DEPARTMENT OF THE ARMY
Omaha District, Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

:NOTICE: Failure to acknowledge : :all amendments may cause rejec- : :tion of the offer. See FAR : :52.215-1 of Section 00100 :	Solicitation No. DACA45 02 R 0012 Date of Issue: 26 MAR 2002 **Date of Receiving Proposals: 02 APR 2002**

Amendment No. 0004
22 March 2002

SUBJECT: Amendment No. 0004 to Request for Proposal Solicitation Package for Design and Construction of CONTROL TOWER, US AIR FORCE ACADEMY, CO. Solicitation No. DACA45 02 R 0012.

TO: Prospective Offerors and Others Concerned

1. The specifications and drawings for subject project are hereby modified as follows (revise all specification indices, attachment lists, and drawing indices accordingly).

a. Specifications. (Descriptive Changes.)

(1) Attachment #3C Essentially reverse what was given by Amendment No. 2 on Specification Section 15951, Page 3, paragraph 1.2:

delete:

The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system and energy management and control system (EMCS) provided by Siemens Controls APOGEE EMCS. Siemens Controls APOGEE EMCS is the only acceptable manufacturer for DDC Controllers, automatic control valves, damper and valve operators, temperature and velocity instruments and data communication equipment. All other materials and equipment may be furnished by other manufacturers but shall be specifically approved by Siemens through the Contracting Officer for use on this project and for the intended application on this project. Notwithstanding Section 00700 Contract Clauses FAR 52.236-5, Material and Workmanship, DDC system shall be manufactured by Siemens Controls in order that the DDC system is compatiable with the existing EMCS. No other product will be acceptable. The Competition Advocate authorizes sole source procurement.

substitute:

"The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system and energy management and control system

(EMCS) provided by Staefa Control System, Inc (SCS). Staefa Control System, Inc. is the only acceptable manufacturer for DDC Controllers, automatic control valves, damper and valve operators, temperature and velocity instruments and data communication equipment. All other materials and equipment may be furnished by other manufacturers but shall be specifically approved by (SCS) through the Contracting Officer for use on this project and for the intended application on this project. Notwithstanding Section 00700 Contract Clauses FAR 52.236-5, Material and Workmanship, DDC system shall be manufactured by Staefa Control System, Inc. in order that the DDC system is compatiable with the existing EMCS. No other product will be acceptable. The Competition Advocate authorizes sole source procurement."

b. Specifications (New and/or Revised and Reissued). Delete and substitute or add specification pages as noted below. The substituted pages are revised and reissued with this amendment. **Section 01006 is reissued with Am_0002 postings, with the exception of reference to "Siemens Controls". Throughout the reissued criteria section 01006, "Staefa Controls" has replaced "Siemens Controls" for the EMCS.**

Pages Deleted	Pages Substituted or Added
Section 01006, Pages 1-39	Section 01006, Pages 1-40

2. This amendment is a part of the proposing papers and its receipt shall be acknowledged on the Standard Form 1442. All other conditions and requirements of the request for proposal remain unchanged. If the proposals have been mailed prior to receiving this amendment, you will notify the office where proposals are received, in the specified manner, immediately of its receipt and of any changes in your proposal occasioned thereby.

a. Hand-Carried Proposals shall be delivered to the U.S. Army Corps of Engineers, Omaha District, Contracting Division (Room 301), 106 South 15th Street, Omaha, Nebraska 68102-1618.

b. Mailed Proposals shall be addressed as noted in Item 8 on Page 00010-1 of Standard Form 1442.

3. **Offers will be received until 2:00 p.m., local time at place of receiving proposals, 02 APR 2002.**

Attachments: Spec pages in 1.b above

U.S. Army Engineer District, Omaha
Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

22 March 2002
MRP/4413

SECTION 01006

MECHANICAL REQUIREMENTS

PART 1 MECHANICAL REQUIREMENTS

SECTION 01006

MECHANICAL REQUIREMENTS

PART 1 MECHANICAL REQUIREMENTS

1.1 MECHANICAL SYSTEMS CRITERIA

1.1.1 General Parameters/References

Mechanical systems, including HVAC systems, plumbing, gas distribution and building temperature controls shall be designed to comply with this section and the documents listed below to the extent referenced in this section. The publications are referred to in the text by basic designation only. The most current edition shall be used, whenever a specific edition is not mentioned. The Air Force Academy Mechanical Standard shall take precedence over all standards except for the Design Guide for Air Traffic Control Towers.

Air Force Academy Mechanical Standards. Access at internet website http:/usafa.af.mil – 10th Air Base Wing/CE Engineering Flight/CEC Standards page.

Air Force Manual (AFM) 88-4/Army Technical Manual (TM) 5-548-1, Chapter 5 Gas Distribution.

Air Force Manual (AFM) 88-36/Army Technical Manual (TM) TM -815-2, Energy Monitoring and Control Systems EMCS).

American Society for Testing and Materials (ASTM) publications - A53.

American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):

Guides; Terminology of HVAC&R, 2nd Edition etc.
Guideline 1, The HVAC Commissioning Process.
Handbooks; 1999 HVAC Applications, 1998 Refrigeration, 1997 Fundamentals, 1996 HVAC Systems & Equipment, 1995 HVAC Applications, 1994 Refrigeration, 1993 Fundamentals, 1992 HVAC Systems & Equipment, 1991 HVAC Applications, etc. SI editions

Standards; 15-1994, 62-1989, 90.1-1989 & Addendum 90.1-1989, 52.1-1992, etc..

American National Standards Institute (ANSI) publications - Z83.6, 61; section 8 & 9..

American Society of Mechanical Engineers (ASME), 22 Law Drive, P.O. box 2900, Fairfield, NJ 07007-2900.

Army Technical Instructions TI 809-04 Seismic Design for Buildings, dated Dec 1998

Design Guide for Air Traffic Control Towers – United States Air Force

ETL 94-4 Energy Usage Criteria for Facilities in the Military Construction Program

Federal Uniform Accessibility Standards

Instrument Society of America Standard (ISA S75.01), Current edition.

Mil-Hdbk 1008C Fire Protection for Facilities Engineering, Design and Construction

Mil-Hdbk 1190 Facility Planning and Design Guide

National Fire Codes (NFPA), with most current updates.

National Standard Plumbing Code, National Association of Plumbing-Heating-Cooling Contractors, P.O. Box 6808, Falls Church, VA 22046.

SMACNA Duct Construction Standards

SMACNA Duct System Design

TI-800-01 Energy Conservation Criteria

Underwriters Laboratories (UL 142),(UL 441) Current edition.

1.2 GENERAL REQUIREMENTS

The mechanical design shall consist of heating, ventilating, and air-conditioning, gas distribution, HVAC controls and plumbing. Drawings, specifications, design analysis and calculations shall be provided for both the 60 percent design and Final design submittals, and shall be in accordance with SECTION 01336 - 60 PERCENT DESIGN REQUIREMENTS, & SECTION 01338 - 100 PERCENT DESIGN REQUIREMENTS.

This chapter contains instructions and engineering requirements for the mechanical design of the following:

- Equipment Identification and Abbreviations
- Identification of Piping
- Seismic Protection for Mechanical Piping and Equipment
- Thermal Insulation of Mechanical Systems
- Plumbing Systems
- Exterior Gas Distribution Systems
- Interior Gas Piping Systems
- Hydronic Heating Systems
- Heating, Ventilating, and Air-conditioning Systems
- Refrigeration/Chilled Water Systems
- Building Temperature Control Systems
- Testing, Adjusting, and Balancing of HVAC Systems
- CEGS Sections
- Energy Use Budget (EUB) Compliance Check
- Training
- Testing
- Commissioning of HVAC

Provide new mechanical systems, complete and ready for operation. The design and installation of all mechanical systems, including manufacturer's products, shall meet the instructions and requirements contained herein and the requirements of the provided technical guide specifications. Where conflicts between these instructions and the guide specifications or criteria exist, these instructions shall take precedence. Any installation requirements within these instructions, but not contained in the specifications, shall be added to the specifications or shown on the drawings. For minimum specification requirements see paragraph CEGS SECTIONS.

Mechanical designs shall give maximum consideration to the comfort of the occupants. The design shall also be economical, maintainable, energy conservative and shall take into account the functional requirements and planned life of the facility. Mechanical designs shall also consider life cycle operability, maintenance and repair of the facility and real property installed equipment components and systems. Ease of access to components and systems in accordance with industry standards and safe working practices is a design requirement. All like equipment and accessories shall be from a single manufacturer.

Standard Products - Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall be essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted.

Calculations shall be provided for all mechanical equipment such as boilers, heating & cooling coils, condensing units, unit heaters, piping, pumps, expansion tanks, fans, ducts, louvers, gas services and piping, plumbing, water heaters, and etc. Heating and cooling calculations may be provided by computer analysis i.e., Elite Software Inc., Trane Trace Load 700, Carrier E20-II Hourly Analysis Program (HAP) version 3.04 loads program etc. Provide a block heating load on the facility to be used for boiler sizing. Heat Loss calculation shall use actual design U-values. Add piping losses allowance of 10 percent and future load allowance of 20 percent. Design Energy Usage shall meet or be below Energy Use Budget target (see paragraph ENERGY USE BUDGET (EUB) COMPLIANCE CHECK).

1.2.1 Electronics Room and Control Tower Cab

For the electronics room, include 13.8 kW of equipment HVAC load. For the control tower cab include 17.1 kW of equipment HVAC load and 15 people.

1.2.2 Break Room

For the Break Room, include a microwave, coffee pot, and refrigerator as part of the cooling load.

1.2.3 Design and Operating Conditions

The designed and installed HVAC systems shall keep the facility's areas within plus or minus 2 Deg Celsius from the Operating Conditions listed below. The following conditions shall be used in designing the mechanical systems:

Site Elevation: Equipment design elevation is 2185 meters above sea level. Appropriate corrections shall be made when calculating the capacity of all mechanical equipment installed at this elevation.

Latitude: 39 Deg N
Heating Degree Days: 3874 (18 deg C)

Outside Design Conditions:

Winter: -22°C for outside makeup air and infiltration
-19°C for building envelope

Summer: 28°C. dB; 16°C. MCWB for building loads.
30°C air cooled equipment.

Inside Operating Conditions:

Winter: 7°C. for Mechanical equipment rooms, vestibules and other unoccupied areas (except Electrical rooms).
21.1°C. for Administrative areas including Conference rooms, corridors, private offices, break rooms, Communications room, LAN rooms, and Electrical room(s) (positive pressurization).

