



REPUBLIC OF THE PHILIPPINES  
**DEPARTMENT OF BUDGET AND MANAGEMENT**  
 GENERAL SOLANO STREET, SAN MIGUEL, MANILA

**SUPPLEMENTAL/BID BULLETIN (SBB) NO. 2**

This SBB No. 2 dated November 27, 2018 for the Project, "Supply, Delivery, Fabrication, Installation, Testing and Commissioning of Variable Refrigeration Flow Multi-Split System for the DBM Arcache Building," is issued to clarify, modify or amend items in the Bidding Documents. Accordingly, this shall form an integral part of said Documents.

PARTICULARS			CLARIFICATIONS / AMENDMENTS		
<b>Section VI. Schedule of Requirements</b>			<b>Section VI. Schedule of Requirements</b>		
<b>Item</b>	<b>Description</b>	<b>Delivery Date</b>	<b>Item</b>	<b>Description</b>	<b>Delivery Date</b>
xxx			xxx		
1	Supply, Delivery, Fabrication, Installation, Testing and Commissioning of Brand New Variable Refrigeration Flow (VRF) Multi-Split Air-conditioning System, as follows:	Within 45 calendar days after issuance of the Notice to Proceed (NTP)	1	Supply, Delivery, Fabrication, Installation, Testing and Commissioning of Brand New Variable Refrigeration Flow (VRF) Multi-Split Air-conditioning System, as follows:	Within 45 <b>120</b> calendar days after issuance of the Notice to Proceed (NTP)
	*Installation of pipes, fittings, conduits, insulation, etc.	Within 7 calendar days after issuance of the NTP		*Installation of pipes, fittings, conduits, insulation, etc.	Within 7 <b>30</b> calendar days after issuance of the NTP
	*Installation of the following indoor and outdoor units:	Within 45 calendar days after issuance of the NTP		*Installation of the following indoor and outdoor units:	Within 45 <b>120</b> calendar days after issuance of the NTP
xxx			xxx		

<b>Section VI. Schedule of Requirements</b>	<b>Attached are the Revised Section VI. Schedule of Requirements and the Revised Section VII. Technical Specifications</b>
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**Other matters:**

- The "No Contact Rule" shall be strictly observed. Bidders are not allowed to call or talk to any member of the Bids and Awards Committee, Technical Working Group or Secretariat effective December 4, 2018 right after the opening of bids.
- For guidance and information of all concerned.

**CLARITO ALEJANDRO D. MAGSINO**

*Assistant Secretary*

*Chairperson, DBM-BAC*

## *Section VI: Schedule of Requirements (Revised)*

The delivery schedule expressed as weeks/months stipulates hereafter the date of delivery to the project site.

Item	Description	Delivery Date
	The Contractor shall provide the needed materials, tools and equipment, manpower, and supervision needed for the Project.	
1.	<p>Supply, Delivery, Fabrication, Installation, Testing and Commissioning of Brand New Variable Refrigeration Flow (VRF) Multi-Split Air-conditioning System, as follows:</p> <p>*Installation of pipes, fittings, conduits, insulation, etc.</p> <p>*Installation of the following indoor and outdoor units:</p> <p><b>Indoor Units</b> <i>Wall Mounted</i></p> <ul style="list-style-type: none"> <li>- 51 units – 2TR 24,000 BTU/HR</li> <li>- 18 units – 1.5TR 18,000 BTU/HR</li> <li>- 2 units – 1.3TR 15,600 BTU/HR</li> <li>- 2 units – 0.6TR 7,200 BTU/HR</li> </ul> <p><i>Ceiling Cassette</i></p> <ul style="list-style-type: none"> <li>- 11 units – 4TR 48,000 BTU/HR</li> </ul> <p><b>Outdoor Units</b></p> <ul style="list-style-type: none"> <li>- 1 unit – 24.6TR 295,000BTU/HR, 14HP + 18 HP</li> <li>- 1 unit – 20.6TR 247,200 BTU/HR, 12HP + 14HP</li> <li>- 1 unit – 20TR 240,000 BTU/HR, 12HP + 14HP</li> <li>- 1 unit- 18TR 216,000 BTU/HR, 10HP + 14HP</li> <li>- 1 unit- 16TR 192,000 BTU/HR, 8HP + 14HP</li> <li>- 1 unit- 15.6TR 187,200 BTU/HR, 8HP + 12HP</li> <li>- 1 unit- 14.6TR 175,200 BTU/HR, 8HP + 12HP</li> <li>- 1 unit- 10TR 120,000 BTU/HR, 12HP</li> <li>- 1 unit - 9TR 108,000 BTU/HR, 12HP</li> <li>- 3 units – 8TR 96,000 BTU/HR, 8HP</li> <li>- 1 unit – 5TR 60,000 BTU/HR, 8HP</li> </ul>	<p>Within 120 calendar days after issuance of the Notice to Proceed (NTP)</p> <p>Within 30 calendar days after issuance of the NTP</p> <p>Within 120 calendar days after issuance of the NTP</p>

2.	Warranty	One (1) year for workmanship and five (5) years for the motor compressor from the issuance of Certificate of Acceptance.
3.	Response time for the repair and replacement of defective parts/units	Within twenty-four (24) hours upon receipt of written or verbal notice from AS-GSD

**I hereby certify to comply and deliver all the above requirements.**

\_\_\_\_\_  
Name of Company/Bidder

\_\_\_\_\_  
Signature Over Printed Name of Representative

\_\_\_\_\_  
Date

## ***Section VII. Technical Specifications*** ***(Revised)***

Bidders must state here either "Comply" or any equivalent term in the column "Bidder's Statement of Compliance" against each of the individual parameters of each "Specification."

