PART 1 GENERAL

.1 This specification document is intended to provide general performance criteria and installation requirements and does not intend to indicate the specific number of items or extent of material or works required. Sections of the specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work and is to be read as a whole.

.2 All bidders must be authorized distributors and service technicians for the product offerings included within their bid package.

.3 Should the Contractor engage a subcontractor, all conditions applicable to the Contractor shall apply to each subcontractor.

.4 It shall be the Contractor's responsibility to maintain adequate protection of the work from damage and protect the Owner's property and the public from injury or loss arising in connection with this work. Make good any such damage, injury, or loss, and accept exclusive liability and hold harmless the Owner and Engineer against injuries or claims therefore of all persons and any alleged damage to property in connection with the work. Erect and always maintain, as required by the conditions and progress of the work, all necessary safeguards for the protection of the workers and the public.

1.2 BACKGROUND

.1 The Department of Public Lands & Buildings is looking to perform a phased renovation of the Heating, Ventilation and Air-Conditioning (HVAC) systems in the Government Administration Building (GAB) located at 30 Parliament Street.

.2 The Government Administration Building, housing a number of governmental departments and related functions, is a steel framed reinforced concrete and masonry building constructed in the late 1970s. The building consists of six floors and approximately 53,000 square feet of mixed office space, conference rooms, courts, and archival storage.

.3 GAB has been served by a chilled water HVAC system since construction, which has reached the end of its service life and is in need of replacement.

.4 The preferred new system type for the renovation efforts is Variable Refrigerant Flow (VRF) from a reputable manufacturer with a history of equipment being successfully utilized locally.

.5 Client preference is for all works to be phased to minimize disruption to building occupants and operations.

1.3 DESCRIPTION OF EXISTING SYSTEMS

.1 The existing GAB HVAC system is in various states of disrepair. The existing chiller is in poor condition, as are many of the air handlers and fan coils units located throughout the building.

.2 The current HVAC system consists of:

- .1 Single Trane Series R air cooled chiller (170 tons) located in 4th floor outdoor mechanical space.
- .2 Ducted air handlers serving VAV systems
  - .1 Large air handler on roof serving 1st through 4th floors
  - .2 Smaller air handlers on ground floor serving basement and ground floors
- .3 Numerous floor standing chilled water fan coil units in perimeter zones/offices.
- .4 Fresh air supply to air handlers on each floor via intake on roof, or through wall adjacent to air handler (ground floor).

.3 The basement and 4th floor systems in particular are in need of immediate replacement and should be replaced first in any phased work plan.

.4 There are a number of existing VRF systems throughout the building serving small, discrete areas where supplemental cooling has been required due to breakdown of the chilled water system.

.5 The basement of the GAB houses the Department of Archives storage, consisting of approximately 3,500 square feet of temperature and humidity-controlled storage space. Uninterrupted conditioning of this space must be maintained during any works.

1.4 OBJECTIVE

.1 Performance and Reliability

.1 The installation of a high-performance VRF HVAC system.

.2 Greater control of cooling and heating energy supplied to each zone to improve comfort of building occupants and reduce wasted energy.

.3 Reduced downtime due to breakdowns and maintenance.

.2 Efficiency and Operating Costs

.1 Increased energy efficiency to bring the GAB in line with commercial buildings of the same age in Bermuda.

.2 Reduction in unplanned expenditures due to equipment failure.

.3 Indoor Air Quality

.1 Improvement of indoor air quality (IAQ) with particular emphasis on reduction in carbon dioxide (CO_2) concentration, through better adherence to the requirements of ASHRAE Standard 62.1 and a modern demand-controlled ventilation system.

1.5 SCOPE

.1 With the information provided in this document, the Contractor shall provide the following:

.1 Detailed design including:

.1 Heat Load, equipment sizing, piping and any other calculations required to document sound engineering design.

.2 Equipment and Materials selections documented through written descriptions of what products will be used in which scenarios and manufacturer's data sheets.

.3 Detailed Design Drawings.

.4 Detailed Design Specifications in MasterSpec format.

.5 As Built Drawings and Operation and Maintenance manuals.