Summer: 24°C. for administrative areas including Conference rooms, corridors, private offices, break rooms, Communications rooms, LAN rooms, and Electrical rooms (positive pressurization). 29.4°C for mechanical rooms.

Minimum Ventilation (Outside Air) Requirements:

Remaining Rooms Including Control Tower Cab	10 L/s supply of outside air per person.
Break Room	50 L/s outside air minimum
Restrooms	10 L/s exhaust per square meter and shall maintain a negative pressure relative to other parts of the facility.
Showers	12.5 L/s exhaust per square meter and shall maintain a negative pressure relative to other parts of the facility.
Janitor's Closets	10 L/s exhaust per square meter and shall maintain a negative pressure relative to other parts of the facility.
Electrical Room(s)	10 L/s outside air minimum

Mech. Equip. Room 10 AC/hour if no boiler but 20 AC/hour if has boiler

Cooling Loads:
Lighting/comm. rm./LANS rms. - Coordinate with Electrical designer (communications equipment shall be assumed 100% resistive heating)
PC/monitor/printer = 400 watts total per station
People - 75 Watts/person sensible and 60 Watts/person latent (moderately active office work per ASHRAE Handbook of Fundamentals)
Solar,Transmission, etc. - ASHRAE Handbook of Fundamentals)

Building Pressurization:

Entire building shall be pressurized. Negative pressurization see paragraph MINIMUM VENTLATION REQUIREMENTS.

Security Engineering:

Provide means to secure (open and/or closed)exterior gas and water main(s) valves with padlocks.

Anti-terrorism & Force Protection:

As applicable, the following shall be provided for all new mechanical systems:

a. **Air intakes.** Air intakes to heating, ventilation, and air conditioning (HVAC) systems that are designed to move air throughout a building that are at ground level provide an opportunity for aggressors to easily place contaminants that could be drawn into the building.
   1) **New buildings.** For all new buildings covered by this document locate all air intakes at least 3 meters (10-ft) above the ground.
b. **Emergency air distribution shutoff.** For all new buildings provide an emergency shutoff switch in the HVAC control system that can immediately shut down air distribution throughout the building. The switch (or switches) must be located to be easily accessible by building occupants. Providing such a capability will allow building occupants to limit the distribution of airborne contaminants that may be introduced into the building.
c. **Utility distribution and installation.** Utility systems can suffer significant damage when subjected to the shock of an explosion. Some of these utilities may be critical to safely evacuating personnel from the building or their destruction could cause damage that is disproportionate to other building damage resulting from an explosion. To minimize the possibility of the above hazards apply the following measures:
   1) **Utility routing.** For all new buildings route critical or fragile utilities such that they are not on exterior walls.
d. **Equipment bracing.** Mount all overhead utilities and other fixtures to minimize the likelihood that they will fall and injure building occupants. Design all equipment mountings to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction. This standard does not

preclude the need to design equipment mountings for forces required by other criteria such as seismic standards.

e. **Under building access.** To limit opportunities for aggressors placing explosives underneath buildings, ensure that access to crawl spaces, utility tunnels, and other means of under building access is controlled.

f. **Mass notification.** All buildings must have a timely means to notify occupants of threats and instruct them what to do in response to those threats.

1**) New buildings.** All new buildings must have a capability to provide real-time information to building occupants or personnel in the immediate vicinity of the building during emergency situations. The information relayed must be specific enough to discriminate appropriate response actions. Any system, procedure, or combination thereof that provides this capability will be acceptable under this standard.

1.2.4 Mechanical Room Layout Requirements

The mechanical equipment room layouts shall be provided with ample floor space to accommodate routine maintenance of equipment and have head-room to accommodate required equipment. Manufacturer recommended clearance shall be provided around equipment to allow unobstructed access for entry, servicing, and routine maintenance. Space provided in rooms for service and/or replacement of filters, coils, motors, and other equipment items shall be indicated with broken (dashed) lines on the drawings. Provisions for installation, removal, and future replacement of equipment shall be coordinated with the architectural design. The as-built drawings shall be provided in accordance with Section 01040, AS-BUILT DRAWINGS. The arrangement, selection, and sizing of all mechanical equipment shall be such that it can be broken down and removed from the building without dismantling any adjacent systems or structures. A 60 percent design submittal shall be provided for approval to verify mechanical room layout. Fire-rated walls shall be as required in Section 01003 ARCHITECTURAL BUILDING REQUIREMENTS. Mechanical equipment shall be energy efficient per Executive Order 12902, and ASHRAE/90.1. Servicing and maintenance areas interior and exterior to building shall be sized according to manufacturer's recommendations for equipment.

1.2.5 Mechanical/Electrical Equipment Coordination

Arrangement of all mechanical equipment and piping shall be coordinated with electrical work to prevent interference with electrical conduits that may run through the mechanical room and to insure adequate space in shared chases. Mechanical equipment (pipes, ducts, etch.) shall not be installed **over or within space** of rooms which are dedicated to transformers, panelboards, or other electrical equipment unless the items serve only that room. When electrical equipment is located in a mechanical equipment room, the dedicated electrical space shall be indicated by a dashed line and noted "Electrical Equipment Space".

1.2.6 General Mechanical Requirements

As applicable, the following shall be provided for all systems:

a. All piping and equipment located in finished areas of the building shall be concealed or furred-in; exposed piping and equipment is only allowed in utility, equipment, storage and other rooms of this nature.

b. Provide isolation valves, balancing valve, flow measuring device, and pressure/temperature test taps at all heating and/or cooling units, pumps, hot water unit heaters .

c. All coils shall be provided with valved drain and air vent connections.

d. Air vents shall be installed on all high points in piping systems. Drain valves shall be installed at low points and at equipment that must be dismantled for servicing.

e. Strainers shall be provided with a valved blowdown connection.

f. All vents, drain valves, and strainers that are located out of mechanical room spaces shall be provided with hose-end connections. All vents, drain valves, and strainers that are located within mechanical room spaces shall be piped to a floor drain.

g. Provide bypass piping with a balancing globe valve or cock around all non-redundant control and regulating valves. (Not applicable to Fan Coil Units.)

h. No type of valve other than ball valves shall be provided in the hot water and chilled water systems.

i. Except at pump intake connections, eccentric reducers shall not be used.

j. Where steel flanges mate with cast-iron flanges, provide flat faces and full face gaskets.

k. Piping and supports shall not interfere with equipment maintenance access or pull space.

l. Dielectric unions shall be installed between dissimilar metals in soldered and threaded piping systems and insulated flanges shall be installed for welded systems.

m. All underground metallic lines, fittings, and valves; except for cast-iron soil and storm drain piping systems, shall be cathodically protected in accordance with Electrical Section paragraph entitled "Cathodic Protection".

n. All exterior, underground non-metallic piping shall be buried with pipe detection tape.

o. Water and natural gas service lines shall be metered where they enter the building and buried with pipe detection tape and tracer wire.

p. All pumps, regardless of service, shall be non-overloading allowing the pump to operate at any point in its characteristic curve.

r. A thermometer shall be installed on the supply and return piping for each coil. Thermometers shall be legible to service mechanics standing at ground level.

s. Temperature/pressure taps shall be provided on the supply and return piping of each coil.

t. Pipe taps, suitable for use with temperature or pressure probe, shall be located at each pressure gauge.

u. Suspended equipment shall not be provided in rooms that have finished ceilings.

v. Expansion Tanks: A floor mounted bladder type expansion tank shall be provided in the heating hot water piping systems. Each expansion tank's precharge pressure and acceptance volume shall be selected based on the layout of its respective piping systems. If there is not adequate floor space, then the Structural Design Engineer shall be thoroughly informed of weights and locations before hanging from the building's structural components.

w. Air Separation Tanks: The heating hot water and chilled water piping systems shall each be provided with an air separation tank. The air separators shall include an automatic air vent and make-up water system, consisting of a pressure reducing valve, strainer, reduced pressure type backflow preventer and isolation valves.

x. Water Treatment Systems: Provide a premixed mixture of 35% propylene glycol and 65% water into the primary loop of both the heating and cooling systems. Provide a shot feeder (chemical feeder) for both of the heating water and chilled water systems to allow introduction of chemicals into each system. Provide the chemical treatment necessary to protect both systems equipment from damage due to corrosion.

y. Air handling Unit Coils: Each air handling unit coil shall be provided with a three-way control valve.

z. Piping: All piping shall be pitched up in the direction of flow (1 inch in 40 feet) (25.4 mm in 12 meters), shall be designed without pockets which would permit accumulation of air, and shall be provided with vents at high points and drains at low points. All new heating and chilled water piping within the facility shall be black steel conforming to ASTM A53, Schedule 40 or copper. Connections to equipment shall utilize unions for pipe 50 mm and smaller and flanges for pipe 65 mm and larger. **PIPING AND EQUIPMENT LOADS SHALL BE COORDINATED WITH THE STRUCTURAL SYSTEM.**

aa. Chilled water storage tank: Provide as necessary to eliminate short cycling of chillers is system volume is less than 1.58 liters per system cooling capacity of 3.51 kW. Tank shall include water baffles with low inlet and high outlet.

bb. All floor-mounted HVAC equipment shall be mounted on 4” concrete pads.

1.2.7 Roof Mounted Equipment

Except for plumbing vents, exhaust fans, and louvered intake penthouses, no other mechanical equipment shall be located on the roof of the facility.

1.2.8 Vibration Isolation/Equipment Pads

Provide vibration isolation devices on all new floor mounted or suspended mechanical equipment . All new floor mounted mechanical equipment shall be provided with 150mm thick housekeeping pads which extends 150 mm all around equipment provided.

1.2.9 Permanent Maintenance Instrumentation

Provide sufficient instrumentation to aid maintenance personnel in balancing and/or troubleshooting mechanical systems. Instrumentation shall be provided in the media at each change in temperature and at all mixing points in air handling systems, at all discharges of air handlers, and at all return mains. Pressure gauges, thermometers, flow indicators, sight glasses, etc., shall be installed to be easily read from the adjacent floor. Separate pressure gauges shall be installed on both the suction end and discharge end of pumps. Provide an isolation valve on all pressure gauges. Thermometers shall have separable socket thermo-wells. Allow for the removal, repair, or cleaning of flow measuring devices without having to shut down the system. Provide a portable meter, with appropriate range, for each type of flow measuring device installed.

1.2.10 Temporary Control Instrumentation

Instrumentation shall be provided for the field calibration of all control and monitoring devices, and for the commissioning of the mechanical systems. Provide local indication measuring instrumentation for each of the HVAC control system components. Local instruments are to be independent of sensing devices used for the control system. The exceptions are air flow measuring stations, turbine flow meters, pitot tubes, and other flow measuring devices that may be shared as sensing devices by local indicating devices and control system devices and are required to be permanent. Local instruments are to be of industrial quality, must be certified as being factory calibrated, and must be capable of field calibration using standard procedures. Measuring provisions shall be provided at each varying input and control output in the system.