<b>Item</b>	<b>Specification</b>	<b>Bidder's Statement of Compliance</b>
<b>1.</b>	<b>Scope of Work</b>	
1.1	<p>Work included: The works of the air conditioning contractor shall consist of furnishing all labor and materials, air conditioning equipment including all related incidental items for the complete installation and operation of the air conditioning system. Contractor shall provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances. Also, contractor shall provide the following;</p> <ol style="list-style-type: none"> <li>1. Materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available.</li> <li>2. Project management on-site supervision to undertake administration meet schedules, ensured timely performance, ensured coordination, established orderly completion and the delivery of a fully commissioned installation.</li> <li>3. Follow manufacturer's recommendation installation details and procedures for equipment, supplemented by requirements of Contract Documents.</li> <li>4. The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist in the drawings or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Consultant in writing during the bidding period.</li> <li>5. All work shall be in accordance with the Project Drawings and Specification and their intents, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.</li> <li>6. Connect to equipment specified in the attached drawings/plans and to equipment supplied and installed by other Contractors or by the Owner.</li> <li>7. The Contractor shall be responsible for certifying the adequacy of seismic restraint details. Restraints shall be cables, expansion joints, flexible joints and others as required. Details showing specifically required restraints shall be submitted for review to the Architect and Consultant's.</li> </ol>	

1.2	<p>Standard of Acceptance</p> <ol style="list-style-type: none"> <li>1. Item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.</li> <li>2. Where other than the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.</li> <li>3. Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.</li> <li>4. Install and test all equipment and material, in accordance with the detailed recommendation of the manufacturer</li> <li>5. A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.</li> </ol>	
1.3	<p>Scheduling</p> <ol style="list-style-type: none"> <li>1. Contractor to submit and incorporate within the Construction Schedule, a complete and realistic schedule, integrated with, and recognizing the reliance on, other divisions of the work. Take into account the lead time for the review of operating and maintenance manuals, commissioning, verification of system operation by the Consultant and the demonstration and instruction to the Owner. The schedule shall include but not limited to the following items: <ol style="list-style-type: none"> <li>a. Installation and testing of piping systems and equipment.</li> <li>b. Connection of electrical services to equipment by electrical contractor.</li> <li>c. Startup of mechanical equipment and systems.</li> <li>d. Check-out of control systems.</li> <li>e. Commissioning of mechanical systems.</li> <li>f. Demonstration of systems and equipment to Consultant and Owner.</li> <li>g. Preparation of maintenance manuals and as-built drawings.</li> <li>h. Submission of the various documents required prior to substantial performance.</li> </ol> </li> </ol>	

1.4	<p><b>Responsibilities</b></p> <ol style="list-style-type: none"> <li>1. Visit the site before tendering. Examine all local and existing conditions on which the work is dependent. No consideration will be granted for any misunderstanding, of work to be done, resulting from failure to visit the site.</li> <li>2. Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.</li> <li>3. Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Consultant during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.</li> <li>4. Examine carefully the mechanical, electrical, structural and architectural drawings and confirm that the work under this Contract can be satisfactorily carried out without changes to the building as shown on the plans.</li> <li>5. Be responsible for prompt installation of this work in advance of concrete pouring or similar work. Provide and set sleeves where required.</li> <li>6. On completion of the work, all tools and surplus and waste materials shall be removed and work left in a clean and perfect condition.</li> </ol>	
1.5	<p><b>Coordination</b></p> <ol style="list-style-type: none"> <li>1. Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation.</li> <li>2. The drawing indicates the general location and route to be followed by the piping. Where details are not shown on the drawings or only shown diagrammatically, the pipes shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass.</li> <li>3. Work out jointly all interference problems on the site with other trades and coordinate all work before fabricating, or installing any material or equipment. Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required.</li> </ol>	

1.6	<p><b>Warranty</b></p> <ol style="list-style-type: none"> <li>1. Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.</li> <li>2. Take note of any extended warranties specified</li> <li>3. Furnish a written warranty stating that all work executed under this Contract will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance. Warranty shall include any part of equipment, units or structures furnished here under that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.</li> <li>4. The above parties further agree that they will at their own expense promptly investigate any mechanical or control malfunction, and repair all such defective work and all other damages thereby which becomes defective during the time of the guaranty warrant.</li> </ol>	
1.7	<p><b>Drawings and Measurements</b></p> <ol style="list-style-type: none"> <li>1. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.</li> <li>2. Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Consultant where definite locations are not indicated.</li> <li>3. Take field measurements, where equipment and material dimensions are dependent upon building dimensions.</li> <li>4. Where imperial units have been indicated in brackets [ ] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.</li> </ol>	
1.8	<p><b>Phased Construction</b></p> <ol style="list-style-type: none"> <li>1. See Architectural specification and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.</li> <li>2. All existing services and the existing building(s) must be maintained in operation. Provide and install temporary services as required.</li> <li>3. All trades in this Contract shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.</li> </ol>	



