could also result in escalated site preparation/earthwork costs. Judgment to begin the fieldwork, and accomplish such at no additional expense to the owner, should be at the discretion and risk of the contractor.

The down slope or gravitational tendency of this fill must be considered. Prior to placing the fill, the slope should be "benched" or "terraced". This will minimize such large masses of soil to creep down slope.

A minimum horizontal distance of 5 feet from the footing(s) to the edge of the slope of the new fill shall be provided. The maximum side slope for the new fill embankment shall be 1.5(H):1(V). As an option, the slope can be terraced or sloped 3(H):1(V) or flatter for mowing safety.

January 1999
GRANULAR MATERIALS COMPACTION SPECIFICATIONS
(Sand and Crushed Limestone)

The subgrade shall be prepared so as to allow downward drainage at all times of any “free water” in the fill, as well as any rainfall. If fill placement should be a low area surrounded by clay, drainage trenches or sumps shall be installed on 25 to 50 foot centers and kept pumped dry.

Compaction shall be done with the fill sufficiently wet so that bulking will be eliminated. Generally, when "free water" appears on the fill surface, the material can be compacted to the proper density.

After the subgrade has been proof rolled and approved by the engineer, the contractor can start his compaction operations. No fill should be placed on any area of the subgrade or subsequent lifts which the engineer has not accepted. Any soft spots where the contractor believes he may have difficulty in obtaining the desired compaction, shall be removed and replaced with compacted backfill as described herein.

The starting layers shall be placed in the deepest portion of the fill/excavation. Each layer shall be constructed parallel to the finished grade line.

During construction of the fill, the contractor shall at all times, evenly route his equipment, both when loaded and when empty, over the layers as they are placed, and shall distribute the travel evenly over the entire width of the lift of fill being placed.

Sand meeting these specifications shall have a maximum of 10% by weight passing the No. 100 mesh sieve and shall be free of all organic matter. Crushed limestone shall conform to specification ASTM D 1241 Type 1, Gradation C.

The borrow source shall be checked to insure the material meets the specifications. Initial acceptance of the fill in the borrow source does not mean general acceptance of the entire pit, since the material in the pit can change.

The materials shall then be compacted in lifts to the density specified. When obtaining the density of any lift, if any density is more than 2% below the required average, that portion of the lift will be rejected. Compacted lift thicknesses can start at 6 inches. Adjustments to greater or lesser thickness will depend upon the progress of the compaction throughout the entire lift thickness.

Some "sheep's foot" rollers have stubby/short prongs. If the lift to be compacted is 7 or more inches thick, and the teeth on the sheep's foot roller are only 4 inches long, it may be necessary to compact the material in two separate lifts. It has been our experience that large drums with short stubby teeth on the roller compact only the top 4 inches of material, and have little effect on compacting material below that depth.

The contractor shall use "vibratory" equipment of sufficient mass needed for achieving compaction. The vibratory frequency of the compaction equipment shall be adjustable.

The re-testing of rejected lifts will be to the contractor's account.

Any clearing, site preparation, or compaction work started between mid November and late March risks encountering delays and difficulties because of our rainy season. With only about 3 days between the passage of "fronts", drying on-site/in-place material will be difficult. Otherwise, lime or fly ash may be required to strengthen these saturated soils and allow equipment to achieve compaction. This could also result in escalated site preparation/earthwork costs. Judgment to begin the fieldwork, and accomplish such at no additional expense to the owner, should be at the discretion and risk of the contractor.

The down slope or gravitational tendency of this fill must be considered. Prior to placing the fill, the slope should be "benched" or "terraced". This will minimize such large masses of soil to creep down slope.

A minimum horizontal distance of 5 feet from the footing(s) to the edge of the slope of the new fill shall be provided. The maximum side slope for the new fill embankment shall be 1.5(H):1(V). As an option, the slope can be terraced or sloped 3(H):1(V) or flatter for mowing safety.
**ASPHALT AND CONCRETE ROADS, PARKING LOTS AND DRIVES**

(Thickness in Inches)

<table>
<thead>
<tr>
<th>TYPE OF PAVEMENT</th>
<th>Parking Slots for Cars and Light Trucks</th>
<th>Entry Drives and Slots in Open Areas</th>
<th>Trash Dumpsters &amp; Medium Trucks w/ 10,000 #/Axle</th>
<th>Heavy Truck Areas “18 Wheelers”</th>
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</thead>
<tbody>
<tr>
<td>ASPHALT</td>
<td>1½” over 6” base</td>
<td>2” over 9” base or 2” over 6” base over 6” subbase (a)</td>
<td>3” over 10” base over 6” subbase (a)</td>
<td>4” over 12” base over 6” subbase (a)</td>
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<td>REINFORCED CONCRETE</td>
<td>4” - no base</td>
<td>5” over 6” base</td>
<td>6” over 8” base</td>
<td>8” over 10” to 12” base</td>
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<td>UNREINFORCED CONCRETE</td>
<td>5” (b)</td>
<td>6” (b)</td>
<td>7” (c)</td>
<td>10” (c)</td>
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</table>

(Bases for Unreinforced Pavement similar to Reinforced Concrete Pavement).