1.2.12 Utility Interruptions

Utilities necessary for this facility include electricity, natural gas and water. Certain limitations on utility interruptions apply. Unauthorized utility interruptions will not be permitted. Any work that requires a utility interruption shall be scheduled in advance. Outages are subject to postponement or cancellation by site authorities without prior notification. Coordination requirements of utility interruptions shall be in accordance with SECTION 00800 SPECIAL CONTRACT REQUIREMENTS. All utility interruptions shall be identified with notes on the project drawings.

1.2.13 Power Outage Start-Up

Upon an electrical power outage, all air handling units, pumps, and other major mechanical equipment will shut down and shall be restarted in a

logical and efficient manner. Timing between starts and sequence of equipment starting upon restoration of electrical power shall be provided and programmed into the HVAC temperature control system, with programming capable of being changed by the operating personnel.

1.2.14 Spare Parts Lists

Proprietary spare parts that require more than a 60 day lead time, and/or any special service tools shall be provided to the Government at the Final Inspection.

1.2.15 Equipment Room Diagrams

The following "As-Built" information, permanently mounted in a frame and covered by clear Plexiglas, shall be provided in the mechanical equipment rooms:

a. Air distribution diagrams and damper schedules.
b. Hot water piping diagrams and valve schedules.
c. Chilled water piping diagrams and valve schedules.
d. Control diagrams, control device schedules, and sequences of operation.

1.2.16 Interior Design - Color Coordination

All mechanical items located in finished areas and on exterior walls, shall be coordinated with and painted to match the color scheme requirements of CEGS Section 09915, COLOR SCHEDULE.

1.3 EQUIPMENT IDENTIFICATION AND ABBREVIATIONS

This Section contains requirements for the identification and abbreviation of mechanical equipment.

1.3.1 Equipment Identification

Provide a brass name tag for each valve, temperature control device, control system device, etc., installed in all mechanical systems. In addition, all mechanical equipment shall be clearly identified with a conspicuously located, permanent label. Mechanical equipment shall be identified by type and sequence number. For example, the air handling unit in the building shall be identified as AHU-1, the first hot water pump shall be HWP-1, the second hot water pump shall be HWP-2, etc..

1.3.2 Abbreviations

The following list of abbreviations shall be used to describe the HVAC equipment types:

Air Dryer	AD
Air Handling Unit	AHU
Boile R	BLR
Cabinet Unit Heater	CUH
Chilled Water Pump	CWP
Control Air Compressor	CAC
Control Valve	CV
Discharge Air Temperature	DAT

D omestic W ater H eater . . . . . DWH
E xhaust F an . . . . . EF
E xpansion T ank . . . . . ET
F an C oil U nit . . . . . FCU
F ilter B ank . . . . . FB
F in T ube R adiation . . . . . FTR
Gov't F urnished C ontractor I nstalled. . GFCI
Gov't F urnished G ov't I nstalled . . . . GFGI
H ot W ater P ump . . . . . HWP
H orizontal U nit H eater . . . . . HUH
L ocal C ontrol P anel . . . . . LCP
M otor O perated D amper . . . . . MOD
N ot I n C ontract . . . . . NIC
R e H eat C oil . . . . . RHC
R elief H ood . . . . . RH
S upply F an . . . . . SF
T ransfer F an . . . . . TF
V ertical U nit H eater . . . . . VUH

1.4 IDENTIFICATION OF PIPING

All exposed and concealed piping in accessible spaces shall be identified with color coded bands and titles in accordance with the requirements of CEGS Section 09900 PAINTING, GENERAL.

1.5 SEISMIC PROTECTION FOR MECHANICAL PIPING AND EQUIPMENT

This Section contains instructions and engineering requirements relating to the seismic protection design of new mechanical piping, ductwork, and equipment. The facility is to be considered standard occupancy type, essential mission classification. Piping, ductwork, and equipment shall be seismically restrained in accordance with TI 809-04, Chapter 10-3. The Guideline is based on Chapter 6 FEMA 302 and National Earthquake Hazard Reduction Program (NEHRP). Accordingly, contractor bracing may be provided by vendors, which are in compliance with these guidelines. Restraints for mechanical bracing shall be similar to the figures 10-12 and 10-13 in the TI-809-04, Chapter 10.

1.6 THERMAL INSULATION OF MECHANICAL SYSTEMS

Insulation requirements of new mechanical systems, including insulation of plumbing systems and equipment, hot water piping systems, chilled water piping systems and equipment, and the insulation of the duct systems shall meet the requirements of CEGS SECTION 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Heating piping in heated spaces and conditioned spaces shall be insulated. Hot water piping shall be required to follow tabulated thicknesses. Domestic hot and cold water piping shall be insulated. All ducts shall be insulated in the mechanical rooms and all supply ducts shall be insulated. Cold piping shall have a vapor barrier. High abuse areas shall have aluminum jackets such as janitor closets and mechanical rooms etc.. Internal liner/insulation can be used for low pressure supply ductwork as long as the overall R-value is as great as the specified/required external insulation and as long as the ductwork size is adjusted to accommodate (from a pressure drop perspective).

1.6.1 Insulation Covers

Provide reusable insulation covers at all check valves, control valves, strainers, filters, or any other piping component requiring access for routine maintenance. Insulation exposed to the weather or possible physical damage shall be covered by an aluminum metal jacket. All piping with metal jacket shall be identified on the drawings.

1.7 PLUMBING SYSTEM

This Section contains instructions and engineering requirements relating to the design of the new plumbing systems as required. A plumbing system consists of the domestic hot and cold water supply distribution system to the various plumbing fixtures; make-up water piping to the various hydronic type environmental control systems (i.e., expansion tanks, boilers, etc.); fixtures, and fixture traps; soil, waste, and vent piping; and shall extend from connections within the structure to a point 1.5 meters outside the structure. The design of all plumbing systems shall, unless otherwise stated herein, comply with the most current National Standard Plumbing Code and shall meet the requirements of CEGS SECTION 15400 PLUMBING, GENERAL PURPOSE. Traps for lavatories, and sinks shall be chromium-plated, adjustable-bent tube, 20-gauge brass, where exposed. All backflow preventers shall be installed for accessibility per National Standard Plumbing Code and shall comply with the requirements of the Department of Environmental Quality (DEQ) of the State of Colorado. State licensed plumbers shall install and/or test backflow preventers and cross connections devices. For Fire Protection backflow preventer requirements see Section 01008 FIRE PROTECTION REQUIREMENTS. Lead content in the water distribution system (including in-line devices) shall comply with SDWA of 1998 with amendments and ANSI/NSF 61, section 8. In-line devices shall include water meters, building valves, check valves, meter stops, valves and fittings and backflow preventers. Shower mixing valves shall be thermostatic mixing type.

1.7.1 Water Service Entrances

Water service entrance lines shall be installed below the recognized frost line (960 mm) below ground and enter the buildings through the mechanical room floors. Water service entrances shall be provided with a positive displacement type water meter up to and including 50mm, a turbine type water meter for greater than 50mm, and a reduced pressure principal backflow preventer with isolation valves located inside the building. Meters shall be provided with a direct non-resettable, digital readout and remote readout for interlock to the EMCS system. Meters shall have a pulse switch initiator capable pulse output of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments or 4-20 ma output. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. Meters shall be connected to the Staefa Control System. Meter shall have tele-metering capability.

1.7.2 Piping Runs

Piping runs in buildings shall be arranged to not interfere with movement of personnel and equipment. Neither water nor drainage piping shall be located over electrical equipment or panels. Domestic water piping located outside of mechanical equipment areas shall be routed in the ceiling space above the

corridors. Water and waste piping shall not be located in exterior walls or other spaces where there is possibility of freezing. Where piping is to be concealed in wall spaces or pipe chases, such spaces shall be checked to insure that clearances are adequate to properly accommodate the piping. Water piping shall be designed not to exceed a velocity of 1.8 meters per second at full flow.

1.7.3 Pipe Materials

Materials for domestic hot and cold water distribution systems shall be copper. All piping 2-inch and smaller shall be soldered using 95/5 tin antimony solder, piping 2/1/2 inches and larger shall be brazed. Multi-flame torch is not required for soldering or brazing. All underground water service, sanitary, waste, vent and drain shall be plastic piping; PVC or ABS.

1.7.4 Protection of Water Supplies

Cross connections between water supply piping and waste, drain, vent, or sewer piping are prohibited. Reduced pressure type backflow preventers shall be provided on all make-up water systems.

1.7.5 Fixtures

Plumbing fixtures (water closets, urinals, lavatories, kitchen sinks, etc.) shall conform to ASME standards the requirements of CEGS Section 15400 PLUMBING, GENERAL PURPOSE and with lead-free faucets. End-point devices shall meet lead leaching requirements of ANSI/NSF 61, section 9, i.e.. lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and endpoint control valves). In-line devices do not have to meet section 9 (ie. bath and shower valves, all drains, backflow preventers). Work shall consist of but not be limited to the following. Coordinate location with the architectural plans.

a. Kitchen sink in Break room.
b. Electric water coolers located near all rest room entrances.
c. Floor-mounted Janitor sink in Janitor's closet.
d. Waterless urinals shall not be allowed; maintenance is required to the trap once every 6 months.
e. Water conservation fixtures (low flow type) with automatic metering devices conforming to the CEGS SECTION 15400 shall be provided in all restrooms.
f. Floor mounted waterclosets in the restrooms.

1.7.6 Janitors Closet Sinks

A enameled cast iron or durastone floor mounted type service sink shall be provided in all janitor closets. Overall sink dimensions shall be approximately 700 mm x 700 mm. The depth of the floor sink bowl shall be approximately 250 mm.

1.7.7 Electric Water Coolers

Bi-level, accessible or barrier-free, Mechanically refrigerated electric water coolers shall be provided (as indicated on Architectural plans), with part of each suitable for use by the physically handicapped. Bottom spout

unit shall be 675 mm above finished floor. Spout shall be 860 mm above finished floor. The push bar shall be front or front and side mounted. Single mechanically refrigerated electric water coolers shall not be permitted. Cooler shall be lead-free and use CFC-free refrigerant R-134a. Unit shall provide a minimum of 15 L/hour at 10 degrees C.. Coolers shall be certified to meet ANSI/NSF 61, Section 9 and meet lead leaching requirements of section 9.