1.9	<p><b>Shop Drawing/Product Data</b></p> <ol style="list-style-type: none"> <li>1. Process           <ol style="list-style-type: none"> <li>a. Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.</li> <li>b. Do not order equipment or material until the Consultant has reviewed and returned shop drawings.</li> <li>c. Shop drawings shall be reviewed by the General Contractor and the Winning Bidder indicating that the shop drawings have been reviewed and coordinated with the work and that the shop drawings are submitted without qualifications. Shop drawings shall bear the "reviewed" stamp dated and initialed by the General Contractor and Mechanical General Sub-contractor prior to submitting the shop drawings to the consultant. Shop drawings, which do not bear the contractors and sub-trades "reviewed" stamps, initials and date will be rejected and sent back as "not reviewed".</li> </ol> </li> <li>2. Content           <ol style="list-style-type: none"> <li>a. Shop drawings submitted title sheet.</li> <li>b. Data shall be specific and technical.</li> <li>c. Identify each piece of equipment.</li> <li>d. Information shall include all scheduled data.</li> <li>e. The project shall be identified on each document.</li> <li>f. The shop drawings/product data shall include:               <ol style="list-style-type: none"> <li>i. Clearly mark submittal material using arrows, underlining or circling to show differences from specified ratings, capabilities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps, seals, materials, or painting.</li> <li>ii. Dimensioned construction drawing with plans and sections showing size, arrangement and necessary clearances, with mounting point loads.</li> <li>iii. Weights of all major equipment for review by the appropriate Consultant.</li> <li>iv. Mounting arrangements.</li> <li>v. Detailed drawings of bases, supports and anchor bolts.</li> </ol> </li> </ol> </li> </ol>	
1.10	<p><b>Demolitions</b></p> <p>Carry out demolition in a manner to cause as little inconvenience to the adjacent occupied building area as possible. Coordinate the activity with the Owner and/or the Consultant. Carry out demolition in an orderly and careful manner.</p>	

1.11

**Project Close-out Requirements**

1. All life safety systems must be operational and tested demonstrated to Consultant. The following is a summary of the requirements.
  - a. Controls:
    - Controls system completion report (check sheet)
    - Controls system final electrical approval certificate.
    - As built control drawings.
    - Control training signed off by Owner (Indicate dates of training in letter and attendance).
    - List of control manuals and documents turned over.
    - Printed copy of control program and database. Printed to disk on word format acceptable.
  - b. Cooling
    - Pressure test reports for refrigeration lines.
    - Vibration isolation report.
    - Seismic inspection report.
    - Valve tag chart.
    - As built drawings.
    - Welding certificate and x-ray reports.
    - Flushing and cleaning of piping report.
  - c. Miscellaneous
    - Identification Schedules
    - Demonstrations to Owner signed off by Owner.
    - List of incomplete or deficient work prepared by each sub trade.
    - Contractor's Letter of Guarantee
    - Signed-off substantial completion inspection report.
    - List of spare parts signed off by Owner.
  - d. Manufacture start-up and other reports including:
    - Commissioning

2.	<p><b>Permits, Codes Regulations and Standards</b></p> <ol style="list-style-type: none"> <li>1. Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal and other legal regulations and by laws applicable to the work.</li> <li>2. Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.</li> <li>3. Work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents: <ol style="list-style-type: none"> <li>a. American Society of Heating, Refrigerating and Air conditioning Engineers (ASHRAE)</li> <li>b. American Society of Ventilating Engineers (ASVE)</li> <li>c. American Refrigeration Institute (ARI)</li> <li>d. Bureau of Labor Standards and Industrial Safety</li> <li>e. National Electric Manufacturing Association (NEMA)</li> <li>f. Philippine Mechanical Engineering Code</li> <li>g. Department of Health (DOH)</li> <li>h. National Fire Codes</li> <li>i. Industrial Health &amp; Safety Regulations</li> <li>j. SMACNA Publications</li> </ol> </li> </ol>	
3.	<p><b>Record Drawings</b></p> <p>Maintain one set of contract drawing white prints, including all supplementary and revision drawing on site, solely for the purpose of recording, in red, any change and/ or deviation from the Contract Drawings as it occurs. Include elevations and detailed locations of buried services. The set of white prints will be provided to the contractor by the Consultant at the contractors cost. The marked-up set of prints shall be reviewed on site monthly by the consultant during the construction process. This review will form a requirement for approval of the monthly progress claim. At the completion of the work, certify the above-mentioned drawings as being accurate and complete by labeling each drawing in the lower right hand corner in letters of at least 12 mm [1/2"] high as follow. "AS BUILT DRAWING".</p>	
4.	<p><b>Mechanical Equipment, Materials &amp; Method</b></p>	
4.1	<p><b>Hangers &amp; Support For HVAC Piping &amp; Equipment</b></p> <ol style="list-style-type: none"> <li>1. General <ol style="list-style-type: none"> <li>a. Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provided for expansion and contraction and accommodate insulation.</li> </ol> </li> </ol>	

- b. Provide insulation protection saddles on all insulated piping.
- c. Fabricated hangers, supports and sway braces in accordance with ANSI B31.1 and MSSSP58.
- d. Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
- e. Support structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hanger from steel channels or angles. Provide supplementary structural members, as necessary.
- f. Do not suspend from metal deck.
- g. Hangers for copper pipe shall be copper plated or plastic dipped unless pipe hangers bear on piping insulation (cold services).

