HVAC DESIGN CRITERIA

OUTDOOR DESIGN CONDITIONS (HOUSTON, TEXAS) PER ASHRAE 90.1–2004 TABLE 5.1.4): 96 DEG. F DB, 80 DEG. WB SUMMER; 28 DEG. DB WINTER. 1371 DEGREE DAYS HEATING; 7357 DEGREE DAYS COOLING; CLIMATE ZONE 2A

CODE INFORMATION:

APPLICABLE CODES INCLUDE BUT ARE NOT LIMITED TO:
2003 INTERNATIONAL BUILDING CODE
2003 INTERNATIONAL MECHANICAL CODE
2003 INTERNATIONAL ENERGY CONSERVATION CODE

ENERGY CODE PER ASHRAE / IES 90.1–2004– MANDATORY PROVISIONS

6.4 .1 ALL EQUIPMENT EFFICIENCIES SHALL MEET OR EXCEED THAT SHOWN IN TABLE 6.8.1 A THRU G
6.4.2 ENGINEER HAS PERFORMED HVAC LOAD CALCULATIONS FOR THIS PROJECT USING ELITE OR TRACE
6.4.3 CONTROLS
6.4.3.1 A DEAD BAND OF AT LEAST 5 DEGREE SHALL BE SET, WITHIN WHICH ENERGY IS REDUCED TO A MINIMUM.
6.4.3.2 HEAT SETPOINT CANNOT EXCEED COOLING SET POINT
6.4.3.3 AUTOMATIC SHUT DOWN AND SETBACK CONTROLS ARE PROVIDED.
OPTIMUM START IS PROVIDED FOR SYSTEMS > 10000 CFM
ZONE ISOLATION CONTROLS ARE PROVIDED.
6.4.4 INSULATION
6.4.4.1 PIPE AND DUCT INSULATION SHALL MEET TABLE 6.4.4.1.1
6.4.4.2 DUCT AND PLENUM LEAKAGE
6.4.4.2.1 DUCTS SHALL BE SEALED
6.4.4.2.2 DUCT LEAKAGE TESTS SHALL BE SPECIFIED WHEN APPLICABLE
6.5.4 .1 FLOW THRU INDIVIDUAL CHILLERS CAN BE AUTOMATICALLY SHUT OFF.

ENERGY CODE PER ASHRAE / IES 90.1–2004– PRESCRIPTIVE METHOD PROVISIONS

6.5.1.1 AIR SIDE ECONOMIZERS ARE NOT REQUIRED IN HOUSTON. WHEN SPECIFIED ECONOMIZERS AND CONTROLS SHALL MEET SECTION 6.5.1.1
6.5.1.1 WATER SIDE ECONOMIZERS ARE NOT USED ON THIS PROJECT.
6.5.2 SIMULTANEOUS HEATING AND COOLING IS NOT USED ON THIS PROJECT, WITH THESE EXCEPTIONS:
6.5.4 .1 HYDRONIC FLOW: PUMP SYSTEMS OVER 10 TOTAL HP ARE VARIABLE VOLUME VIA PUMP STAGING OR SPEED CONTROL. INDIVIDUAL PUMPS OVER 100 FT HEAD AND 50 HP SHALL HAVE VARIABLE SPEED CONTROLLER. FLOW THRU INDIVIDUAL CHILLERS OR BOILERS CAN BE AUTOMATICALLY REDUCED OR SHUT OFF.
6.5.4.3: CHILLED AND HOT WATER SYSTEMS OVER 300000 BTUH SHALL HAVE AUTOMATIC TEMPERATURE RESET
6.5.6 ENERGY RECOVERY IS REQUIRED FOR SYSTEMS OVER 5000 CFM AND 70% OUTSIDE AIR
6.5.9 COOLING SYSTEM WITH HOT GAS BYPASS SHALL ONLY BE USED IN EQUIPMENT HAVING MULTIPLE STEPS OF UNLOADING OR CONTINUOUS CAPACITY MODULATION