.2 Demolition of all replaced or abandoned existing HVAC equipment, materials, conduit and related components. Demolition shall be carried out to minimize disturbance to building occupants. Waste and rubble shall be removed on a daily basis and all egress paths left clear for safe travel.

.3 Temporary cooling and dehumidification for areas of the building that must remain operational during demolition/construction phases.

.4 Installation of all new HVAC equipment including all required electrical and architectural modifications as required to provide a working HVAC system and restore Architectural finishes to as-found condition.

PART 2 BASIS OF DESIGN

2.1 ENVIRONMENTAL DESIGN CONDITIONS

.1 Outdoor Design Conditions: 89°F DB, 78°F WB (ASHRAE Climatic Design Conditions 2021, 0.4% monthly coincident high)

.2 Climate Zone 2A

2.2 MINIMUM INDOOR DESIGN CONDITIONS

.1 Indoor Air Design Conditions: 74°F, 55% RH

.2 Equipment shall be selected, designed and installed to meet NC criteria for respective installation locations. Acceptable NC ratings for each occupancy type are as follows:

.1 Entrances, lobbies, foyers and public waiting rooms – NC-45
.2 Open plan offices, corridors – NC-40
.3 Private offices, meeting and conference rooms – NC-35
.4 Courtrooms, court waiting areas and similar – NC-25
.5 Mechanical, computer, utility rooms, etc. – NC-50
.6 Other occupancies not specified – NC-40

.3 Zoning Layout:

.1 Thermostatic control shall be provided throughout the building to allow for automatic regulation of internal temperature to a desired setpoint. Thermostats shall be located in suitable positions/locations to allow for accurate and prompt responses to changes in environmental conditions of the area(s) served.

.2 Thermostatic control must be provided for each enclosed area, or for a designated group of enclosed areas (a 'zone')

.3 Multiple rooms or areas within a larger control zone must share a similar load profile and occupancy type.

.1 No more than four enclosed rooms shall be part of a single thermostatically controlled zone.

.2 Perimeter offices in a single control zone shall have similar exterior wall areas, glazing areas and orientations.

.4 Zoning shall take into account:

.1 Total floor area of zone

.2 Area of each room within zone

.3 Occupancy of each room or area

2.3 GENERAL STANDARDS

.1 Design, installation, equipment and materials shall be in accordance with the following codes and standards where applicable. Where no version of code or standard is indicated, the latest version shall apply:

.1 Government of Bermuda

.1 Bermuda Building Code 2014 (BBC)

.2 The Bermuda Occupational Safety and Health Act 1982

.3 The Bermuda Occupational Safety and Health Regulations 2009

.2 International Code Council (ICC):

.1 International Building Code 2012 (IBC)

.2 International Plumbing Code 2012 (IPC)

.3 International Mechanical Code 2012 (IMC)

.4 International Energy Conservation Code 2012 (IECC)

.3 ASHRAE:

.1 ASHRAE Standard 15

.2 ASHRAE Standard 34
.3 ASHRAE Standard 55
.4 ASHRAE Standard 90.1
.5 ASHRAE Standard 62.1
.6 ASHRAE Standard 183

.4 NFPA

.5 SMACNA

2.4 DESIGN

.1 Cooling

.1 Design cooling loads shall be determined in accordance with the procedures described in ANSI/ASHRAE Standard 183. Results of cooling load calculations shall be made available at time of proposal or RFP response for evaluation by Client.

.2 Ventilation requirements

.1 Mechanical ventilation shall be provided in accordance with Chapter 4 of the International Mechanical Code and the procedures outlined in ASHRAE Standard 62.1. The system or systems shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.

.2 The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in IMC 2012 Section 403.3.

.3 The ventilation system shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated.

.4 Ventilation system(s) shall be designed as a demand-controlled ventilation system in order to modulate fresh air volumes in line with actual occupancy. System is to be controlled via measured CO_2 concentration or similar IAQ indicator.

.5 The system shall include an energy/enthalpy recovery system. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of

not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions.

2.5 RELIABILITY

.1 Level of Redundancy

.1 While no specific full or partial system redundancy is required, the system should be designed so that no single point of failure is likely to cause disruption to half a floor (approx. 6,200 sq. ft.) or more in the event of malfunction or failure.