2. Execution

a. Hanger Spacing

Maximum hanger spacing table.

Pipe Size: NPS	Rod Diameter mm [in]	Maximum Spacing Steel Pipe m [ft]	Maximum Spacing Copper Pipe m [ft]
1/2	10 {3/8}	1.8 {6}	1.5 {5}
3/4, 1	10 {3/8}	2.4 {8}	1.8 {6}
1 1/4, 1 1/2	10 {3/8}	3.0 {10}	1.8 {6}
2	10 {3/8}	3.0 {10}	3.0 {10}
2 1/2, 3, 4	12 {1/2}	3.0 {10}	3.0 {10}

b. Hanger Installation

- i. Offset hanger so that rod is vertical in operating position.
- ii. Adjust hangers to equalize load.
- iii. Install hanger to provide minimum 12mm [1/2"] clear space between finished covering and adjacent work.
- iv. Support vertical piping at every other floor.
- v. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- vi. Where practical, support riser piping independently of connected horizontal piping.
- vii. Install plastic inserts between steel studs and piping.

	<ul style="list-style-type: none"> <li>viii. For beam clamps, extend hanger rod tight to underside of beam with top bolt and washer.</li> <li>c. Inserts <ul style="list-style-type: none"> <li>i. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.</li> <li>ii. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm (4") or ducts over 1500 mm (60") wide.</li> <li>iii. Where concrete slabs form finished ceiling, finish inserts, flush with slab surface.</li> <li>iv. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square plate and nut above slab, in concealed locations.</li> <li>v. Provide a test mock up for review.</li> <li>vi. Insert shall be installed in accordance with manufacturer's recommendations and in no case closer than 2.1 m (7ft) apart.</li> </ul> </li> </ul>	
4.2	<p><b>Vibration Isolation for HVAC Piping and Equipment</b></p> <ul style="list-style-type: none"> <li>1. Related Work <ul style="list-style-type: none"> <li>a. Provide vibration isolation on all motor driven equipment, piping such that noise transmitted to occupied space by any other path than airborne is less than airborne noise transmitted from mechanical space to occupied space.</li> </ul> </li> <li>2. General Requirements <ul style="list-style-type: none"> <li>a. This project is deemed a post disaster design.</li> <li>b. Provide vibration isolation on all motor driven equipment with motors of ½ HP and greater power output (as indicated on the motor nameplate) and on piping, as specified herein. For equipment less than ½ HP, provide vibration isolation grommets at the support points.</li> <li>c. Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the center of gravity of the equipment.</li> <li>d. Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified.</li> <li>e. Provide concrete inertia bases or structural steel bases, where specified or required by equipment manufacturers, located between vibrating equipment and the vibration isolation elements, unless the equipment manufacturer certifies direct attachment capabilities.</li> </ul> </li> </ul>	

- f. Use ductile materials in all vibration and seismic restraint equipment.
- g. Follow structural consultant's instruction for drilling for installation of anchors.
- h. Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.

### 3. Execution

#### a. Installation

- i. Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.
- ii. For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm [2"] to other structures, piping, equipment, etc.
- iii. Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchor and/ or welding.
- iv. After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.
- v. Where hold down bolts for isolators or seismic restraint equipment penetrates roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Coordinate with roofing section of specifications and with roofing subcontractor.
- vi. Use Type I pads only where specified.
- vii. Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.
- viii. Provide concrete inertia bases on centrifugal fans where specified.
- ix. Isolate all equipment within rooftop units in accordance with this section, including fans, compressor, pumps and piping. Ensure structure borne transmission of noise from rooftop unit is less than airborne transmission.

	<p>b. Inspections</p> <ol style="list-style-type: none"> <li>i. The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment.</li> <li>ii. The supplier shall inspect the complete installation after system start up and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any malfunction performance. The supplier shall submit a statutory declaration to the Consultant stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operate to his satisfaction.</li> </ol>	
4.3	<p><b>HIVAC Piping Insulation</b></p> <ol style="list-style-type: none"> <li>1. General       <ol style="list-style-type: none"> <li>a. Provide thermal insulation on all piping, valves, fittings and radiant ceiling panels, as called for and as scheduled. Note items listed that do not require insulation.</li> <li>b. Journeyman insulation applicators, skilled in this trade, shall perform the work.</li> <li>c. Be responsible for ensuring that sufficient space is always provided to allow proper installation of insulation materials.</li> <li>d. Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping.</li> </ol> </li> <li>2. Execution       <ol style="list-style-type: none"> <li>a. Application           <ol style="list-style-type: none"> <li>i. Apply insulation to piping only after all tests have been made and systems accepted by Consultant as tight.</li> <li>ii. Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform in diameter, smooth in finish, pleasing to the eye and with the longitudinal seams positioned to be concealed from view. Apply piping insulation materials, accessories and finishes in accordance with manufacturer's recommendations.</li> </ol> </li> <li>b. Insulation Termination Points           <ol style="list-style-type: none"> <li>i. Terminate insulation 75 mm [3"] back from all un-insulated fittings to provide working clearance and terminate insulation at 90° and finish with reinforced scrim cloth and vapor barrier mastic system. Cover onto pipe and over the insulation vapor barrier. On concealed hot services terminate insulation 75 mm [3"]</li> </ol> </li> </ol> </li> </ol>	