Integral curbs, thickened edges, joints, and reinforcement in slabs must also be used. Joints in valleys should be sealed to prevent water entry; joints across ridges should be tied to prevent separation. Joints shall be made while the concrete is wet/green”. Sawed Joints shall be cut as soon as the concrete cures without raveling, but within 6 hours after pouring.

<table>
<thead>
<tr>
<th>Base Materials</th>
<th>Optional Materials</th>
<th>Compaction</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Crushed Limestone (d)</td>
<td>75% Relative Density</td>
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<tr>
<td></td>
<td>*Soil-Cement</td>
<td>92% Modified Proctor</td>
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<td></td>
<td>*Soil-Lime</td>
<td>92% Modified Proctor</td>
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<tr>
<td>Subbase Materials (a)</td>
<td>Crushed Limestone (d)</td>
<td>70% Relative Density</td>
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<td>*Soil-Lime</td>
<td>90% Modified Proctor</td>
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<tr>
<td></td>
<td>Clean Sand (e)</td>
<td>70% Relative Density</td>
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<tr>
<td>Embankment (h)</td>
<td>“CL” Type Clay Per ASTM D 2487 (f)</td>
<td>90% Modified Proctor</td>
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<tr>
<td></td>
<td>River Silt (g)</td>
<td>90% Modified Proctor</td>
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</tbody>
</table>

Notes:

(a) 6” thick subbase (minimum) unless more is required due to “bridging-up” at spongy/pumping areas.
(b) 6” thick or less … use 10 feet maximum Joint Spacing.
(c) 6” thick or more … use 12 feet maximum Joint Spacing.
(d) Crushed Limestone - ASTM D 1241 Type I Gradation A (#810).
(e) Clean Sand is material with less than 10% passing the No. 100 Sieve.
(f) Maximum Liquid Limit of 45, minimum Plasticity Index of 11.
(g) River Silt is material with more than 12% passing the No. 200 Sieve.
(h) On imported or existing soil, varies from “as required” to zero at cut areas.

* Lime and Cement to be used only with soils specifically tested and approved for such use. Estimates of percentages are given in text. Monitoring agency should determine exact percentages.

Specifications - Modified Proctor ASTM D 1557.
Relative Density ASTM D 4254 or EM 1110-2-1906.

October 1998
GAUTREAU & GONZALEZ, INC. GEOTECHNICAL ENGINEERS

Vicinity Map

Boring 24:
Water Tower

- Very stiff clay
- Medium slightly silty clay

Boring 25:
Clarifier

- Stiff clay
- Soft clay
- Medium clay

Skilled Care Unit

- Very soft to medium clay
- To very silty clay with organic matter
- 2' thick silt & sand layers (2 < N < 18)

Notes:
1) Interpolations between borings are inferred and may or may not be representative of actual conditions.

2) N = Blow counts from Standard Penetration Test (SPT)...

3) Groundwater level at the time of sampling.
Groundwater level ranged from none recorded to 10 feet below ground at the time of sampling.

4) Skilled Care Unit: Borings 1 through 23, Water Tower:
NOTES:

1. #5 rebar x 36" long, spaced on 18" ctrs.
2. 2 - #5 rebars x 5'-0" long, 2" clear, @ 45°, mid-slab.
3. COLD OR METAL "KEYED" CONTROL JOINT UNDER PARTITIONS OR IN CARPETED AREAS, IF POSSIBLE.
Note: Optional Base and Subbase materials listed below.

**Base Materials**
- Crushed Limestone *(b)*
- *Soil-Cement
- *Soil-Lime

**Subbase Materials *(a)***
- Crushed Limestone *(b)*
- *Soil-Lime
- Clean Sand *(c)*

**Embankment *(f)***
- "CL" Type Clay Per ASTM D 2487 *(d)*
- River Silt *(e)*

**Compaction**
- 75% Relative Density
- 92% Modified Proctor
- 92% Modified Proctor
- 70% Relative Density
- 90% Modified Proctor
- 70% Relative Density
- 90% Modified Proctor
- 90% Modified Proctor

**Notes:**
- *(a)* 6" thick subbase (minimum) unless more is required due to "bridging-up" at spongy/pumping areas.
- *(b)* Crushed Limestone - ASTM D 1241 Type I Gradation A (#610).
- *(c)* Clean Sand is material with less than 10% passing the No. 100 Sieve.
- *(d)* Maximum Liquid Limit of 45, minimum Plasticity Index of 11.
- *(e)* River Silt is material with more than 12% passing the No. 200 Sieve.
- *(f)* On imported or existing soil, varies from "as required" to zero at cut areas.

* Lime and Cement to be used only with soils specifically tested and approved for such use. Estimates of percentages are given in text. Monitoring agency should determine exact percentages.

**Specifications -**
Modified Proctor ASTM D 1557.
Relative Density ASTM D 4254 or EM 1110-2-1906.
NOTE: ALL PAVING PLACED ON 6 INCHES BASE OTHER THAN SLOTS FOR CARS ONLY.