HVAC GENERAL NOTES (APPLY TO ALL SHEETS)

– DRAWINGS ARE DIAGRAMMATIC; CONFIRM DIMENSIONS AND LOCATIONS IN THE FIELD.
– RUNOUTS TO INDIVIDUAL AIR DEVICES ARE SAME SIZE AS AIR DEVICE NECK.
– DUCT SIZES SHOWN ARE FREE AREA
– SEE ARCHITECTURAL REFLECTED CEILING PLANS FOR TYPE OF CEILING AND LOCATION OF CEILING DEVICES.
– SEE ARCH ELEVATIONS FOR LOCATION OF WALL MTD DEVICES
– PLENUMS ARE CROWDED AND NOT ALL OBSTACLES ARE INDICATED. ALLOW FOR ADDITIONAL DUCT OR PIPE OFFSETS OR TRANSITIONS NOT INDICATED ON DRAWINGS
– SEAL ALL PENETRATIONS OF FLOORS, RATED WALLS, EXTERIOR WALLS
– CONTRACTOR SHALL SUBMIT DRWGS FOR ALL PERMITS IN A TIMELY MANNER AND PAY ALL PERMIT FEES
– PROVIDE ANY REQUIRED TEMPORARY UTILITIES
– SELECT AND INSTALL ALL EQUIPMENT TO PROVIDE CLEARANCE AROUND ALL HVAC EQUIPMENT CONFORMING TO MANUFACTURER'S MINIMUM RECOMMENDED SPACE FOR MAINTENANCE AND/ OR AIR FLOW AND SUFFICIENT TO ALLOW INSPECTION, SERVICE, REPAIR OR REPLACEMENT WITHOUT REMOVING ELEMENTS OF PERMANENT CONSTRUCTION OR DISABLING THE FUNCTION OF FIRE RESISTANCE RATED ASSEMBLIES.
– DO NOT RUN DUCT OR PIPE ABOVE ELECTRICAL PANELS
– ALL WORK IN OR ABOVE OCCUPIED AREAS SHALL BE AT OWNERS CONVENIENCE AND MAY BE DURING EVENINGS OR WEEKENDS. SCHEDULE ALL SERVICE INTERRUPTIONS IN ADVANCE WITH OWNER
–ONLY OWNER'S REPRESENTATIVE MAY SHUT OFF EQUIPMENT OR DISCONNECT UTILITIES
– VISIT SITE PRIOR TO BID––NO EXTRAS WILL BE ALLOWED FOR CONDITIONS THAT COULD BE READILY OBSERVED

HVAC SPECIFICATIONS

23 05 00 BASIC MECHANICAL REQUIREMENTS

Warranty: Guarantee labor and materials for 1 year. Warranties begin upon Owner's acceptance of substantial completion of the installation.
Shop drawings: Submit information on all:

- PIPING MATERIALS
- VALVES
- CONTROLS
- INSTRUMENTATION
- INSULATION
- PUMPS
- DRIVES
- VIBRATION ISOLATION
- Incomplete submittals will be returned to the contractor unreviewed. No time extensions or cost increases will be allowed for delays caused by return of incomplete submittals.

Operations and maintenance instructions: Provide 3 copies of operation and maintenance manuals to Owner. Provide within 90 days after the date of system acceptance. These manuals shall be in accordance with industry–accepted standard such as ASHRAE Guideline 1 and shall include, at a minimum, the following: (a) Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance. (b) Operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified. (c) Names and addresses of at least one service agency. (d) HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field–determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments. (e) A complete narrative of how each system is intended to operate, including suggested setpoints. Provide instruction on system operation to Owner's representatives.
Record drawings: Within 90 days after the date of system acceptance, provide record drawings in AutoCAD 2004 or higher, plus full size hard copy. Electronic backgrounds may be available from Engineer for a fee. Record drawings shall include as a minimum the installed location and performance data on each piece of equipment, air devices, control sensors, control panels, general configuration of duct and pipe distribution system including sizes, and the terminal air or water design flow rates.
Coordination: Provide Electrical Contractor with electrical requirements of approved equipment in sufficient time to order panel boards, disconnects, etc.
Access doors: Provide Milcor or equal as required for access to all valves, filters, controls, dampers or other devices requiring attention. Doors shall match wall or ceiling rating. Architect must approve location and appearance of all access doors. Access panels for fire or smoke dampers shall be openable without the use of tools.
Sleeves: Provide metal sleeves where pipes or control wiring penetrate walls