	<p>back from all un-insulated fittings, cut off at 90° and apply reinforced scrim cloth and breather mastic system.</p> <ul style="list-style-type: none"> <li>ii. Cut back insulation at 45° and finish with a silicone caulking sealant around the base of thermometer wells, pressure gauges, flow switches and pressure and control sensors.</li> </ul> <p>c. Vertical Risers</p> <p>On vertical pipe over 75 mm [3"] provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting. Thereafter, locate on 4.5 m [15 ft.] centers.</p> <p>d. Pipe Insulation Finishes</p> <ul style="list-style-type: none"> <li>i. Concealed insulation in horizontal and vertical service spaces will require no further finish.</li> <li>ii. Exposed flexible insulation shall be painted with a heavy brush coating of foam plastic white insulation coating.</li> </ul> <p>e. Fire Stopping and Smoke Seals</p> <ul style="list-style-type: none"> <li>i. Install fire stopping and smoke seal material and components in accordance with the attached drawings/plans.</li> <li>ii. Maintain insulation around pipes penetrating fire separation only as permitted by Firestop Assembly Listing.</li> <li>iii. Submit Certificate of Inspection that all work is complete and in accordance with the specified requirements before Substantial Completion.</li> </ul>	
<p><b>4.4</b></p>	<p><b>Variable Refrigerant Flow (VRF) Type Air-conditioning Unit</b></p> <p>1. Submittals</p> <ul style="list-style-type: none"> <li>a. Product Data</li> </ul> <p>Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.</p> <p>2. Quality Assurance</p> <ul style="list-style-type: none"> <li>a. Product Options</li> </ul> <p>Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to attached drawings/plans – See "Equipment Schedule."</p> <ul style="list-style-type: none"> <li>b. Electrical Components, Devices and Accessories</li> </ul> <p>Listed and labelled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.</p> <ul style="list-style-type: none"> <li>c. ASHRAE Compliance</li> </ul> <p>Applicable requirements in ASHRAE 62.1-2004, Section 5- "Systems and Equipment" and Section 7- "Construction and Startup."</p>	



	<p>d. ASHRAE/IESNA 90.1-2004 Compliance Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 – “Heating, Ventilating, and Air-conditioning.”</p> <p>3. Coordination</p> <p>a. Coordinate size and location of concrete bases for units. Supply and cast anchor-bolt inserts into concrete bases done by the General Contractor.</p> <p>4. Concealed evaporator-fan components</p> <p>a. Chassis</p> <p>b. Refrigerant Coil Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal expansion valve.</p> <p>c. Fans</p> <p>d. Fan Motors Comply with requirements in the attached Drawings /plans and Division 15 Section “Motors” – Annex 1.</p> <p>i. Special Motor Features: Multispeed with internal thermal protection and permanent lubrication.</p> <p>e. Disposable Filters 1 inch (25 mm) thick, in fiberboard frames with ASHRAE 52.2 MERV rating of 8 or higher.</p> <p>f. Wiring Terminations Connect motor to chassis wiring with plug connection.</p> <p>g. Cabinet</p> <p>h. Refrigerant Coil Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal expansion valve.</p> <p>i. Filters Disposable, with ASHRAE 52.2 MERV rating of 8 or higher.</p> <p>j. Refrigerant Coil Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal expansion valve.</p> <p>k. Fan Direct drive, centrifugal fan.</p> <p>l. Fan Motors Comply with requirements in the attached drawings /plans and Division 15 Section “Motors” – Annex 1.</p> <p>i. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.</p> <p>m. Filter Disposable, with ASHRAE 52.2 MERV rating of 8 or higher.</p> <p>5. Ceiling-mounting, evaporator-fan component</p> <p>a. Cabinet Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.</p>	
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- i. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- ii. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2004.

b. Refrigerant Coil

Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

c. Electric Coil

Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contractors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

d. Fan

Direct drive, centrifugal fan, with power-induced outside air, and integral condensate pump.

e. Fan Motors

Comply with requirements in the attached drawings /plans and Division 15 Section "Motors" – Annex I.

- i. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.

f. Filters

Disposable, with ASHRAE 52.2 MERV rating of 8 or higher.

6. Air-cooled compressor-condenser components

a. Casing

Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage sports on exterior of casing.

b. Compressor

Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal-and current-sensitive overload devices, start capacitor, relay and contactor.