1.7.8 Water Hammer Arresters

Commercially available water hammer arresters shall be provided at all new quick closing valves such as flush valves and solenoid valves and will be installed according to manufacturers recommendations. Vertical capped pipe columns are not permitted in lieu of arrestors.

1.7.9 Not Used
1.7.10 Not Used

1.7.11 Wall Hydrants

Exterior freeze-proof wall hydrants with vacuum-breaker-backflow-preventer shall be located on outside walls of the facility. A wall hydrant shall be provided near all Mechanical Room exterior doors and another one provided on the other side of the building. Exterior wall hydrants shall be mounted 600 mm above finished grade. Install one wall hydrant at the catwalk for cleaning of the windows.

1.7.12 Wall Faucets

An interior wall faucet shall be provided in all Mechanical Rooms. Wall faucets shall be mounted 900 mm above the finished floor.

1.7.13 Waterclosets

Floor mounted waterclosets with flush valve, siphon-jet, elongated bowl. Floor flange shall be copper alloy, cast iron or plastic.

1.7.14 Urinals

Wall hanging with integral trap and extended shields. Top supply connection, back outlet with siphon-jet.

1.7.15 Service Stop Isolation Valves

For normal maintenance or replacement, servicing stop isolation valves shall be installed in water connections to all installed new equipment and new fixtures. In addition, stop valves shall be provided to isolate portions of systems so as to not require shutdown of entire systems. Stop isolation valves for piping and equipment shall be shown on the drawings. Service stop isolation valves to faucets shall meet ANSI/NSF 61, section 9 lead leaching requirements.

1.7.16 Floor Drains

A floor drain shall be provided in all mechanical rooms, toilet rooms/lockers, shower drying areas, and janitors closets. To prevent traps

from drying out, deep seal traps shall be provided on all floor drains located in areas other than mechanical rooms.

1.7.17 Cleanouts

On straight runs of pipe, cleanouts shall be provided at not more than 15 meters apart. Cleanouts shall be provided at each change of direction of pipe and shall be provided at the base of all storm, soil, waste, and vent stacks.

1.7.18 Plumbing Vents

Where feasible, combine circuit vents in a concealed space to a main vent through the roof in lieu of an excessive number of individual vents through the roof. All vent lines through roof shall be 100 mm and terminate a minimum of 150 mm above finished roof. Where vents connect to horizontal soil or waste lines, the vent shall be taken off so that the invert of the vent pipe is at or above the centerline of the horizontal soil or waste pipe.

1.7.19 Duct Drainage

Outside air intake louvers and louvered penthouses shall be ducted and shall have provisions to dispose of melted snow and wind-blown rain, which enters through the louvers. The duct seams shall be sealed watertight soldering or brazing is required - and a drain provided at the duct low point. The drain shall be routed to a floor drain. Duct access doors shall be provided near the louvers.

1.7.20 Domestic Hot-Water

a. Domestic water heaters shall be located in the mechanical room and as adequately sized. New heaters shall be gas fired with a combined water storage tank. The capacity of the water heaters shall be adequate to meet the peak hot water requirements of the facility and shall be designed in accordance with Chapter 48, Service Water Heating, of the 1999 ASHRAE HVAC Applications Manual. An inlet water temperature of 4 degrees C. shall be used for sizing the water heater. Minimum efficiency shall be 80 percent for gas-fired type. Water storage temperature shall be approximately 49 degrees C. to prevent bacterial growth within the tank. Electric instantaneous water heaters may be used or remote restrooms and Cab sink in the tower.

b. Domestic Water Heater Vents

Domestic water heater vents shall be type "B", and shall conform to UL 441. Boiler stacks and domestic hot water heater vents shall not be tied together. Height of vents shall be as required by NFPA 54 and shall be provided with a rain cap. Also, see paragraph Vents and Stacks.

1.7.20.1 Domestic Hot Water Re circulation System

Domestic hot water recirculating pumps shall be provided for each water heater when distance served exceeds 30 meters. Pump sizing shall be in accordance with simplified pump sizing method 1995 ASHRAE Applications Manual unless specific conditions warrant the need for more detailed calculations. The system shall continually circulate domestic hot water in

order to insure that domestic hot water is available at each fixture without delay. The domestic hot water recirculating pumps shall be all bronze for long life. A clock or other automatic control shall be installed on domestic hot water circulation pumps to permit operation only during periods of occupancy plus 30 minutes beforehand. Initial operation shall be 24 hours per day.

1.7.21 Storm Drainage

Where required storm drainage system shall include roof drains, overflow drains, leaders, and conductors within the building to a point 5 feet outside the building. Where required by the architectural drawings, roof drains, with auxiliary overflow drains, shall be provided at the low points of the roof. Storm water shall be routed through one common interior downspout and piped directly to the facility storm system. Horizontal storm drain piping shall be plastic. Roof drains shall be designed for a maximum rainfall rate of 6.1 inches per hour (101mm per hour) and shall be sized in accordance with the National Standard Plumbing Code. All elbows for the storm drainage and overflow drainage piping 10 inches and smaller shall be 90 degree short sweep elbows.

1.7.22 Cathodic Protection

Cathodic protection shall be provided for any new underground metallic piping, fittings, and valves except cast iron soil pipe. Design of cathodic protection system shall in accordance with Section 01007 ELECTRICAL REQUIREMENTS, paragraph entitled "Cathodic Protection".

1.8 EXTERIOR GAS DISTRIBUTION SYSTEMS

This Section contains instructions and engineering requirements relating to the design of the new exterior natural gas distribution system where required, including the building gas service lines and gas service regulator assemblies. The gas distribution systems shall be designed in accordance with NFPA-54 and shall meet the requirements of CEGS Section 02556 GAS DISTRIBUTION.

1.8.1 Service Line

a. A new service line shall be provided from the high pressure 1½" natural gas line running along Airfield Drive 3500 feet south of the site. The design/build team must verify capacity in the existing line is adequate for this project as well as the existing facilities served by this line. The new service shall have an isolation valve on an anodeless riser. The tap into the existing line may be a "hot tap" and the Base Fire Department shall be given 30 days advance notification of the date of the tap (see paragraph Service Line Sizing below). The point of connection shall be provided with a shutoff plug valve, conveniently located outside of any traffic area and protected with a valve box.

Service lines shall not be installed under or routed through the facility. Except for piping located at the new gas meter/service regulator assemblies, no aboveground gas piping shall be exposed to view. The service line shall enter the buildings in an accessible location outside the mechanical room(s). The gas meter/service regulator assemblies shall be hidden from view to the greatest extent possible.

b. Service lines to buildings shall run parallel and/or perpendicular to the building lines, shall be buried at least 450 mm below the ground surface, shall not be laid in the same trench with other utilities, and shall be above other utilities whenever they cross. Gas lines shall not be laid under paved streets, parking lots, roads or in other locations subject to heavy traffic whenever practicably avoidable and economically feasible to locate elsewhere. Whenever it is necessary to locate gas lines in such locations, the lines shall be protected by suitable cast-iron-pipe encasement or by burying to a depth to provide at least 1.25 meters of cover over the top of the pipe, except that gas lines shall be provided with suitable cast-iron-pipe encasement when laid under new or existing paved streets, and parking lots.

c. All manholes, valve boxes, or inlets of any nature within the project that do not conform to the new finish grade in either surfaced or unsurfaced areas shall be adjusted to the new finish grade. Where inlets, manholes, or valve boxes fall within a surfaced or unpaved roadway or parking, the existing frames and cover shall be removed and replaced with a heavy-duty frame and cover. The structure shall be adjusted as needed to fit the new conditions. All structures shall be of a type suitable for the intended use and shall conform to the requirements of the applicable section of these specifications

1.8.2 Service Line Sizing

The size of the service lines shall be sufficient to supply the demand without excessive pressure drop and shall not be less than 25 mm in size.

1.8.3 Service Line Materials

All new underground service lines shall be polyethylene and all aboveground lines steel.

1.8.4 Service Line Markers

New underground service lines shall be identified by a permanent on grade utilities marker, which indicates the type of service and depth of burial. Markers shall be located a maximum of 30 meters apart on straight runs and at every change in direction. Markers in high traffic areas shall be protected from physical damage. Markers shall consist of a stamped or engraved brass name plate embedded in concrete.

1.8.5 Service Line Protection

New below grade lines shall be protected from physical damage by placing a continuous, detectable plastic ribbon in the trench such that any excavation will uncover the ribbon prior to reaching the line. When non-ferrous service lines are in stalled, a foil backed magnetic tape shall be installed above the pipe to permit locating with a metal detector. Metallic tracer wire shall be provided for all non-ferrous service lines.

1.8.6 Cathodic Protection

Cathodic protection shall be provided for underground metallic piping and metallic fittings. Design of cathodic protection system shall in accordance with Section 01007 ELECTRICAL REQUIREMENTS, paragraph entitled "Cathodic Protection".

1.8.7 Gas Meters

A new gas meter shall be provided as part of the new service regulator assemblies. Meters shall be provided with a direct non-resettable, digital readout. Meters shall have a pulse switch initiator capable pulse output of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments or 4-20 ma output. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall provide not less than one pulse per 2.8 cubic meter of gas. Meters shall be connected to Staefa Control System. Meter shall have tele-metering capability.

1.9 INTERIOR GAS PIPING SYSTEMS

This Section contains instructions and engineering requirements relating to the design of new interior natural gas piping systems. Interior gas piping systems shall extend from the outlet of the gas service regulator/meter assembly to the point of connection of each gas utilization device. The aboveground gas piping system shall be steel designed in accordance with NFPA 54 and shall meet the requirements of CEGS Section 15190 GAS PIPING.

1.9.1 Gas Piping

Piping shall be sized in accordance with NFPA 54 to supply the demand without excessive pressure drop between the point of delivery and the gas utilization equipment. Minimum interior gas pipe size shall be 20 mm. The calorific value of the natural gas to be used in calculations for sizing equipment and piping is 31300 KJ per cubic meter. Gas piping shall be shown on the mechanical HVAC Drawings.

1.9.2 Equipment Connections

The final connection to gas equipment shall be made with rigid metallic pipe and fittings. Accessible gas shutoff valve and coupling are required for each piece of gas equipment.