23 05 03 PIPES FOR HVAC PIPING AND EQUIPMENT

Air vents at high points; drains at low points. Provide dielectric unions between dissimilar metals.

HVAC condensate drains: Inside building use insulated copper or galvanized steel in environmental air plenums. Inside (but not in environmental air plenums) may use insulated Provide trap (unless HVAC unit is internally trapped) and clean out plugs. Size condensate drain per applicable code; size shall not be less that outlet size of unit or less than 3 /4 inches. Discharge condensate to an approved location inside or outside building. Do not discharge into a gutter system if that gutter discharges on to a public walk or street.

Chilled water–schedule 40 ASTM A53 black steel; or type L or M copper. System shall be rated for 150 psi.

Copper pipe fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube. Joints: Solder, lead free, ASTM B32, 95–5 tin–antimony, or tin and silver, with melting range 430 to 535 degrees F. Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 – 1480 degrees F.

23 05 16 EXPANSION FITTINGS FOR HVAC PIPING

Flexible pipe connectors: rubber bellows type.

23 05 23 VALVES FOR HVAC PIPING

Ball valves: Nibco Scott 580 NIB SEAL or eq. two piece, fullport, bronze body, stainless steel trim, memory stop, insulated handle.

Butterfly Valves: drop tight closure at rated working pressure. Bi–directional flow. Dry stem journals with no leakage to stems. One piece, cast iron, lug or grooved body with end–of–line liquid service at 200 psig with the downstream flange removed. Disc: Aluminum bronze or 316 stainless steel. Seat: Resilient EPDM liner molded to a rigid backing ring. Stainless steel stem. Manual lever actuator with memory stop. Worm gear operators for 8" and larger. Nibco or equal
Gate valves: Nibco Scott or eq., bronze body.
Check valves: Nibco Scott or eq., iron body swing check.

23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT

Pipe, duct and equipment hangers and supports shall be per the local code. Support piping at a minimum every 10' or less for 1" and larger pipe, every 6' on 3/4" or smaller. With copper pipe use copper hangers or tape at contact point.

23 05 48 VIBRATION CONTROLS FOR HVAC PIPING & EQUIPMENT

Pipe: All new piping shall be vibration isolated.
Pump: concrete inertia bases with spring isolators are required for all new pumps
Chiller: chiller shall sit on neoprene pads.

23 05 53 IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

Equipment: Permanent label (stencil, metal tag or engraved plastic) with unit tag or name and area or space served.
Piping: Provide pipe markers every 20ft. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Install after painting of pipes
Valve tags: Install engraved metal tags with corrosion resistant chain. Number tags consecutively by location. Tag Chart: Typewritten letter size list in anodized aluminum frame or plastic laminated.

23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC

Balance may be by a qualified employee of the mechanical contractor. Technician shall be AABC or NEBB certified.
Balance according with NEBB Procedural Standards –1999 Procedural Standards for Building Systems, or AABC 2002 Associated Air Balance Council Test and Balance Procedures.

Submit report (NEBB or AABC format). Include:
General data: Nameplate data on all equipment. Outside air temp.