- i. Compressor Type: Scroll
- ii. Two-speed compressor motor with manual-reset high-pressure switch and automatic reset low-pressure switch.
- iii. Refrigerant: R-407C/R R-407/410-A/R-134-A

c. Refrigerant Coil

Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub-cooler.

d. Fan

Aluminum propeller type, directly connected to motor.

e. Motor

Permanently lubricated, with integral thermal-overload protection.

f. Low Ambient Kit

Permits operation down to 45° F (7°C)

	<p style="margin-left: 40px;">g. Mounting Base Polyethylene.</p> <p style="margin-left: 40px;">b. Minimum Energy Efficiency Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Building except Low-rise Residential Buildings."</p> <p>7. Accessories</p> <p style="margin-left: 20px;">a. Control equipment and sequence of operation are specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation." – Annex I.</p> <p style="margin-left: 20px;">b. Thermostat</p> <ul style="list-style-type: none"> <li>• Low voltage with sub-base to control compressor and evaporator fan.</li> <li>• Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features: <ul style="list-style-type: none"> <li>i. Compressor time delay.</li> <li>ii. 24 hour time-control of system stop and start.</li> <li>iii. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.</li> <li>iv. Fan-speed selection, including auto setting.</li> </ul> </li> </ul> <p style="margin-left: 20px;">c. Automatic-reset timer to prevent rapid cycling of compressor.</p> <p style="margin-left: 20px;">d. Refrigerant Line Kits Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.</p> <ul style="list-style-type: none"> <li>i. Minimum Insulation Thickness: 1 inch (25 mm) thick.</li> </ul> <p>8. Execution</p> <p style="margin-left: 20px;">a. Installation</p> <ul style="list-style-type: none"> <li>i. Install units level and plumb</li> <li>ii. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.</li> <li>iii. Install ground-mounting, compressor-condenser components on 4 inches (100 mm) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Coordinate anchor installation with concrete base done by the General Contractor.</li> <li>iv. Install ground-mounting, compressor-condenser components on polyethylene mounting base.</li> <li>v. Install seismic restraints.</li> </ul>
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	<ul style="list-style-type: none"> <li>vi. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection on 1 inch (25 mm)</li> <li>vii. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.</li> </ul> <p>b. Connections</p> <ul style="list-style-type: none"> <li>i. Piping installation requirements are specified in the attached Drawings/plans. Drawings indicate general arrangement of piping, fittings, and specialties.</li> <li>ii. Install piping adjacent to unit to allow service and maintenance</li> <li>iii. Ground equipment according to Division 16 Section "Grounding and Bonding."</li> <li>iv. Electrical Connections: Comply with requirements in the attached Electrical Drawings/Plans for power wiring, switches, and motor controls.</li> </ul> <p>c. Field Quality Control</p> <ul style="list-style-type: none"> <li>i. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.</li> <li>ii. Perform the following field and inspections and prepare test reports: <ul style="list-style-type: none"> <li>• Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.</li> <li>• Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.</li> <li>• Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.</li> </ul> </li> <li>iii. Remove and replace malfunctioning units and retest as specified above.</li> </ul>	
4.5	<p><b>General Execution</b></p> <p>1. Concealment</p> <p>Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces, and ceiling spaces, unless otherwise noted. Do not install piping and conduit in outside wall of roofs slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.</p>	

## 2. Accessibility

Install all works included in the Contract to be readily accessible for adjustment, operation and maintenance.

## 3. Protection of Work

Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage. Mask machined surfaces. Secure covers over equipment openings and open ends of piping and conduits, as installation work progresses. Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.

## 4. Air system to have air filters installed before fans is operated.

Install new air filters before system acceptance.

## 5. Service Penetrations in Rated Fire Separations

All piping, tubing, wiring, conduits, etc. passing through rated fire separations shall be smoke and fire proofed with ULC approved materials and which meet the requirements of the Building Code in effect. This includes new services, which pass through existing separations, and also all existing services, which pass through a new rated separation or existing separations whose rating has been upgraded. Fire resistance rating of installed fire stopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. All smoke and fire stopping shall be installed by a qualified Contractor who shall submit a letter certifying that all work is complete and in accordance with this specification. Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions in formed sleeved or cored penetrations.

## 6. Service Penetration in Non-Rated Separations

All piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound. Refer to "pipe sleeve" clause in this section for packing and sealing of pipe sleeves.

## 7. Pipe Sleeves

Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves are to be concentric with pipe. Pipes and ducts passing through fire rated separations that no fire resistance (non-rated separations) do not require a sleeve, but the insulations at the separation should be wrapped with 0.61 [24 ga] thick galvanized sheet steel band to which to apply the flexible caulking compound to. Pipe sleeves for floors and interior walls shall be minimum 0.61 [24 ga] thick galvanized sheet steel with lock seam joints. Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeves or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm [6"] beyond sleeve diameter. Annular fin shall be embedded into center of wall. Pipe sleeves for wet or wash down floor areas such as washrooms, janitor's rooms, laboratories and mechanical equipment room shall be Schedule 40 steel pipe. Except as otherwise noted pipe sleeves are not required for

holes formed or cored in interior concrete walls or floors. Pipe sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas. .8 Pipe sleeves shall extend 25 mm [1"] on each side of wall in unfinished areas and 6 mm [1/4"] in finished areas. Pipe sleeves shall extend 25 mm [1"] beyond exterior face of building. Caulk with flexible caulking compound. Sleeve size: 12 mm [1/2"] clearance all around, between sleeve and pipe or between sleeve and pipe insulation. Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

#### 8. Escutcheons and Plates

Provide on pipes passing through finished walls, partitions, floors and ceilings. Plates shall be stamped steel, split type, chrome plated or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulations. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter shall cover opening or sleeve. Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension. Do not install escutcheons and plates in concealed locations.