1.10 HYDRONIC HEATING SYSTEMS

Heating system shall be a forced-air/hot water system consisting of one natural gas fired boiler, water distribution system, two circulating pumps, (and associated space heating equipment). The heating system shall be capable of providing all heat for the building (including all outside air ventilation loads). The heating water piping system shall be used to circulate hot water to the heating equipment during the heating season as indicated herein. The heating system designs shall meet the requirements of CEGS Section 15569 WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH and, unless otherwise stated, shall comply with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbooks and Terminology of HVAC&R guide. The heating system design shall include safeguards to protect against freezing damage. Hot water pipe velocities shall be sized to not exceed 2.5 m/s. Hot water reset shall be provided such that the boilers' discharge temperature does not vary but rather the system supply temperature varies (from 48.9/120 to 93.2/200 degrees C/F - adjustable). This shall be accomplished by means of two 3-way valves with two boiler circulating pumps (one 3-way valve and circulator per boiler).

The system hot water supply temperature shall be 93.2/200 degrees D/F (adjustable) when negative 17.8/zero degrees D/F outdoors and shall be 48.9/120 degrees C/F when 12.8/55 degrees D/F (adjustable) outdoors.

1.10.1 Boiler

The hot water supply shall be heated to 95 degrees C. and supplied by natural gas-fired, water-tube type boilers rated for a pressure of 207 kPa. Boiler shall be provided with a forced-draft unless noted otherwise, modulating burners and shall be interlocked with water flow sensor to provide a continuous flow of hot water to the facility at outdoor temperatures below 18 degrees C. (adjustable). The hot water system supply temperature to the space shall be automatically controlled by manufacturer's standard controls. The boiler shall be interlocked with it's heating water flow sensor through the control system, such that the boiler's burner cannot fire unless flow is present through the boiler's piping system. The boiler shall have a minimum efficiency of 80 percent.

1.10.1.1 Boiler Connections

Design of boiler connections and auxiliary equipment shall conform to the requirements of ASME Boiler Code.

1.10.1.2 Low-Water Cutoffs

Float-type safety water feeders with low water cutoffs shall be provided for the hot-water boilers.

1.10.1.3 Water Column Connections

Provide crosses at right-angle turns on water column connections to boiler.

1.10.1.4 Smoke Connection

Boiler flue stack connections shall be in accordance with NFPA 211. Also, see paragraph Vents and Stacks.

1.10.1.5 Boiler Flue Termination

The boiler flue shall extend up through the roof of the building. The flue shall be provided with a rain cap fitting.

1.10.1.6 Boiler Location

The boiler shall be located in the mechanical room.

1.10.1 Heating Water Circulating Pumps

The heating water shall be circulated by two parallel in-line, centrifugal pumps with mechanical seals. Each pump shall be sized for 100 percent of the maximum required heating water flow and 100 percent of the maximum system head pressure. The pumps capacity shall be based on a 95 degree C. supply and 82 degree C. return water. The pumps shall be non-overloading allowing the pump to operate at any point on its characteristic curve. Each pump shall be provided with a suction diffuser and shall be mounted on a 150 mm

thick concrete housekeeping pad. Each pump shall be provided with a calibrated bronze balancing valve. Pumps shall run at temperatures below 18.3 degrees C. If one pump should fail, the other stand-by pump shall start (providing 100% of the full flow capacity). Lead/lag pumps shall be alternated automatically so that each pump has approximately the same run time after 14 days of use.

1.10.3 Variable Air Volume Box Reheat Coils

Each VAV Box shall be provided with a two-way control valve. Leaving air temperatures for reheat coils shall be a minimum of 40 degrees C while at 75% of maximum cooling airflow rate (L/s). Heating shall be provided with the automatic volume damper at approximately 75% of the maximum cooling airflow rate (L/s).

1.10.4 Pipe Expansion

In runs of pipe 15 meters and longer, or in shorter runs where required, indicate on project drawings, the location of all anchors, bends, loops, and pipe guides to adequately limit and provide for pipe expansion. Do not use expansion joints in piping unless absolutely necessary and justified. Anchors and guides shall be indicated on the project drawings and detailed for installation in the building structure provided. The structural Design Engineer shall be thoroughly informed of all forces generated.

1.10.5 Vents and Stacks

Stacks shall be in accordance with NFPA 211. Generally all stacks will be of the prefabricated type with individual stack provided for each appliance. Stacks are generally used for forced draft applications. Vents shall conform to UL 441 and be Type B. Vents are generally used for atmospheric burners only. Vents can be tied together to a main vent. Combined stacks shall not be used for appliances with power burners or draft fans. Stacks and vents can not be tied together. Height of stacks and vents shall be as required by NFPA 54 and shall be provided with a rain cap.

1.10.6 Heating of Mechanical Equipment Room(s)

The mechanical equipment room(s) shall be provided with a thermostatically controlled, hot-water, horizontal throw unit heaters to maintain a space temperature of 7 degrees C minimum. The unit heater airflow shall be directed toward the combustion air intake(s) in order to warm the combustion air.

1.10.7 Combustion Air

The mechanical equipment room(s) shall be provided with combustion air louvers sized and located in accordance with NFPA 54. The combustion air louvers shall be provided without dampers and shall be ducted to within 12 inches (300 mm) of the mechanical room roof (in order to minimize the potential for piping freeze-up in the mechanical room due to combustion air intake).

1.10.8 Fintube

Fin tube shall not be allowed.

1.10.9 Unit Heaters

Thermostatically controlled, hot water unit heaters are permitted in non-administrative areas, mech. room(s), and elect. room(s) except that unit heaters shall not be installed in main entrance vestibule(s)- these shall be recessed fan coil units instead for aesthetic reasons.. Unit heaters shall cycle on and off to maintain setpoint.

1.10.10 Electric Resistance Heating

The use of electric resistance heating is not permitted.

1.11 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

This Section contains instructions and engineering requirements relating to the design of the new HVAC supply and distribution systems. The design of all systems shall comply with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbooks, to the requirements of NFPA Standards Nos. 90A and 96 Terminology of HVAC&R shall meet the requirements of CEGS Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS. Mechanical ventilation and ventilation requirements for occupants shall provide the minimum outdoor air supply rates for occupants in heated or air-conditioned facilities, or both, required by ASHRAE Ventilation Standard 62. Air distribution systems shall be designed to prevent infiltration at the anticipated prevailing wind. Design of variable air volume systems shall ensure proper ventilation rates at low and high system air flow by providing constant volume of outside air. Cooling shall be produced by mechanical ventilation and air conditioning. The use of gas-fired "unit heaters & air-handling units or furnaces" is not permitted. Equipment capacities and flows shall be corrected for altitude on drawings (schedules). Noise Criteria unless otherwise indicated is as follows:

a.	Equipment rooms	= 60 NC (max)
b.	Administrative/Office areas	= 30 NC (max)
c.	Lobby/Toilets/Corridors	= 40 NC (max)
d.	Conference rooms	= 32 NC (max)
e.	Control Tower Cab	= 25 NC (max)

1.11.1 System Designs

All spaces in the facility except for stairs, vestibules, interior janitor closets and interior storage closets shall be either (A: heated and also ventilated by mechanical ventilation) or (B: air-conditioned) as indicated. Vestibules, stairs, etc, shall be heated for freeze protection of sprinklers only (or Mechanical design shall be coordinated with the Fire Sprinkler Installation for freeze protection). Ventilation in rest rooms/lockers, storage/laundry and janitors shall be for odor exhaust only and shall be provided with time clock control. Unheated or air conditioned closets and storage areas in air-conditioned facilities shall be provided either directly with air conditioned air or provided with exhaust to transfer conditioned air to adjacent spaces. Building shall be maintained at a positive pressure when operating. Excess outside air shall first be relieved through areas generating odors (such as toilet rooms & lockers) then through relief system.

1.11.2 Air Handling Units

1.11.2.1 Variable Air Volume AHU System

AHU-1A,1B in Mechanical Room serving the administrative areas and control tower shall be a modular type draw through unit equipped with a hot water pre-heating coil, chilled water cooling coil, and a filter section. The mixed air dampers shall modulate to maintain the minimum outside airflow rate. The two air handling units shall be provided and shall be 100% redundant. Units may be horizontal arrangement stacked vertically to optimize mechanical room space. An intake louver shall be provided on an outside wall and shall be ducted to the end of the AHU filter section. The pre-heating operation shall be capable of supplying the minimum outside air required at a constant discharge temperature and shall be selected with no more than 3 meters/second coil velocity. Minimum outside air shall be relieved through toilet exhausts. The AHU in mechanical room shall be a variable air volume system. The VAV air handling unit shall provide a variable volume of primary air, at a constant temperature, to VAV terminal units in the air handling system. The speed of the supply fan shall be modulated by a variable frequency drive to maintain a constant pressure in the air distribution system. Discharge air reset shall be provided. (ie. DAT = 12.8 degrees C. when RAT is greater than 25.6 degrees C. and DAT = 18.3 degrees C. when RAT is less than 21.1 degrees C.)[DAT=discharge air temperature; RAT= return air temperature; MAT=mixed air temperature; OAT=outside air temperature). An air flow station shall be provided in the outside air duct to the air handling unit filter/mixing section to provide and maintain minimum outside air requirements. Economizer mode shall not be used due to the large amount of electronics equipment in this facility that would be affected by large variations in space humidity. The VAV box minimums shall be set to maintain the AHU minimum ventilation rate for a fully occupied facility. During unoccupied hours and warm-up mode, the mixed air dampers shall be positioned for 100 percent re-circulation. Each temperature control zone is to be served by a VAV terminal unit that modulates the quantity of primary air supplied to each room with pressure independent controls, to maintain the temperature set point. When the damper in the VAV terminal unit closes to the minimum position, and the room temperature continues to drop, a control valve on the VAV terminal unit heating coil shall modulate open to maintain the room temperature set point. During the unoccupied and warm-up modes of operation, the VAV terminal unit dampers shall be at minimum position, and the VAV terminal unit heating valves shall be open. The air handling unit supply and return fans cycle to maintain the set back room temperature and to warm-up the rooms to the occupied heating set point during the warm-up mode of operation.

1.11.3 Filtration

Indoor air quality is of primary concern. The combined supply air, including return and outside air, shall be filtered by a combination of 25 to 30 percent efficient pre-filter(s) and 80 to 85 percent final filter as determined by the dust spot test specified in ASHRAE Standard 52.1.

1.11.4 Ductwork

Supply air duct (for all VAV ductwork upstream of the VAV boxes) shall be sized using the static regain method. All other ductwork shall be sized using the equal friction method. Supply air ducts from VAV air handling units to VAV boxes shall be built to at least medium pressure standards and class A seal requirements. Private offices shall be zoned by exposure and/or function and shall not be zoned with open areas or conference rooms.