Air–cooled chillers– chilled water pressures and temps in and out; flow rates
Pumps: Pressures in and out, rpm, amps, volts, impeller size

Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump speed shall be adjusted to meet design flow conditions. Exceptions: pump speed need not be adjusted: (a) For pumps with pump motors of 10 hp or less. (b) When throttling results in no greater than 5% of the nameplate horsepower draw, or 3 hp, whichever is greater.

HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. Submit test documentation.

No adjustment to existing equipment or systems serving the area are allowed without Owner's express knowledge and consent.

23 07 01 PIPING INSULATION

Pipe insulations, mastics and jackets located in environmental air plenums shall have maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

Primary condensate drains inside buildings– 3/4" Armaflex for entire length. No insulation required outdoors.
Chilled water– Closed cell insulations only (fiberglass is not acceptable) with vapor barrier sealant at all seams, joints and butts. Acceptable products are:

1. Koolphen 'K' or Resolco Insul–Phen phenolic foam with factory applied vapor retarder jacket
2. Pittsburgh Corning Foamglas. A vapor retarder jacket is not required, but a foil scrim kraft type All Service Jacket for decorative/ dbuse purposes shall be provided.

Minimum installed R value or thickness shall be per the local energy code. For ASHRAE 90.1 –2004, Table 6.8.3: minimum 0.5" for pipes 1.0" or smaller; minimum 1" for pipes 1.5"or larger (based on conductivity not exceeding .28 Btu per inch/hr–ft–degree F).
Insulation thickness shall also be of sufficient thickness to result in NO external surface condensation under the following conditions; as calculated by current version of 3E Plus® Insulation Thickness Computer Program developed by the North American Insulation Manufacturers Association (NAIMA)(submit calculations):

1. Chilled water temperature, degrees F: 44
2. Surface emittance of the submitted and approved jacket
3. Wind velocity: pipes outdoors: 15 miles per hour; pipes inside bldg : 0 mph
4. Ambient conditions:
   a. pipe indoors, but in non–conditioned areas such as garage: 90 degree F. and 90% relative humidity
   b. pipes inside the conditioned building shell: 80 degrees F. and 75% relative humidity

Vapor retarder jackets shall be:

1. Indoors and hidden from public view (i.e. above ceilings, in chases, or in mechanical rooms) : foil (or polypropylene)–scrim –kraft type All Service Jacket (ASJ) with self sealing lap; or Venture Clad 1577CW self adhesive zero perm vapor barrier jacket; white
2. Where specified to be painted: foil scrim kraft type All Service Jacket with self sealing lap; white
3. Where visible to the public, but not painted (mechanical rooms are not 'public'): Venture Clad 1577CW self adhesive zero perm vapor barrier jacket; standard color and finish as selected by Engineer

Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
Secure factory–applied vapor retarders and jackets with pressure sensitive adhesive self–sealing longitudinal laps and butt strips. Do not use staples.
Secure field–applied jackets with manufacturer's published method, such as bands and mastic; do not use staples or other methods that penetrate the jacket.
Follow manufacturer's instructions for field–applied vapor retarders.

At locations, size and spacings recommended by insulation manufacturer, provide: a) galv. steel shield between outside of pipe jacket and pipe support ; b) insert of compression resistant insulating material between support shield and piping and under finish jacket.

Install vapor stops at all changes in configuration such as elbows, flanges, valves, and insulation terminations and all locations on piping and equipment requiring maintenance including instrumentation connections. Vapor stops are also required where straight pipe runs exceed 24 ft between pipe supports. Vapor stops shall be constructed using reinforced vapor barrier mastic. When the vapor stop is dry, the adjacent layer of insulation shall be installed using joint sealer.

Vapor Barrier Mastic: Vimasco Vapor–Block, Fosters 30–80, #749 or Childers' Chil–Perm #CP–35, or as recommended by insulation manufacturer. Use to seal all fittings, valves, heads and equipment insulation prior to application of outer covering. Water–based, compatible with the insulation material and flexible at the environmental temperature.