#### 9. Equipment Supports

Provide stands and supports for equipment and materials supplied. Lay out concrete bases and curbs required under Division.

#### 10. Equipment Installation

Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping without interfering with building structure or other equipment. Provide means of access for servicing equipment including permanently lubricated bearings. Pipe equipment drains to floor drains. Line up equipment, rectangular cleanouts and similar items with building walls whatever possible.

#### 11. Flashing

Flash and counter flash where mechanical equipment passes through weather or water proofed walls, floors and roofs.

#### 12. Lubrication of Equipment

Lubricate all new equipment prior to being operated, except sealed bearings, which shall be checked. Use the lubricant recommended by the manufacturer for the service for which the equipment is specified. Extend lubricating connections and sight glasses to the outside of housings where lubricating positions are not readily accessible. Submit a checklist, showing that all operated equipment has been lubricated prior to and during any temporary heating period and the demonstration and instruction period.

#### 13. Painting

Clean exposed bare metal surfaces supplied removing all dirt, dust, grease and mill scale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal. Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed. Repaint all marred factory finished equipment supplied which is not scheduled to be

	<p>repainted, to match the original factory finish.</p> <p>14. Equipment Protection and Clean-up</p> <p>Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign materials into working parts of piping. All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area. Thoroughly clean piping and equipment of dirt, cuttings, and other foreign material. Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes. Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.</p>	
<b>5.</b>	<b>Testing, Adjusting and Balancing For HVAC</b>	
<b>5.1</b>	<p><b>Test</b></p> <ol style="list-style-type: none"> <li>1. Give written 24 hour notice of date for tests</li> <li>2. Do not externally insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.</li> <li>3. Conduct test in presence of Inspector. Arrange for the Owners representative to be present.</li> <li>4. Bear costs including retesting and making good.</li> <li>5. Refer to Piping Section for specific requirements.</li> <li>6. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.</li> </ol>	
<b>6.</b>	<b>Commissioning of HVAC Systems</b>	
<b>6.1</b>	<p><b>Quality Assurance</b></p> <ol style="list-style-type: none"> <li>1. The commissioning shall be executed in accordance with the intent of ASHRAE Standard guideline for "Commissioning of HVAC System". For list of acceptable Commissioning Agency, refer to DBM.</li> </ol>	
<b>6.2</b>	<p><b>General</b></p> <ol style="list-style-type: none"> <li>1. Be responsible for the performance and commissioning of all equipment supplied. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.</li> <li>2. In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.</li> </ol>	
<b>6.3</b>	<p><b>Commissioning and Demonstration</b></p> <ol style="list-style-type: none"> <li>1. Submit a schedule for the commissioning phase of the work. This schedule shall show:</li> </ol>	

	<ul style="list-style-type: none"> <li>a. Equipment start-up schedule</li> <li>b. Submission dates for the various documents required prior to substantial completion.</li> <li>c. Timing of the various phases of the commissioning, testing, balancing and demonstration process.</li> <li>d. Plug all air pressure and flow measuring holes.</li> <li>c. Set up and test all alarm and protective devices</li> </ul> <p>2. At the conclusion of commissioning demonstrate the operation of the systems to be Consultant and then to the Owner's Operation Staff.</p> <p>3. The verification process shall include the demonstration of the following:</p> <ul style="list-style-type: none"> <li>a. The ease of access that has been provided throughout for servicing coils, motor, drives, fusible link fire dampers, smoke dampers, control dampers and damper operators.</li> <li>b. Location of and opening and closing of all access panels.</li> <li>c. Operation of all automatic control dampers and automatic temperature control devices.</li> <li>d. Operation of all alarm and protective devices.</li> <li>e. Proper response of all mixing boxes and air valves to thermostats and volume adjustment controls.</li> <li>f. Operation of all smoke dampers and all smoke pressurization and removal provisions.</li> <li>g. Operability of randomly selected fire dampers.</li> <li>h. Noise level from typical mixing boxes and air valves under extreme operating conditions.</li> <li>i. Operation of all equipment and system under each mode of operating, and failure, including: BMS control features, Automatic control including air compressors, Fan, Coils, Humidifiers, Steam pressure reducing stations, Condensate return units.</li> </ul> <p>4. At the completion of the commissioning, testing, balancing and demonstration submit the following to the Consultant:</p> <ul style="list-style-type: none"> <li>a. A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.</li> <li>b. Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.</li> <li>c. "AS-BUILT" record drawing, as specified.</li> </ul>	
6.4	<p><b>Commissioning and Demonstration</b></p> <ul style="list-style-type: none"> <li>1. Provide the services of an approved independent specialist firm to coordinate the commissioning process.</li> <li>2. The cooperation of all trades is essential for an efficient and planned process. A team comprising the following is recommended.</li> <li>3. Commissioning Coordinator:</li> </ul>	