The control tower cab and observation level shall be served by shut-off type VAV terminals with hot water reheat similar to the administrative areas. The terminals serving the cab shall be constant volume with the unit damper set to fail open. Ductwork sized using the equal friction method shall done using 0.6 Pa per meter for supply ducts and 0.8 Pa per meter for return and exhaust ducts. Medium pressure duct velocity shall never exceed 12 meters/sec. Ductwork shall be metal except for fan connections. Low pressure duct velocity shall not exceed 8 meters/sec. Ductwork serving Administrative areas shall typically be run above the ceiling in the corridors. Fifteen feet (4.6 m)of return air duct to each air handling unit shall be provided with acoustical liner 15 feet (4.6 m) (This is the minimum amount of return air duct that will be accepted for each air handling unit). Flexible ductwork shall never exceed 2 meters in length. All ductwork shall be constructed from galvanized sheetmetal, in accordance with SMACNA guidelines.

1.11.5 Variable-Air Volume Boxes

VAV Boxes shall be concealed above ceiling of the controlled space and provide varying amounts of conditioned air in response to a space thermostat. All VAV boxes shall be equipped with a hydronic reheat coil with a two-way control valve. Minimum heating airflow rate shall be set for 75% of full flow cooling airflow rate.

1.11.6 Ceiling Mounted Supply Diffusers

Ceiling diffusers shall be suitable for use in a lay-in ceiling or a gyp board ceiling and shall be located as necessary. All new diffusers shall be provided with a 4-way discharge pattern; standard diffusers with fixed discharge patterns are not permitted. Diffusers shall be sized to distribute the required quantity of air evenly over the space intended without causing noticeable drafts, air movement faster than 15 meters per minute in the occupied zone, or causing dead spots anywhere in the conditioned space (Maximum velocity of 3 meters/sec with a NC of 30 maximum).

1.11.7 Ceiling Mounted Return Grilles

Ceiling return air grilles, suitable for use in lay-in ceilings or gyp board ceilings, shall be located as necessary. The maximum size of new return grilles shall be 600 mm X 600 mm, minimum size shall be 600 mm X 300 mm. Return grilles shall not be located close to outdoor openings or in locations where bypassing of supply air may occur. Recommended return air velocities based on free area of the opening shall be 3 meters/sec.

1.11.8 Supply and Exhaust Fans

Except for wall mounted propeller units, all fans shall be centrifugal type and connected directly to weather-proof louvers using ductwork. Low leakage motorized dampers shall be provided. Fans larger than 944 L/s in capacity shall be provided with V-belt drives. Care shall be taken to ensure that the noise level generated by exhaust fans and associated relief louvers is not transmitted to the exterior of the building. In-line fans located outside the main mechanical and electrical areas shall be the provided with a manufacturers standard acoustical enclosure to inhibit noise transmission to the adjoining occupied spaces. Sone value of fans measured 1.5 meters from fan inlet shall be less than 30 sones outside the mechanical equipment

room. Sound transmission data shall be submitted for approval and design shall indicate noise criteria on schedules.

1.11.9 Outdoor Intakes and Exhausts

New outdoor air intakes shall be located in areas where potential for air contamination is lowest such as away from overhead doors and such that noise is not transmitted to the interior of the building. Maximize the distance between intakes and exhausts by maintaining a minimum distance of 10 meters between intakes and exhausts and between intakes and toilet, janitor room and etc.. Motorized low-leakage damper with blade and jamb seals, shall be provided at all outside air intake and exhausts. If feasible, locate intakes and exhausts on different building faces. Maximum velocity through net area of air intakes shall be limited to 3 meters/sec. Required L/s shall be corrected for altitude.

1.11.10 Special Requirements

1.11.10.1 Toilet Rooms

The rest rooms shall be exhausted at the required rate (see paragraph Design and Operating Conditions).

1.11.10.2 Janitors Closet

The janitors closet shall be exhausted at the required rate (see paragraph Design and Operating Conditions). The required make-up air for the exhaust system shall be supplied through a door grille (sized for a velocity of 3 meters/sec or less).

1.11.10.3 VAV Box System For Control Tower Cab

The control tower cab shall have its own VAV terminal boxes and respective thermostat controlled only by the cab occupants and located out of direct sunlight. HVAC load calculations must include 17.1 kW of equipment load and 15 people in the cab. Calculate Cab HVAC load with no shading on the windows. Multiple VAV boxes shall be used to allow for system back-up. The VAV boxes will be constant volume serving the Cab and located in the above ceiling of the observation room. Ductwork from the VAV boxes will run up to the raised floor area of the Cab to pressurize the raised floor area. Linear bar supply diffusers will be hard ducted down into the raised floor.

1.11.10.4 Mechanical Equipment Room(s) (MER)

The MER(s) shall be ventilated and cooled with outside air at a minimum rate of 20 AC/hr by a thermostatically controlled supply fan set to operate when temperature exceeds 29.4 degrees C.

1.11.10.5 Electronics Room

The electronics room shall be served by a dedicated VAV terminal unit(cooling only). HVAC load calculations must include 13.8 kW of equipment load.

1.11.11 Transfer/Return Air Openings/Ducts

These openings/ducts shall be sized for a velocity of no more than 1.17 M/s (200 fpm). The openings/ducts shall incorporate fire dampers wherever the fire rating for the respective wall is 1/2 hour or more. The OVERALL pressure drop for the worst case shall not exceed 12.5 Pa (0.05" water column" back to the air handler (so doors will not be difficult to open or held open and/or closed by the pressure differential created).

1.12 REFRIGERATION/CHILLED WATER SYSTEMS

These systems shall meet the requirements of CEGS Section 15650 CENTRAL REFRIGERATATED AIR-CONDITIONING SYSTEM and unless otherwise stated, shall comply with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbooks and ASHRAE 15. Refrigeration equipment provided shall utilize either refrigerant R-407 or HFC-134A (have an ozone depletion factor of 0.05 or less).

1.12.1 Air Cooled Chillers and Related Equipment

Each chiller shall be air-cooled and have it's own dedicated chilled water pump. All components (chiller, air handling unit, coils, pumps etc.) shall be corrected (both head pressure and flow) to give capacity with 35% propylene glycol. Two chillers, with 100% total design cooling capacity each (total design cooling capacity including all outside air loads for the entire facility), shall be provided. The entire chilled water system including all piping, equipment and appurtenances, shall be filled with a pre-mixed solution of 35 percent propylene glycol and 65 percent water (by volume). This solution shall be added after all pressure testing and cleaning of piping systems has been satisfactorily completed and prior to testing and balancing of the systems. Chiller shall be a packaged unit. Chiller shall be provided with at least four steps of capacity reduction. Chillers must include low ambient controls down to -10 degrees C to allow for year-round operation.

1.12.2 Chilled Water System.

Air-conditioning shall be designed chilled water/glycol mix as required in paragraph 1.12.1 as the cooling media. The pumping, piping and hydronic ancillaries scheme shall be designed to include components described for the HYDRONIC HEATING SYSTEM that are applicable such as piping, pipe expansion, air separators, expansion tanks, pumps, water treatment, air handling unit coils, etc. piping velocities shall be sized to not exceed 2.5 m/s.

1.12.3 Other Systems

The use of evaporative cooling, heat pump, and dx coil type systems <u>will not</u> be permitted.

1.12.4 Chilled Water Circulating Pumps

Two (one per chiller) base mounted centrifugal pumps with mechanical seals shall circulate the cooling water. Each pump shall be sized for 100 percent of the maximum required chiller capacity and 100 percent of the maximum system head pressure. The pumps shall be non-overloading allowing the pump to operate at any point on its characteristic curve. Each pump shall be provided with a suction diffuser and mounted on a 150-mm thick concrete housekeeping pad. Each pump shall be provided with a calibrated bronze

balancing valve and check valve. Pumps shall run at temperature above 18.3 degree C. (adjustable)

1.1.13 BUILDING TEMPERATURE CONTROL SYSTEMS

This Section contains instructions and engineering requirements for the design of the new building temperature control systems required for the operation of the building mechanical systems. The temperature controls shall be Staefa Controls and shall be fully integrated and connected to the Base EMCS Staefa system supplied by the Contractor and coordinated with Staefa Controls in this contract. The design of the control systems for the HVAC equipment shall be in accordance with CEGS Section 15951 DIRECT DIGITAL CONTROL FOR HVAC, attached. Staefa Controls shall re-program the head-end computer to accommodate the Control Tower facility and provide equipment and services, including software database programming, graphics generation, calibration and end-to-end testing of the head-end computer (in the EMCS room of Bldg. 2354, and this project's remote DDC panels, DTCs and temperature control panels. EMCS fiber shall be extended in accordance with Section 01007 ELECTRICAL REQUIREMENTS. The control system shall be designed to provide continuous and automatic control of all HVAC equipment. Where equipment is provided with a packaged control system, such as in the case of a boiler or chillers, the building control systems will interface with the equipment's packaged control systems. The temperature control panels shall be located in the mechanical room(s). The number of and types of equipment in the final design shall dictate the number of control panels. This type of control system(s) allows the building operator to easily adjust setpoint, operating times and other system parameters, if and when necessary, after the building has been occupied.

Notwithstanding Section 00700 Contract Clauses FAR 52.236-5, Material and Workmanship, for the DDC/EMCS shall be manufactured by Staefa Control Systems (SCS)in order that the systems installed are fully compatible and fully integrated and connected to the Base Staefa Control System. No other product will be acceptable. The competition Advocate authorizes sole source procurement.