Junction Details
SPLIT 2" PVC PIPE
NAILED TO FORM BOARD
REMOVED AFTER POURING 1

TYPICAL PAVING JOINT BETWEEN LANEES
@ COLD JOINTS OR END OF DAY

EXPANSION JOINT REQUIRED EVERY 100' LONGITUDINALLY AND EVERY 3 LANES TRANSVERSELY

1/2 DEEP JOINT WITH FILLER

TOOLED JOINT (DUMMY) EVERY 12'-15' OF PAVING TRANSVERSELY

### Table: Welded Wire Fabric

<table>
<thead>
<tr>
<th>T (INCHES)</th>
<th>WELDED WIRE FABRIC</th>
<th>B (24&quot; c.c.) DEFORMED SIZE LENGTH</th>
<th>DOWELS</th>
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<td>4</td>
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<td>3/4&quot;Ø x 1'-4&quot; on 12&quot; c.c.</td>
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<td>3/4&quot;Ø x 1'-4&quot; on 12&quot; c.c.</td>
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<tr>
<td>7 - 8</td>
<td>6 x 6 - W4 x W4</td>
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<td>1&quot;Ø x 1'-6&quot; on 10&quot; c.c.</td>
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<tr>
<td>10 - 12</td>
<td>6 x 6 - W3 x W3</td>
<td>#6 3'-0&quot;</td>
<td>1 1/8&quot;Ø x 2'-0&quot; on 8&quot; c.c.</td>
</tr>
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</table>

Dowel Note:
ALL DOWELS TO BE SMOOTH, GREASED OR PLASTIC COATED WITH NO BURRS.
## TABLE 1

RESULTS OF LABORATORY ANALYSES

HUNT CORRECTIONAL
ST GABRIEL, LOUISIANA

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<tr>
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<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Unconfined Compressive Strength</th>
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ST GABRIEL, LOUISIANA

G & G JOB NO.: 99-30

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ST GABRIEL, LOUISIANA

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RESULTS OF LABORATORY ANALYSES

HUNT CORRECTIONAL
ST GABRIEL, LOUISIANA

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25  | 0 - 2        | 21               | 96.0         | 52           | 34            | 33               | 1.55 | 5      | VERT. SHEAR  |
| 2 - 4 | 31         | 85.0             | 50            | 43           | 34            | 37               | 1.99 | 8      | MULT. SHEAR  |
| 4 - 6 | 34         | 76.7             | 78            | 31           | 47            |                 | 1.12 | 10     | VERT. SHEAR  |
| 6 - 8 | 34         | 87.2             | 78            | 31           | 47            |                 | 0.34 | 10     | VERT. SHEAR  |
| 8 - 10 | 38        | 81.0             | 78            | 31           | 47            |                 | 0.24 | 10     | VERT. SHEAR  |
| 13 - 15 | 40         | 76.1             | 78            | 31           | 47            |                 | 0.35 | 10     | VERT. SHEAR  |
| 18 - 20 | 38        | 77.3             | 78            | 31           | 47            |                 | 0.31 | 10     | VERT. SHEAR  |
| 23 - 25 | 73        | 54.3             | 78            | 31           | 47            |                 | 0.44 | 5      | MULTI. SHEAR |
| 28 - 30 | 70        | 54.4             | 78            | 31           | 47            |                 | 0.50 | 5      | MULTI. SHEAR |
| 33 - 35 | 75        | 52.7             | 78            | 31           | 47            |                 | 0.48 | 8      | SLICKENSIDED |
| 38 - 40 | 108       | 39.4             | 175           | 29           | 146           |                 | 0.63 | 6      | VERT. SHEAR  |

26  | 0 - 2        | 21               | 96.0         | 52           | 34            | 33               | 1.55 | 5      | VERT. SHEAR  |
| 2 - 4 | 31         | 85.0             | 50            | 43           | 34            | 37               | 1.99 | 8      | MULTI. SHEAR  |
| 27  | 0 - 2        | 30               | 86.9         | 62           | 30            | 32               | 2.56 | 3      | NONE         |
| 4 - 6 | 35         | 83.8             | 70            | 27           | 43            |                 | 1.93 | 4      | MULTI. SHEAR  |
| 6 - 8 | 38         | 81.9             | 70            | 27           | 43            |                 | 0.86 | 6      | MULTI. SHEAR  |
| 8 - 10 | 41        | 74.0             | 98            | 38           | 36            |                 | 1.04 | 10     | YIELD        |
| 13 - 15 | 41        | 75.3             | 98            | 38           | 36            |                 | 1.40 | 5      | VERT. SHEAR  |
| 18 - 20 | 38        | 70.3             | 98            | 38           | 36            |                 | 1.40 | 5      | VERT. SHEAR  |
| 23 - 25 | 39        | 74.7             | 98            | 38           | 36            |                 | 2.06 | 5      | MULTI. SHEAR  |
| 28 - 30 | 39        | 74.7             | 98            | 38           | 36            |                 | 2.06 | 5      | MULTI. SHEAR  |
| 33 - 35 | 39        | 74.7             | 98            | 38           | 36            |                 | 2.06 | 5      | MULTI. SHEAR  |