23 07 02 EQUIPMENT INSULATION

Flame spread less than 25, smoke developed less than 50 as per ASTM E84, NFPA 255, UL273.
Pumps: Construct rigid insulation box around pump with removable sections for pump maintenance
Strainers: Insulation shall allow for screen removal
Chillers: insulate all sweating surfaces with Armaflex sheets

23 09 00 INSTRUMENTATION FOR HVAC

Pressure gages: 1 percent accuracy, ASME B40.1, bourdon tube, rotary brass movement, brass socket, recalibration adjustment, black scale on white background.. Supply and install pressure gauges in readily accessible locations in piping adjacent to the chiller so they can be easily read from a standing position on the floor. Gauges shall be Marsh Master or approved equal with 4 1/2–in. nominal diameter dial face. Scale range shall be such that design–operating values shall be indicated at approximately mid–scale.

Test plugs: Pete's Plug or equal, with temperature and pressure test gages.

Thermometers: ASTM E1, 2 percent accurate, red appearing mercury, lens front tube, adjustable joint with positive locking device. Scale appropriate to service. Supply and install thermometers in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Thermometers shall be Moeller or equal; adjustable, mercury–filled, with 7–in. long glass–faced metal cases, separable sockets and wells. Bulbs shall project sufficiently into the pipe to accurately measure fluid temperature. Cases shall have extensions of sufficient length to clear insulation.
Thermometer wells shall be installed in the entering and leaving water lines to the cooler and condenser

23 09 23 DIRECT DIGITAL CONTROLS FOR HVAC

Provide system consisting of temperature sensors, control valves, dampers and operators, indicating devices, interface equipment, low voltage transformers and wiring, apparatus, relays and accessories to operate mechanical systems and perform functions specified. Electrical control interlocks are the responsibility of the mechanical contractor. Motor starters are furnished by Div. 26, unless integral with equipment. Provide 120 volt power to system controllers and transformers. Control cabling shall be installed in conduit and electrical wiring in accordance with Section 26.

New work shall be an expansion to the existing Johnson MeTasys system.

Add new chiller and pumps to graphics.

Provide latest of version software plus all software updates during the 1–year warranty period. For the purpose of warranty servicing: include remote monitoring and trouble shooting of the chiller during warranty period.

Incorporate new sequences of operation, per section 23 09 93

Monitoring points or status measurements required are:
For the new chiller: start/stop; alarm status, chilled water setpoint adjustment. All alarm and monitoring points available from the new chiller control panel

For new chilled water pumps: start/stop; flow alarm

For each new Variable Freq Drive ; all data and alarms available from drive including drive speed, motor amps and cumulative kwh

23 09 93 SEQUENCES OF OPERATION

CHILLED WATER SYSTEM:

1. The new chilled water pumps will provide chilled water circulation through the new and existing chillers and the building distribution system. One pump will be located on the south end of the building and one on the north end, but each will be capable of supplying the entire flow to the system. One pump will be primary and the other back–up. The new cross–over connections will allow the flow to shift from north to south, depending on which pump is operating. Each pump will be controlled by a variable speed drive. The pump speed will be controlled based on maintaining a minimum pressure in the system.
   a. Reset pump differential pressure setpoint based on actual cooling demands of the airhandler chilled water valves, using this algorithm:
      Differential Pressure Reset. *The set point for differential pressure between supply and return lines should be reset at smaller time intervals than the supply water temperature reset and pump sequencing strategies (e.g., 5 min) using the following procedure:*
      1. Check the water valve positions (or controller output) for "representative" air handlers and determine the time-averaged values over the last decision interval.
      2. If more than one valve has been saturated at 100% open, then increase the differential pressure set point by a fixed value (e.g., 5% of the design value) and go to Step 4. Otherwise, go to Step 3.
      3. If none of the valves have been saturated, then decrease the differential pressure set point by a fixed value (e.g., 5% of the design value).
      4. Limit the differential pressure set point between upper and lower constraints.
   The building operator shall have the option to operate the chilled water plant manually or automatically.