1.13.1 General DDC Requirements

All mechanical systems and equipment, shall be controlled by local direct digital control (DDC) panel(s) located in the facility Mechanical room. The DDC panel(s) shall operate in a stand-alone fashion. A Staefa Control design shall be provided, using CEGS Section 15951 DIRECT DIGITAL CONTROL FOR HVAC, as attached. To facilitate maintenance and to allow manual starting and stopping of equipment by maintenance personnel, a hard-wired Hand-Off-Automatic (HOA) control switch shall be provided for each new major piece of equipment (air handling unit, pump, exhaust fan, etc.) in order to override the automatic DDC start and stop functions. Coordination with and input from the Base, and existing facility User & (Staefa Controls) has been required in order to ensure that the appropriate system points are monitored. The temperature controls for the control tower cab shall only be monitored by the base EMCS, the occupants shall have full control of the space setpoints.

a. Fire alarm condition on any fire alarm circuit shall automatically initiate the deactivation of the air handling units throughout the building.

b. All computing devices, shall be as defined in FCC Rules and Regulations FCC Part 15, and shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in FCC Rules and Regulations FCC Part 15.

c. Temperature Control Contractor Experience - The temperature control Contractor shall have a working knowledge of Staefa Control system and experience installing these systems. The Contractor shall provide for approval the names and qualification of supervisory personnel (i.e. Project Manager and /or Superintendent) that will be used on this project. The Contractor shall also provide a list of references to be contacted from recent projects on which the proposed personnel performed similar duties. Approval shall be based on previous experience with Staefa Controls systems, qualifications and demonstrated ability of proposed personnel to manage resources in an efficient and effective manner. Experience and supervisory personnel qualifications must be submitted and approved before submittal of any technical data.

d. Emergency Service - The Government will initiate service calls when the installed DDC/EMCS is not functioning properly. Qualified personnel shall be available to provide service to the complete DDC/EMCS installed under this project. Qualified personnel shall be defined as a factory trained journeyman in the brand of control system provided, this level of training shall be considered a minimum. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 8 hours after receiving a request for service. The control system shall be restored to proper operating condition within 3 calendar days after receiving a request for service. This requirement shall be for one year in addition to the warranty period at no cost to the Government.

e. Software - The Contractor shall provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with base operators, and shall be incorporated into the operations and maintenance manuals, and software documentation provided as submittals in section 15951. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Contractor's software.

f. All utility meters shall be connected to the base Staefa Control System to allow the necessary monitoring.

g. Fuses shall not be used for surge protection.

h. System descriptions and analyses submittal shall include "and shall indicate how new system will interface with the existing Base EMCS as manufactured by “Staefa Controls”

i. Scheduled inspections shall be at the beginning of construction.

j. Temperature sensors for the DDC controllers shall be selected to be standard Platinum 100 Ohm elements that would permit their use with electronic or DDC controls from other sources of supply. Other readily available control devices or standard commercial grade control devices as normally sold by the major temperature controls companies and necessary for control system operation shall be specified.

1.13.2 Existing Staefa Controls System Interface

The control system serving the facility shall be a system expansion of, and sourced to match, the existing Base EMCS. All services, materials, equipment, hardware, and software necessary to install the EMCS expansion

and for interfacing to the existing system shall be provided. At the completion of the system expansion, all the new control panels and input and output control points/devices shall be fully integrated into the existing system.

Operator Access

Access to the system expansion by the Base EMCS operators shall be seamless via the existing workstations on the EMCS LAN and the expansion connections to it. That is, it shall require no different hardware or software or operation steps to access than any of the control panels on the existing system. System expansion access shall allow the EMCS operator to perform the following real-time functions on the new equipment using the same workstations and software required for accessing the existing EMCS:

a. Display the status of all inputs.
b. Display and manually change the status of all outputs.
c. Display and adjust all control loops and all other permanent (battery-backed RAM and/or EEPROM-based) database parameters.

Graphic Screens

Provide and integrate graphic display screen files into the existing system, each consisting of a schematic diagram of a mechanical system with real-time statuses of new inputs and outputs superimposed upon the schematic diagram. In conjunction with existing software base packages, the screens shall allow an operator to not only view, but also command changes to the statuses of all outputs.

Alarm Monitoring

Alarm monitoring shall be provided for all major pieces of equipment. Indication of failure shall alarm at the existing EMCS Operators Workstation. The maximum allowable time for the EMCS to display an alarm condition is 10 seconds starting from the time the alarm condition first exists. The maximum allowable time for equipment to respond to manual EMCS commands is 10 seconds starting from the time the command is initiated at the work station. The system expansion shall not impede the capabilities of the Staefa Control Systems to meet these requirements. Alarm monitoring shall include, but not limited to the following alarm indications:

Loss of flow
Loss of power
High and low pressure
Freeze detection
Summary alarm
Start/stop actual status different from commanded state

Each start/stop is to be paired with a true status input. EMCS alarms shall be generated whenever the status input state varies (longer than some adjustable time delay) from the corresponding output's matching state.

1.13.2.1 Not Used

1.13.2.2 Controllers

Except in the case of application specific controllers (ACS), All modulating mechanical processes (e.g., temperature, pressure, flow control) shall be controlled directly by the local DDC control panel. Except for safety and protection functions, software logic shall be used in lieu of relay logic. The contacts of safety and protection function instruments shall be hard wired in series with the common side of each equipment's HOA switch, and their proper operation shall not depend in any way upon the DDC.

1.13.2.3 Digital Controllers

Digital controller blocks or points within the control panels shall utilize a full proportional algorithm. Digital controller blocks or points within the control panels shall utilize a full proportional-integral-derivative (PID) algorithm which can provide the following combinations of control modes: P, PI, PD, and PID. Controllers shall eliminate integral windup when controlled equipment is shutdown. Provide remote adjustment capabilities for the following parameters via the normal Staefa Control Systems operator interface:

a. Input manual/automatic.
b. Input value in engineering units (when in manual).
c. Proportional, integral, and derivative gains.
d. Direct/reverse action.
e. Output manual/automatic.
f. Output value in percent of full output range (when in manual).
g. Anti-windup initiation.

1.13.2.4 Stand-Alone Operation

The local control panels, although fully integrated into Staefa Control Systems network, shall be capable of stand-alone operation in the event of a complete failure of the network. When communication is lost with the network, local programs, including those based upon real-time clock or calendar events, shall continue to function without operator intervention. "Local" or "non-global" programs are considered to be those which are not dependent upon multiple controllers for either input information or output actuation. A program which requires a shared input, or "global" value, communicated over the network from another controller (e.g., a boiler temperature reset based on outside air temperature) shall continue to operate with the last valid value received prior to a loss of communication.

1.13.3 Input/Output Devices

The control system shall utilize off-the-shelf input and output instruments (e.g., RTD sensors, actuators, relays) which are commercially available from third party vendors and who are independent from the DDC panel manufacturers.

1.13.4 Analog Sensors, Digital inputs & Digital outputs

All sensing devices shall be capable of removal from the system without disruption of service to the system in which they are installed. Sensors provided shall include, but not limited to, the following:

Supply air, return air, & outside air; Air Flow Measuring Stations (to be shown on mechanical HVAC drawings)

Boiler inlet temperature
Boiler outlet temperature
Boiler fuel flow
Boiler water reset
Heating water flow
Chilled water flow
Chilled water inlet temperature
Chilled water outlet temperature
Space temperature(s) (to be shown on mechanical HVAC drawings)
Outside air temperature sensors (to be shown on HVAC mechanical drawings)
Mixed air temperature sensors
Discharge air temperature sensors
Preheating Coil Controls
Heating Coil Controls
Chilled water Cooling Coil Controls
Hot water pump(s) status
Hot water pump(s) start/stop
Chilled water pump(s) status
Chilled water pump(s) start/stop
Air handling unit status
Air handling unit start/stop
Kilowatt meter
Gas meter
Water meter

Liquid flow measurement for use by the DDC system shall be performed by paddle wheel-type flow sensors only. Pitot-type sensing elements may be installed for local instrumentation used for testing and balancing purposes only.

1.13.5 Cable and Wiring

Cable and wire for the DDC system shall be separate from the distribution system serving any other system. All cable and wiring shall be installed in conduit. The data transmission media (DTM) shall be provided by the Contractor. The DTM shall be fiber optics cable complying to Class A computing devices as set forth in FCC Part 15. The Contractor shall provide data transmission media (DTM). DTM shall be as specified and extended as shown on the electrical drawings in accordance with section 01007 ELECTRICAL REQUIREMENTS.

1.13.6 Control Valves

Sizing of control valves shall take into account upstream and downstream fittings and shall be in accordance with Instrument Society of America standard ISA S75.01-1985.

1.13.7 Variable Air Volume Boxes

VAV boxes shall be fitted with DDC controllers and velocity sensors compatible with the existing Staefa Controls Systems. VAV box temperature sensors shall be located atop an associated return grille and be provided with 9.2 meters of sensor wire for future relocations. Where VAV air handling units with VAV boxes are provided, flow monitoring stations shall

be provided to ensure proper indoor air quality when operating at minimum supply air flows.

1.13.8 Damper Actuators

All dampers shall be provided with 4-20 ma-operated damper actuators.

1.13.9 Valve Actuators

All valves shall be provided with 4-20 ma-operated valve actuators.

1.13.10 HVAC Control Drawings

HVAC control drawings, for both the 60 percent and Final submittals, shall be in accordance with SECTION 01336 - 60 PERCENT DESIGN REQUIREMENTS, & SECTION 01338 - 100 PERCENT DESIGN REQUIREMENTS. Control drawings for each facility shall include a system schematic section, an elementary (ladder) diagram, a detailed sequence of control, a list of required components with a brief description of each component, a control panel detail, legend and schedules, a listing of input and output points and a matrix showing the point type, alarms and applications programs associated with each of the input or output points. EMCS details and points to be monitored will be detailed on the contract drawings and follow the conventions as set forth in TM 5-815-2. System I/O summaries will be detailed.

1.13.11 Control Schematic

The control schematic shall be a schematic representation of the HVAC system and the associated control equipment. The control schematic shall be drawn to a large scale to allow for ample space to indicate any necessary performance parameters such as setpoint, etc.. The control schematic shall be cross-referenced to the elementary diagram and the control panel detail by numbered terminal points. Each component shall be identified by a unique alphanumeric designator such as S1 for sensor number 1. This provides a means of cross-referencing to the description of components and the sequence of control. All major control items relative to the system shall be shown. This may include, but shall not be limited to:

Supply Fans
Filters
Cooling Coils
Heating Coils
Pressure Sensors/Switches
Flow Sensors/Switches
Freezestats w/manual reset
Smoke Detectors w/connection to the FACP
Temperature Sensors
Valves and Valve Actuators
Dampers and Damper Actuators
VAV Boxes

1.13.12 Elementary Diagram

An elementary diagram or diagrams shall be provided showing the wiring of the control system devices. It shall be drawn to a large scale for easy reading and to allow space for indicting performance parameters. The

elementary diagram shall be cross-referenced to the control schematic and the control panel detail through the use of numbered terminal points.

1.13.13 Sequence of Control

The sequence of control is a written statement of the operation of the system. It should be as detailed and complete as possible and it should refer to individual components by their alphanumeric designator whenever possible. The sequence shall break the overall system into sub-systems, such as supply fan control, mixed air control, pre-heating coil, heating coil control, cooling coil control, etc., and shall describe the operation of each of the subsystems. The sequence of control shall also describe the operation of all safety devices such as smoke detectors or freezestats, fire alarm interlock and shall describe the operation of the system in both the occupied, warm-up and unoccupied modes.

1.13.14 Description of Components

The description of components shall provide a generic description of the performance of each component. The components shall be referred to by their alphanumeric designator.