29  | 0 - 2        | 41               | 74.0         | 98           | 38            | 36               | 2.60 | 5      | VERT. SHEAR  |
| 2 - 4 | 41         | 75.3             | 98            | 38           | 36            |                 | 1.40 | 5      | VERT. SHEAR  |
| 30  | 0 - 2        | 27               | 84.7         | 77           | 30            | 47               | 2.06 | 5      | MULTI. SHEAR  |
| 2 - 4 | 39         | 74.7             | 86            | 31           | 54            |                 | 1.12 | 5      | MULTI. SHEAR  |
| 31  | 0 - 2        | 11               | 89.5         | 60           | 26            | 34               | 1.36 | 10     | YIELD        |
| 2 - 4 | 30         | 89.5             | 60            | 26           | 34            |                 | 1.36 | 10     | YIELD        |

TABLE 5
RESULTS OF LABORATORY ANALYSES
HUNT CORRECTIONAL
ST GABRIEL, LOUISIANA
G&G JOB NO.: 99-30

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS

99-30 Strength, 05/20/99
Page 5 of 5
### LOG OF BORING

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- Stiff brown and dark gray clay with organics (1.6)
- Soft brown and gray slightly silty clay with organics (1.9)
- Very soft brown and gray silty clay with ferrous deposits (0)
- Soft gray silty clay (0)
- Soft gray silty clay (0)

- 5     | UNDISTURBED SAMPLE  |

- 10    | STANDARD PENETRATION TEST |

- 15    | INITIAL GROUNDWATER |

- 20    | FINAL GROUNDWATER |

- 20    | END OF BORING |

Boring Depth: 20 Feet

**For:** State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

**Technician:** Corey

**Date:** 16-Mar-99

**File:** 99-30
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

BORING: 2
FILE: 99-30
DATE: 16-Mar-99
TECHNICIAN: Corey

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

AUGER SAMPLE
(TOP/BOTTOM) POCKET PENETROMETER (TSP)
UNDISTURBED SAMPLE
STANDARD PENETRATION TEST

INITIAL GROUNDWATER
FINAL GROUNDWATER

Boring Depth: 25 Feet

0
Stiff brown and gray clay with organics (2.5)

5
Soft brown and gray slightly silty clay with organics and ferrous deposits (2.0)
Medium brown and gray slightly silty clay with ferrous deposits (.5)

10
Medium brown and gray slightly silty clay (.5)
Soft brown and gray clay (.8)

15
Soft gray clay with wood (.1)

20
Soft gray clay with wood (.0)

25
Soft gray clay with calcareous deposits and wood (.0)

END OF BORING 2

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
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<td>Medium brown and gray clay (1.8)</td>
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<td>Soft gray clay with ferrous deposits (.1)</td>
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Boring Depth: 25 Feet

END OF BORING 5
### LOG OF BORING

**Project:** Skilled Nursing Care/Mental Health Unit  
Aids Unit and Renovation of Related Support Facilities  
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

**FOR:** State Of Louisiana - Facility Planning and Control  
Coleman & Partners, Architects, AIA

**Operation:**  
- AUGER SAMPLE  
- UNDISTURBED SAMPLE  
- STANDARD PENETRATION TEST

**Boring:** 6  
**FILE:** 99-30  
**DATE:** 17-Mar-99  
**TECHNICIAN:**

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<td>Medium brown and gray silty clay with organic traces (1.5)</td>
</tr>
<tr>
<td>10</td>
<td>Medium brown and gray clay with ferrous deposits and organic traces (1.1)</td>
</tr>
<tr>
<td></td>
<td>Soft gray clay with organic traces (.6)</td>
</tr>
<tr>
<td></td>
<td>Soft gray clay (.0)</td>
</tr>
<tr>
<td>15</td>
<td>Soft gray slightly silty clay (.0)</td>
</tr>
<tr>
<td>20</td>
<td>Soft gray clay with organic traces (.0)</td>
</tr>
</tbody>
</table>

**END OF BORING 6**

**Boring:** 7  
**Boring Depth:** 20 Feet  
**DATE:** 15-Mar-99

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
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<tbody>
<tr>
<td>0</td>
<td>Very stiff brown clay with organic matter traces (4.5/1.5)</td>
</tr>
<tr>
<td>5</td>
<td>Medium brown and gray silty clay with organic matter traces (3.0/0.0)</td>
</tr>
<tr>
<td></td>
<td>Soft gray silty clay with organic matter traces (.25/5)</td>
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<tr>
<td></td>
<td>Soft gray silty clay with organic matter traces (.0/0)</td>
</tr>
<tr>
<td></td>
<td>Soft gray silty clay with organic matter traces (.0/.25)</td>
</tr>
<tr>
<td></td>
<td>Soft gray silty clay with organic matter traces (.25/.25)</td>
</tr>
</tbody>
</table>

**END OF BORING 7**

Gautreau & Gonzalez, Inc.  
Geotechnical Engineers
## LOG OF BORING

**PROJECT:** Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

**FOR:** State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLES</th>
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<tbody>
<tr>
<td>0</td>
<td>AUGER SAMPLE</td>
</tr>
<tr>
<td></td>
<td>(TOP/BOTTOM) POCKET PENETROMETER (TSF)</td>
</tr>
<tr>
<td></td>
<td>UNDISTURBED SAMPLE</td>
</tr>
<tr>
<td></td>
<td>STANDARD PENETRATION TEST</td>
</tr>
<tr>
<td></td>
<td>INITIAL GROUNDWATER</td>
</tr>
<tr>
<td></td>
<td>FINAL GROUNDWATER</td>
</tr>
<tr>
<td></td>
<td>Boring Depth: 25 Feet</td>
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</tbody>
</table>