2. Each chilled water pump and chiller shall have a starter mounted (pumps) or control panel mounted (chiller) Hand–Off–Auto (HOA) switch. When the HOA switch is in the Auto position, the pump or chiller controlled shall be stopped and started by the EMCS / interlock wiring. When the HOA switch is in the Hand position, the pump or chiller shall be manually started, subject to safety interlocks.

3. Manual Chilled Water Operation
   Each chilled water pump is individually started by command from the EMCS. Each chilling unit shall be hardware interlocked with its respective pump to start 20 seconds after the differential pressure switches in the chilled water piping to the water chilling unit indicate proper flow conditions. After each unit is started, it shall be individually controlled by the factory furnished controller to maintain a constant chilled water supply temperature of 42° F. When the chilling unit is stopped, the chilled water pumps shall shutoff. If the chiller continues to operate following shutdown of the chilled water pump, then an appropriate alarm shall be generated.

4. Automatic Operation of Water Chilling Units
   When the control mode selector switch is in the automatic position, the lead chilled water distribution pump shall be activated and controlled by it's variable speed drive responding to system pressure.

   A request for cooling from any one zone sensor shall cause the EMCS to energize the individual chillers with the system pump in sequence to meet the building load requirements.

   Each air handler controller will transmit a signal to the chiller manager that indicates its cooling requirements. Any area of the building that is in its maximum cooling position will transmit a signal to the chiller manager to provide additional cooling. The chiller manager shall compile all of the information received and reset the building chilled water supply setpoint as required. System must be capable of maintaining a discharge temperature of 55 deg. F at all times.

5. The chiller shall be equipped with complete factory operating and safety controls. A flow switch in the chilled water of the chiller shall be provided to be interlocked as recommended by the chiller manufacturer.

23 21 16 HYDRONIC PIPING SPECIALTIES

Air vents – Manual vents at all piping high points. Carbon steel barstock body, stainless steel ball, RTFE seats and seals, lever handle, ANSI Class 3000.
Drains: same as air vents
Strainer– Y pattern type with blow down valve piped to floor drain.
Pump suction fittings: Taco SD or equal
Combination fittings (shutoff, balance, check): Taco Plus One or equal
Safety Relief Valves: ASME rated direct spring loaded type, lever operated, with non–adjustable factory set discharge pressure.

23 21 23 HYDRONIC PUMPS

End suction: Frame mounted, bronze fitted, end suction, high efficiency motor; mechanical seal; Taco or equal. See schedule.

26 29 23 VARIABLE FREQUENCY DRIVES (provided by Mechanical contractor)

ABB ACH550, DANFOSS VLT6000, YASKAWA, TOSHIBA Q7 FLOWSAVER. Variable Frequency Drive mounted in a NEMA 1 enclosure with all of the below feature mounted and wired. LCD display keypad control, min. 3% input line reactor or 3% dc link reactor (harmonics meeting IEEE 519–1993), RFI/EMI Filters, adjustable acceleration and deceleration, auto restart with speed search, .95 true harmonic power factor correction, compatible with 4–20 ma or 0–10 vdc signal, electronic motor overload with phase to phase short circuit protection, ground fault protection, LCD display and keypad to include manual speed control with HOA operation, contact closure for remote alarm indication and run indication. Controls interface shall be BACnet, MODBUS, LON as dictated by control contractor
Manual bypass shall be provided.
Line voltage disconnect shall be provided.

#	REVISION DESCRIPTION	DATE
1	ISSUED FOR BID	11/04/10

CHILLER REPLACEMENT PROJECT
MHMRA BUILDING, 7011 SW FREEWAY
HOUSTON, TX

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REGISTERED
PROFESSIONAL ENGINEER
11/04/10

DATE: 11/04/2010
PROJECT # 10100.00
SHEET # M-4.10

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