1.13.15 Control Panel Detail

The control panel detail shall show the intended mounting location of any devices that are to be located in the control panel or on the front face of the panel. All field sensors and controls will be connected to data terminal cabinets to provide ease of diagnosis and repair of the system components. DTC panels shall be as specified in section 15951 with installed spares plus 25 percent expansion of each type of I/O function being provided. Control panels and DTC panels shall be shown on mechanical drawings.

1.13.16 Legends and Schedules

The legend shall provide a definition of all symbols used in the control drawings. Schedules shall provide all necessary information to clarify the operation of the components or the overall system.

1.13.17 System Checklists and Startup Instructions

The designer shall develop Pre commissioning Test Checklists, Functional Performance Test Checklists, and Startup Instructions for each system and item of equipment controlled by the temperature control system and shall include them in the temperature controls submittals. Each system and item of equipment shall have its own separate Checklist and Startup Instructions. The Checklists and Startup Instructions shall be tailored to each individual component of the respective system or item of equipment and shall use the terminology and nomenclature used in the drawings and specification.1.14 TESTING, ADJUSTING, AND BALANCING (TAB)OF HVAC SYSTEMS

Testing, adjusting, and balancing shall be meet the requirements of CEGS Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS and all TAB shall be complete, including all test and inspection reports, before starting the EMCS Field Test.

1.15 CEGS SECTIONS

Government provided (CEGS) Corps of Engineers Guide Specifications (available to the Design-Build Contractor as indicated in Section 01332, SUBMITTALS FOR DESIGN) shall be completely edited and fully coordinated with the drawings to accurately and clearly identify the product and installation requirements for the facility. The specifications shall be edited in accordance with the designer notes associated with each specification and with the Specification Requirements (Division 01 General Requirement Specifications). In case of a conflict, the criteria found in the Specification Requirements (Division 01 General Requirement Specifications) shall take precedence. The provided specifications define the minimum requirements for items of equipment, materials, installation, training, operating and maintenance instructions, O&M manuals and testing that shall be provided for the facility. Where items of equipment, materials, installation, training, operating and maintenance instructions, O&M manuals or testing requirements are not specified in the provided specifications, special paragraphs within each applicable guide specification shall be prepared to specify those items. Specific items of equipment identified in the provided specifications but not required for the facility shall be edited out. The specification, SECTION 15951 DIRECT DIGITAL CONTROL FOR HVAC, has been completely edited by the Corps of Engineers' Designer for this project and is to be considered as an extension of the Specification Requirements. Government approval is required for any specification addition or deletion from SECTION 15951 DIRECT DIGITAL CONTROL FOR HVAC.

1.16 ENERGY USE BUDGET (EUB) COMPLIANCE CHECK

Design energy Usage (DEU)estimates shall be calculated for the new building to verify compliance with EUB. Energy Usage Budget shall be done without process loads. Values indicated below shall be the maximum EUB target allowed. DEU shall be less than Energy Usage (EUB) target values indicated in Table I.

Table I
Energy Usage Budget Target For This Project.

Building	Type	Region	EUB Target	Days/Week
Control Tower	W	6	680 Mjoules/sq. meter/yr	7

M = Million

1.16.1 Computer Simulation

The Energy Usage Budgets shall be calculated using a computer simulation. Method used must take into account the constantly changing temperatures, sun loads, etc., through a year's operation. Use of the program "BLAST" is encouraged. If "BLAST" is used, the "REVIEW SUMMARY REPORT" shall be included in the output report. Any program other than Building Load Analysis and Systems Thermodynamics "BLAST","TRANE TRACE 600",Carriers'

latest version, DOE 2.1.E or BESA (Canada) requires prior approval for use. Request for use must demonstrate compliance with the following:

1.16.1.1 Acceptable Engineering Procedures

The energy analysis and building simulation will use a computer program that is based on acceptable engineering procedures. Load calculations and the systems simulation will be on an hourly basis for 12 to 365 days. Although hourly data for 365 days is preferred, a minimum of 12 model days (a statistically average day per month) is acceptable. If calculations are based on less than 365 days, the weather data selected for these days will be statistically derived.

1.16.1.2 Capable of Change

The computer program must be capable of changing the various cooling and heating loads and the thermostat settings to simulate building operations and to simulate dead band and deck/coil reset control strategies.

1.16.1.3 Cooling and Heating Loads Influencing the Building Design

The program must consider all cooling and heating loads that influence the building design. These include solar, outside air, people, lighting, equipment, etc., as well as taking into account the thermal time lag of materials.

1.16.1.4 Alternatives

Some of the alternatives that the program should be capable of analyzing include:

a. Orientation of Building.
b. Wall and roof construction and insulation.
c. Dimensions of Building.
d. Window area, solar shielding, tinted, and single or multiple glazed windows.
e. Types of fuel.
f. Central heating versus individual systems.
g. Type of equipment.
h. Type of mechanical systems, e.g., Constant/Variable volume, single zone/multizone.
i. Type of lighting systems, e.g., standard incandescent or fluorescent and low wattage, high output lighting systems.

1.16.2 NOT USED

1.16.3 Summary Report

Provide a summary section in the separate energy analysis report and results in the design analysis. Include all input data such as U values, design temperatures, hours of operation, building population and size, etc. Include output data such as distribution percentages (lighting, heating, cooling, fan, etc.).

1.17 TRAINING

A training course (2 to 4 hours in the classroom or actual time to cover everything, whichever is greater) shall be conducted for 3 to 5 operating staff members (designated by the Contracting Officer) in the maintenance and operation of all systems. A two-week notice shall be given the Contracting Officer for start of training. For guidance in planning the required instruction, the Contractor shall assume that the attendees will have a high school education or equivalent, and are familiar with the systems. No training shall be scheduled until training manuals and O&M manuals have been approved by the Government. A minimum of 3 O&M manuals shall be provided for the instructions and 1 manual for each facility shall be given to the Contracting Officer to turnover to the Base Civil Engineer.

1.17.1 Training Course Content

The courses shall be taught at the project site. The training courses shall cover all the material contained in the Operating and Maintenance Instructions, and O&M manuals the layout and location of each system and shall include the following for each system:

a. Troubleshooting
b. Diagnostics
c. Calibration
d. Adjustment
e. Commissioning
f. Repair procedures

(1) Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification tests and the calibration,adjustment and commissioning reports shall be presented as benchmarks of the system(s) performance by which to measure operation and maintenance effectiveness.

1.18 **ENGINE-GENERATOR SYSTEM**.

1.18.1. Generator Set Selection. Designer notes contained in the Corps Of Engineers Guide Specifications should be read and understood prior to initiating design. It is not uncommon for manufacturer's standard cataloged generator sets to not meet the requirements of the guide specifications. Engines larger than those cataloged with standard generator sets are often required to conform to the guide specifications. The designer must ensure that adequate space is provided to accommodate a generator set that conforms to the specifications. A minimum of three generator sets shall be selected which conform to the specifications. The selections shall be included in the Design Analysis. Space for the generator set shall be based on the largest of the selected generator sets.

1.18.2. Generator Set Locations. Generator sets are located inside and should be provided with a remote radiator located outside to eliminate the ventilation problems associated with an interior radiator. If the radiator must be located indoors, provisions must be made to recirculate the discharge air from the radiator into the room to lessen the amount of outside air required. The recirculation dampers shall be controlled to maintain the space at 80 Deg.F during *winter. Interior generator sets shall be located on concrete equipment pad isolated from the building. When generator sets are located exterior, they shall be housed in a factory fabricated housing.

1.18.3. Mechanical Ventilation. Rooms containing generator sets shall be provided with mechanical ventilation to prevent excessive interior temperatures.

1.18.4. Jacket Water Heaters. Jacket water heaters will be specified for all generator set applications installed inside or outside. Glow plugs will be required for all units installed exterior. Either will not be required unless specifically requested by the Customer.

0.0.5. Fuel System. The design and installation of fuel systems shall conform to NFPA No. 30 and NFPA No. 37.

0.0.5.1. Fuel Tank. Fuel storage tanks shall be installed underground or above ground. Tanks will be double wall or provided with other leak and spill containment and leak detection conforming to Federal and local regulations. Piping shall be double walled with leak detection to meet all Federal and Local regulations. If the fuel tank is requested by the Customer to be installed above ground, the designer shall ensure that the Customer is aware that fuel conditioners may have to be added to the fuel in winter to prevent fuel gelling at low temperatures. Fuel storage tanks shall be sized for a 3-day fuel supply for standby units and a 30-day supply for prime power units.

0.0.5.2. Day Tank. An auxiliary or day tank should be provided to ensure a ready supply of fuel to the engine. Day tanks shall be sized to provide a minimum of two hours operating supply for the engine but in no case will the fuel storage capacity exceed that permitted by NFPA No. 31 and NFPA No. 51. Each day tank shall be provided with a vent to the exterior, an overflow piped to the main storage tank, and a valved drain. Day tanks shall be located so that when full, the fuel level is below the engine fuel injectors.

0.0.5.3. Fuel Piping. Fuel piping in prime power plants will be installed in floor trenches with removable covers. Fuel oil piping in standby plants will be installed to minimize tripping hazards and will be installed in floor trenches if practical.

0.0.6. Mufflers and Exhaust Piping. When generator sets are installed inside, the muffler shall be installed inside to eliminate unsightly exterior muffler installations. Mufflers and exhaust piping installed inside shall be insulated. Exhaust pipe outlets shall discharge horizontal, be directed away from buildings, and shall be a minimum 10 feet (3 m) above the ground. The discharges shall be mitered to minimize entry of snow and rain.

1.19 ELEVATORS

Elevator design and ventilation shall follow ANSI A17.1 and the Corps Of Engineers Guide Specifications.

1.20 COMMISSIONING OF HVAC SYSTEMS

This section contains instructions and engineering information relating to the commissioning of HVAC systems, including the pre commissioning checks and functional performance tests. Commissioning shall begin only after all work required in paragraphs entitled "Testing, Adjusting, and Balancing of HVAC Systems" and the "Temperature Controls System" have been successfully completed, and all test and inspection reports and operation and maintenance

manuals required in other Section's specifications have been submitted and approved. The commissioning of HVAC systems shall meet the requirements of CEGS Section 15995 COMMISSIONING OF HVAC.

a. Pre-commissioning Checks shall be performed for each item of mechanical equipment. Deficiencies discovered during these checks shall be corrected and retested prior to start of the Functional Performance Tests.

b. Functional Performance Tests shall be performed for each equipment item. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed.

c. Commissioning of HVAC systems shall begin only after all work required in related sections, including Sections HVAC Control Systems and TAB of HVAC Systems has been successfully completed. All test and inspection reports and O&M manuals shall be submitted and approved before commissioning is conducted.

-- End Of Section --