- **0 ft:** Very stiff brown and gray clay with roots and sand traces (2.3)
- **5 ft:** Medium brown and gray clay with ferrous deposits (2.0)
- **10 ft:** Soft brown and gray clay with ferrous deposits (.9)
- **15 ft:** Medium gray very silty clay (.4)
- **20 ft:** Soft gray very silty clay (.2)
- **25 ft:** Very soft gray very silty clay (.0)

- **20 ft:** Very loose gray clayey silt
  - Penetration Resistance: 2 Blows Per Foot (2/1/1)
- **25 ft:** Very loose gray clayey silt
  - Penetration Resistance: 3 Blows Per Foot (1/1/2)

**END OF BORING 8**

**BORING:** 8
**BORING DEPTH:** 25 Feet
**DATE:** 17-Mar-99

**BORING:** 9
**BORING DEPTH:** 15 Feet
**DATE:** 10-Mar-99

- **0 ft:** Stiff brown clay with organic matter traces, shell fragments, and roots (1.5)
- **5 ft:** Medium brown and gray clay with organic matter traces and wood (.25/.5)
- **10 ft:** Medium brown and gray clay with organic matter traces and ferrous deposits (.25/.5)
- **15 ft:** Medium brown and gray clay with organic matter traces and ferrous deposits (.25/.25)
- **20 ft:** Very loose gray sandy clayey silt and organic matter traces and ferrous deposits
  - Penetration Resistance: 1 Blow per Foot (1/1/0)
- **25 ft:** Soft gray silty sandy clay with organic matter traces and wood (.0/.0)

**END OF BORING 9**

Gautreau & Gonzalez, Inc.
Geotechnical Engineers
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

FILE:
99-30

DATE:
15-Mar-99

TECHNICIAN:
Corey

0 5 10 15 20 25
DEPT.
FEET

0 5 10 15 20 25
SAND AND GRAVEL

0 5 10 15 20 25
SAND AND GRAVEL


AUGER SAMPLE
(TOP/BOTTOM) POCKET PENETROMETER (TSF)

UNDISTURBED SAMPLE
STANDARD PENETRATION TEST

I INITIAL GROUNDWATER
FINAL GROUNDWATER

Boring Depth: 15 Feet

Very stiff brown silty clay with roots (4.6)
Medium brown silty clay with roots and ferrous deposits (4.1)
Soft brown and gray slightly silty clay with wood (.5)
Very soft gray clay with wood (.0)
Very soft gray clay with wood (.0)
Very soft gray clay with wood (.0)

END OF BORING 10

BORING:
11
BORING DEPTH:
25 Feet

Stiff brown and gray silty clay with organic matter and roots (4.0/3.75)
Firm brown and gray clayey silt with organic matter traces and ferrous deposits (2.0/.75)
Medium brown and gray slightly silty clay with organic matter traces (.5/.75)
Medium gray silty clay (.0/.25)
Soft gray silty clay with organic matter traces (.0/.0)

END OF BORING 11

Gautreau & Gonzalez, Inc.
Geotechnical Engineers
**LOG OF BORING**

**PROJECT:**
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

**FOR:**
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

**BORGNS:**
12

**FILE:**
99-30

**DATE:**
10-Mar-99

**TECHNICIAN:**
Corey

---

### BORING 12

**Initial Groundwater**
- Stiff brown and gray clay with organic matter traces and shell fragments (2.0/.5)
- Medium gray clay with organic matter traces (.75)
- Medium gray silty clay with organic matter traces, wood, and ferrous deposits (.25/.25)
- Medium gray silty clay with organic matter traces (.25/.5)
- Very loose gray clayey silt with organic matter traces and wood
  - Penetration Resistance: 3 Blows Per Foot (1/2/1)
- Soft gray clay with organic matter traces (.0/.25)
- Soft gray clay organic matter traces and wood (.0/.5)
- Soft gray silty clay with organic matter traces and wood (.25/.5)

**Final Groundwater**

---

### BORING 13

**Boring Depth:** 15 Feet

**BORING DEPTH:**
- Stiff brown and gray clay with organic matter traces (1.5/1.25)
- Medium brown and gray clay with organic matter traces and ferrous deposits (.25/.75)
- Soft brown and gray silty clay with organic matter traces, wood and ferrous deposits (.0/.0)
- Soft brown and gray silty sandy clay with organic matter traces and wood (.0/.0)
- Loose gray clayey silty sand with organic matter traces
  - Penetration Resistance: 5 Blows Per Foot (3/2/3)
- Loose gray clayey silty sand with traces of organics and wood
  - Penetration Resistance: 7 Blows Per Foot (4/3/4)

**END OF BORING 13**
LOG OF BORING

PROJECT: Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

FOR: State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BORING: 14
FILE: 99-30
DATE: 10-Mar-99
TECHNICIAN: Phil