- a. General Contractor
  - b. Mechanical Contractor's Supervisor
  - c. Mechanical Consultant
  - d. Building Owner's Representative
  - e. Trades: Especially Control Contractor and Balancing Agency
  - f. Electrical
4. Prepare a commissioning statement for each of the four (4) phases that the process is perceived to be worked through. In sequence, the phase are expected to be:
    - a. PHASE 1 – System readiness
    - b. PHASE 2 System start-up, testing, balancing, etc.
    - c. PHASE 3 – Verification of system performance
    - d. PHASE 4 - Demonstration and instruction.
  5. Regular meetings shall be held during the commissioning process. Minutes of the meeting shall be issued to all contractors involved, the Consultant and the Owners representative.
  6. Plan the work to be specific in respect of personnel, schedule, and review and laboratory tests.
    - a. Personnel: Assign direct overall charge of commissioning to a person (the commissioning coordinator) fully qualified through practical experience and a comprehensive knowledge of the interactive nature of building and their controls to understand the complete system and be available to carry the project through to total completion. This person shall be responsible for – Commissioning, Demonstration to the Consultant and Owner and Certification of Substantial and Total Performance.
    - b. Schedule: Submit a schedule, as part of the construction schedules, for the commissioning phase of the work.
    - c. Review: Within three (3) months of commencing with the project work, the person having direct overall charge of commissioning shall review design intent and intended commissioning procedures with the Consultant. Six (6) prior to the date of schedules substantial performance, submit a detailed plan that addresses the entire approach to the commissioning process. The plan should be prepared specifically for the project at hand.
    - d. Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic function in troubleshooting are:
      - i. What – Identification and definition of the problem
      - ii. Why Determination and evaluation of the cause.

	<ul style="list-style-type: none"> <li>iii. When – Determine the time available to resolve the problem.</li> <li>iv. Involve the Consultant in the review of the problem and proposed resolution.</li> <li>v. Coordinate remedial action with the appropriate parties.</li> <li>vi. Evaluate the effectiveness of the remedial action.</li> </ul> <p>e. Laboratory Tests: If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner.</p> <p>7. The work included in each of the four (4) phases shall be generally as follows:</p> <ul style="list-style-type: none"> <li>a. PHASE 1 – System Readiness</li> <li>b. PHASE 2 – System startup, testing and balancing</li> <li>c. PHASE 3 – Verification of system performance</li> <li>d. PHASE 4 – Demonstration and Acceptance</li> <li>e. Post Substantial Performance Visits</li> </ul>	
6.5	<p><b>Shop Drawings</b></p> <ul style="list-style-type: none"> <li>1. Submit shop drawings</li> <li>2. Shop drawings shall include: <ul style="list-style-type: none"> <li>a. Control center layouts.</li> <li>b. Manufacturer's descriptive technical literature for all equipment and devices.</li> <li>c. Interconnection schematics.</li> <li>d. Wiring and piping diagrams.</li> <li>e. One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.</li> <li>f. Terminal cabinets, including termination listings.</li> <li>g. Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.</li> <li>h. All input/output points which shall include the following information associated with each point. <ul style="list-style-type: none"> <li>i. Sensing element type and location.</li> <li>ii. Details of associated field wiring schematics and schedules.</li> <li>iii. Pneumatic schematics and schedules. (Not required on "all electronic" projects).</li> <li>iv. Software and programming details.</li> </ul> </li> <li>i. Copies of all system graphics complete with system specific point labels.</li> </ul> </li> </ul>	

6.6	<p><b>Operating and Mechanical Manuals</b></p> <ol style="list-style-type: none"> <li>1. The maintenance manual data is intended to cover the operation and maintenance of all control systems and equipment installed. Forward 3 copies of the Controls and Instrumentation section of the operating and maintenance manuals to the Balancing Agency to ensure the binding and format of material are compatible. Ensure sufficient time has been given to the Balancing Agency for the compiling of the complete operating and maintenance manuals by the commissioning deadline. One complete manual shall be furnished prior to the time that system or equipment tests are performed.</li> <li>2. The manual shall include the name, address and telephone number of the control subcontractor installing the systems and a list of emergency number for service personnel. The manuals shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject.</li> <li>3. Manuals shall be furnished which provide full and complete coverage of the following subjects: <ol style="list-style-type: none"> <li>a. Operational Requirements</li> <li>b. System Operation</li> <li>c. Functional Description</li> <li>d. Software</li> </ol> </li> </ol>	
6.7	<p><b>Demonstration and Instruction to Owner</b></p> <ol style="list-style-type: none"> <li>1. The Controls Contractor shall provide the services of competent instructors who will give full instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified. The training shall be oriented toward the system installed rather than being a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. A training manual shall be provided for each trainee which describes in detail the data included in each training program. All equipment and material required for classroom training shall be provided by the Contractor.</li> </ol>	

**I hereby certify to comply with all the above Technical Specifications.**

\_\_\_\_\_  
Name of Company/Bidder

\_\_\_\_\_  
Signature over Printed Name of  
Representative

\_\_\_\_\_  
Date