DEPT FT  SUPER

0

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2

3

4

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AUGER SAMPLE (TOP/BOTTOM) POCKET PENETROMETER (TSP)
UNDISTURBED SAMPLE STANDARD PENETRATION TEST

- INITIAL GROUNDWATER
- FINAL GROUNDWATER

Boring Depth: 25 Feet

Very stiff brown and gray clay with organic matter traces (4.5/2.5)
Stiff brown and gray slightly silty clay with organic matter traces, shell fragments, and ferrous deposits (4.5/0)
Soft brown and gray silty clay with organic matter traces (.0/.25)
Soft gray silty clay with organic matter traces (.0/.0)
Soft gray silty clay with organic matter traces and wood

Medium gray silty clay with organic matter traces and wood (.5/.25)

Medium gray silty clay with organic matter traces and ferrous deposits (.25/.0)

Soft gray clay with wood (.0/.25)

END OF BORING 14

BORING: 15
BORING DEPTH: 15 Feet

Very stiff brown and gray clay with organic matter traces, roots, and shell fragments (4.5/1.5)
Medium brown and gray clay with organic matter traces (.25/2.0)
Medium brown and gray silty clay with organic matter traces and ferrous deposits (.25/0)
Soft brown and gray clay with organic matter traces and ferrous deposits (.0/.25)
Soft gray clay with organic matter traces (.25/0)
Soft gray clay with organic matter traces (.00/0)

END OF BORING 15

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BORING: 16
FILE: 99-30
DATE: 15-Mar-99
TECHNICIAN: Corey

TOP/BOTTOM POCKET PENETROMETER (TSF)

UNDISTURBED SAMPLE □
STANDARD PENETRATION TEST □

INITIAL GROUNDWATER □
FINAL GROUNDWATER □

Boring Depth: 20 Feet

DEPTH
FEET
0
5
10
15
20

SAMPLES

Very stiff brown very silty clay with roots (4.4)
Medium brown clayey silt with pea gravel and shell fragments (2.2)
Medium brown and gray silty clay with ferrous deposits (2)
Soft gray silty clay with wood and ferrous streaks (.1)
Soft gray silty clay with wood (.5)

Soft gray clay (.0)

Very soft gray clay (.0)

END OF BORING 16

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
**LOG OF BORING**

**PROJECT:**
Skilled Nursing Care/Mental Health Unit  
Aids Unit and Renovation of Related Support Facilities  
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

**BORING:**
17

**FILE:**
99-30

**FOR:**
State Of Louisiana - Facility Planning and Control  
Coleman & Partners, Architects, AIA

**DATE:**
16-Mar-99

**TECHNICIAN:**
Corey

<table>
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<th>FINAL GROUNDWATER</th>
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<td>AUGER SAMPLE</td>
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<td></td>
</tr>
<tr>
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<td></td>
<td>UNDISTURBED SAMPLE</td>
<td></td>
<td></td>
</tr>
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<td>STANDARD PENETRATION TEST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Stiff brown clay with roots (2.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
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<td>Soft brown silty clay with roots, ferrous nodules, and sand traces (4.8)</td>
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</tr>
<tr>
<td>10</td>
<td></td>
<td>Medium brown and gray silty clay with ferrous deposits (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Medium gray and brown clay with ferrous deposits (1.0)</td>
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<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Medium gray and brown clay with ferrous deposits (1.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Soft gray slightly silty clay with wood (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Very soft gray clay (0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Very soft gray clay (0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Boring Depth:** 25 Feet

**END OF BORING 17**
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BORE: 18
FILE: 99-30
DATE: 17-Mar-99
TECHNICIAN:

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>SAMPLES</th>
<th>(TOP/BOTTOM) POCKET PENETROMETER (TSF)</th>
<th>INITIAL GROUNDWATER</th>
<th>FINAL GROUNDWATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>AUGER SAMPLE</td>
<td>UNDISTURBED SAMPLE</td>
<td>STANDARD PENETRATION TEST</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stiff brown silty clay with roots (1.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Medium brown silty clay with roots and organic traces (1.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Soft brown and gray slightly silty clay with ferrous deposits (.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Soft gray clay (.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Soft gray silty clay (.0)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>15</td>
<td>Very loose gray clayey silt with sand traces</td>
<td>Penetration Resistance 3 Blows Per Foot</td>
<td>(1/2/1)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Soft gray clay</td>
<td></td>
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<td></td>
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</table>

Boring Depth: 20 Feet

END OF BORING 18

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
## LOG OF BORING

**PROJECT:** Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center, St. Gabriel, Louisiana

**FOR:** State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

**BORING:** 19
**FILE:** 99-30
**DATE:** 15-Mar-99
**TECHNICIAN:** Corey

### Boring Depth: 25 Feet

<table>
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<tr>
<th>Depth (Ft)</th>
<th>Sample Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>AUGER SAMPLE</td>
<td>Very stiff brown slightly silty clay with shell traces, organic matter, and roots (4.75/4.75)</td>
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<tr>
<td>5</td>
<td>UNDISTURBED SAMPLE</td>
<td>Medium brown and gray slightly silty clay with organic matter traces and shell (2.5/1.0)</td>
</tr>
<tr>
<td></td>
<td>PENETROMETER (TSF)</td>
<td>Soft gray very silty clay with sand traces (0.25)</td>
</tr>
<tr>
<td></td>
<td>INITIAL GROUNDWATER</td>
<td>Final Groundwater</td>
</tr>
<tr>
<td>10</td>
<td>Standard Penetration Test</td>
<td>Very loose gray clayey silt with sand traces</td>
</tr>
<tr>
<td></td>
<td>Penetration Resistance</td>
<td>1 Blow Per Foot (1/1/0)</td>
</tr>
<tr>
<td>15</td>
<td>Standard Penetration Test</td>
<td>Very loose gray clayey silt with sand traces</td>
</tr>
<tr>
<td></td>
<td>Penetration Resistance</td>
<td>2 Blows Per Foot (1/1/1)</td>
</tr>
<tr>
<td>20</td>
<td>Standard Penetration Test</td>
<td>Firm gray clayey silt with sand traces</td>
</tr>
<tr>
<td></td>
<td>Penetration Resistance</td>
<td>13 Blows Per Foot (5/5/7)</td>
</tr>
<tr>
<td>25</td>
<td>Standard Penetration Test</td>
<td>Medium gray silty clay with organic matter traces and sand traces</td>
</tr>
<tr>
<td></td>
<td>Penetration Resistance</td>
<td>7 Blows Per Foot (1/3/4)</td>
</tr>
<tr>
<td></td>
<td>Soft gray silty clay with organic matter traces and wood (0.25)</td>
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</tr>
</tbody>
</table>

**END OF BORING 19**

### BORING: 20
**BORING DEPTH:** 15 Feet

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<th>Sample Type</th>
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<tbody>
<tr>
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<td></td>
<td>Stiff brown clay with organic traces, shell fragments and pea gravel (4.5/4.5)</td>
</tr>
<tr>
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<td></td>
<td>Medium brown slightly silty clay with organic matter traces and roots (4.5/4.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very soft gray sandy clay with organic matter traces and roots (4.5/4.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Penetration Resistance</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Soft gray clay with organic matter traces and ferrous traces (0.0)</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Soft gray clay with organic matter traces and ferrous streaks (0.25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very soft gray clay with organic matter traces and wood (0.25)</td>
</tr>
</tbody>
</table>

**END OF BORING 20**

Gautreau & Gonzalez, Inc.
Geotechnical Engineers
<table>
<thead>
<tr>
<th>Depth (Ft)</th>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Stiff brown and gray clay with roots (1.9)</td>
</tr>
<tr>
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<td>Medium brown clay with roots (1.3)</td>
</tr>
<tr>
<td>10</td>
<td>Medium brown and gray clay with ferrous deposits (.7)</td>
</tr>
<tr>
<td>15</td>
<td>Medium gray clay (.4)</td>
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<tr>
<td>20</td>
<td>Soft gray clay (.1)</td>
</tr>
<tr>
<td>25</td>
<td>Very soft gray clay (.0)</td>
</tr>
</tbody>
</table>

Very soft gray clay with ferrous deposits (.0)

END OF BORING 21
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BOREDINO:
22
FILE:
99-30
DATE:
17-Mar-99
TECHNICIAN:

Boring Depth: 25 Feet

DEPTH FEET
SAMPLER

0

AUGER SAMPLE
TOP/BOTTOM POCKET PENETROMETER (TSP)

UNDISTURBED SAMPLE
STANDARD PENETRATION TEST

- 5
Very stiff brown and gray silty clay with roots (.4)
Soft brown and gray silty clay with roots and organic traces (.6)
Soft gray slightly silty clay (.2)
Soft gray clay (.4)

- 10
Soft gray clay (.0)

- 15
Very soft gray clay with ferrous deposits (.0)

- 20

- 25
Very soft gray clay with organic traces (.0)

END OF BORING 22

BORING: 23
BORING DEPTH: 15 Feet

- 0
Stiff brown and gray silty clay with ferrous nodules and roots (4.3)
Medium brown and gray slightly silty clay with ferrous nodules and organic traces (2.3)

- 5
Soft gray clay (.0)

- 10
Soft gray clay with brown silty sand traces (.0)
Soft gray clay (.9)

- 15
Soft gray clay with wood (.0)

END OF BORING 23

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
**LOG OF BORING**

**PROJECT:**
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

**FOR:**
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

**BORING:**
24

**FILE:**
99-30

**DATE:**
11-Mar-99

**DRILLER/TECHNICIAN:**
Corey

**DEPH FEET**

<table>
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<th>SAMPLES</th>
<th>(TOP/BOTTOM) POCKET PENETROMETER (TSF)</th>
<th>INITIAL GROUNDWATER</th>
<th>FINAL GROUNDWATER</th>
<th>STANDARD PENETRATION TEST</th>
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<tr>
<td>50</td>
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</tr>
</tbody>
</table>

**BORING DEPTH:** 80 Feet

- Very stiff brown and gray clay with organic matter traces, roots, and silt pockets (4.5/1.25)
- Medium brown and gray slightly silty clay with organic matter traces (4.5/25)
- Soft brown and gray silty clay with organic matter traces and ferrous streaks (.0/.0)
- Stiff gray silty clay (1.0/.75)
- Soft gray very silty clay with sand traces (.0/.0)
- Soft gray slightly silty clay with pockets and organic matter traces (.0/.25)
- Medium gray clay with organic matter traces and ferrous deposits (.5/.0)
- Soft gray silty clay with organic matter traces (.5/25)
- Soft gray clay with organic matter traces (.25/5)
- Gray clay with organic matter traces
- Soft gray clay with organic matter traces with wood
- Medium gray clay with organic matter traces and ferrous traces (.5/1.25)
- Medium gray clay with organic matter traces and wood (1.0/1.5)

**GAUTREAU & GONZALEZ, INC.**
**GEOTEchnical ENGINEERS**
<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample Type</th>
<th>Description</th>
<th>Penetration Resistance</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>AUGER SAMPLE</td>
<td>Soft gray clay with organic matter traces (.25/.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>UNDISTURBED SAMPLE</td>
<td>Very soft gray clay with organic matter traces and wood (.5/.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>UNDISTURBED SAMPLE</td>
<td>Soft gray clay with organic matter and wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>UNDISTURBED SAMPLE</td>
<td>Medium to stiff gray clay with organic traces</td>
<td>8 Blows Per Foot</td>
<td>4/4/4</td>
</tr>
<tr>
<td>75</td>
<td>STANDARD PENETRATION TEST</td>
<td>Stiff gray clay with organics</td>
<td>10 Blows Per Foot</td>
<td>4/5/5</td>
</tr>
</tbody>
</table>

END OF BORING 24
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

BORING: 25
FILE: 99-30
DATE: 12-Mar-99
TECHNICIAN: Corey

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

DEPTH FEET

SAMPLES

- Auger Sample (TOP/BOTTOM POCKET PENETROMETER (TSP))

- Undisturbed Sample (STANDARD PENETRATION TEST)

- Initial Groundwater

- Final Groundwater

Boring Depth: 40 Feet

0
- Stiff brown clay with roots (3.7)
- Stiff brown clay (1.5)
- Stiff brown clay (1.3)
- Soft brown and gray clay (.8)
- Soft brown and gray clay (.5)

5
- Soft gray clay (.4)

10
- Soft gray clay (.4)

15
- Soft gray clay with ferrous streaks (.2)

20
- Medium gray clay with wood (.3)

25
- Soft gray clay with wood (.2)

30
- Medium brown clay with wood (.5)

35

40

END OF BORING 25

Gautreau & Gonzalez, Inc.
Geotechnical Engineers
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BORING: 26
FILE: 99-30
DATE: 17-Mar-99
TECHNICIAN:

DEPTH FEET
0
SAMPLES

\\ [ ] AUGER SAMPLE
[ ] (TOP/BOTTOM) POCKET PENETROMETER (TSP)
[ ] UNDISTURBED SAMPLE
[ ] STANDARD PENETRATION TEST
\[ ] INITIAL GROUNDWATER
\[ ] FINAL GROUNDWATER

BORING DEPTH: 4 Feet

Stiff brown clay with roots and shell fragments (3.0)
Soft brown and gray slightly silty clay with ferrous deposits (1.3)

END OF BORING 26

BORING: 27
BORING DEPTH: 4 Feet
DATE: 10-Mar-99

Very stiff brown and gray clay with roots (2.0/4.5)
Stiff brown and gray clay with organic traces (1.0/.25)

END OF BORING 27

BORING: 28
BORING DEPTH: 4 Feet

Stiff brown and gray clay with organic matter traces, roots and shell fragments (3.25/1.25)
Medium brown and gray clay with organic matter traces (.5/1.5)

END OF BORING 28

BORING: 29
BORING DEPTH: 4 Feet
DATE: 10-Mar-99

Stiff brown and gray clay with organic matter traces (3.0/1.0)
Medium brown and gray clay with organic matter traces and ferrous streaks (.5/.25)

END OF BORING 29

GAUTREAU & GONZALEZ, INC.
GEOTECHNICAL ENGINEERS
LOG OF BORING

PROJECT:
Skilled Nursing Care/Mental Health Unit
Aids Unit and Renovation of Related Support Facilities
Elayn Hunt Correctional Center; St. Gabriel, Louisiana

FOR:
State Of Louisiana - Facility Planning and Control
Coleman & Partners, Architects, AIA

BORING: 30
FILE: 99-30
DATE: 10-Mar-99
TECHNICIAN: Corey

DEPT. FEET
AUGER SAMPLE
TOP/BOTTOM POCKET PENETROMETER (TSF)

UNDISTURBED SAMPLE
STANDARD PENETRATION TEST

INITIAL GROUNDWATER
FINAL GROUNDWATER

BORING DEPTH: 4 Feet

Very stiff brown and gray clay with organic matter traces and ferrous deposits (4.5/2.0)
Stiff brown and gray clay with organic matter traces and roots (1.5/75)

END OF BORING 30

BORING: 31
BORING DEPTH: 4 Feet
DATE: 17-Mar-99

Top soil, asphalt 5", shell 2"
Stiff gray clay (1.2)

END OF BORING 31

Gautreau & Gonzalez, Inc.
Geotechnical Engineers