.2 Spares

.1 Provide details on spare parts policies and availabilities/lead times of spare parts.

.3 Service Contract

.1 Provide details on scope and cost(s) for any proposed service contract for review by Client.

.4 Minimum Service Interval and Cost

.1 Provide details and costs of minimum service intervals for review by Client.

PART 3 EQUIPMENT

3.1 HVAC

.1 General

.1 Equipment shall meet the minimum efficiency requirements of International Energy Conservation Code 2012 Section C403.2 when tested and rated in accordance with the applicable test procedure and at stated design conditions.

.2 The efficiency shall be verified through certification under an approved certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.

.3 Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components from different manufacturers are used, calculations and supporting data

shall be furnished that demonstrates that the combined efficiency of the specified components meets requirements.

.4 All equipment is to be UL listed or approved by a similar Nationally Recognized Testing Laboratory.

.2 Variable Refrigerant Flow Cooling Systems

.1 The air conditioning system will consist of modular high efficiency heat pump Variable Refrigerant Flow (VRF) cooling/heating systems. System configuration will include rooftop mounted heat pump outdoor condenser units and associated refrigerant distribution to floor level headers and/or branch controllers.

.2 Outdoor Units

.1 VRF condensers unit to be constructed of marine environment rated materials and coatings, along with all associated components. All exposed elements and coils to be coated and selected with corrosion inhibiting materials from the factory or field coated as required for the environment to meet ASTM B117 1000-hour rating or greater.

.3 Indoor Units

.1 Shall consist of ceiling cassettes and/or medium static ducted units with independent heat, cool or dehumidification operation.

.2 All evaporators shall be provided with refrigerant connections, controls, power and condensate management. Each floor level VRF system shall have a minimum 50% and maximum 130% connected load for equipment operation and commissioning.

.3 Cassettes and fan coils to be field insulated to prevent external condensation.

.4 Floor area per ceiling cassette shall be limited to 350 square feet, unless it is demonstrated that sufficient cooling coverage can be achieved by the cassette in question at high fan speed.

.1 Maximum and minimum installation distances between ceiling cassettes shall be in accordance with manufacturer's recommendations and industry best practices.

.5 Floor area per concealed ducted unit shall be limited to 1,200 square feet.

.1 Concealed ducted fan coils providing conditioning to multiple areas shall be designed and installed as per zoning requirements in section 2.2.4.

.4 Refrigerant Piping

.1 Shutoff valves shall be provided in accessible locations to allow for modification of downstream refrigerant piping without requiring entire system to be pumped down and refrigerant charge removed.

.2 All refrigerant piping shall be thermally insulated with a minimum of 3/4" of insulation of a thermal conductivity between 0.21-0.28 BTU*in./(h*ft2*°F.) or as per the manufacturer's minimum requirements.

.3 All refrigerant piping insulation to be plenum rated.

.3 Condensate Drains

.1 Condensate drains shall be provided for all VRF cassettes and ducted units.

.2 Condensate drains shall tie into building sanitary or waste drainage system via air gapped connection.

.3 Where condensate drains receive condensate at a temperature below the ambient dew point of the adjacent space, the drain shall be insulated sufficiently to prevent condensation on the surface of the drain.

.4 Condensate drain (and similar water-carrying) piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms and all other spaces provided primarily for the installation of electrical equipment shall be avoided.

.4 Fresh/Outdoor Air Pretreatment System

.1 Shall be designed in accordance with section 2.4.2 above.

.2 Shall achieve a minimum enthalpy recovery ratio of 50 percent at full load at summer and winter design conditions.

.3 A single energy recovery ventilation unit (ERV) located in the upper floor mechanical space, or multiple smaller units located in existing mechanical rooms will deliver all the

ventilation air for the building. This unit (or units) will typically consist of supply and exhaust air fans with variable frequency drives, high efficiency disposable filters, and an enthalpy wheel type rotary heat exchanger to recovery energy from the general and washroom exhaust air with the incoming air ventilation air stream.

.4 Air will be delivered via a single shaft with floor connection points for distribution to tenants, in the case where no immediate works are planned for the space in question.

.5 Air volume delivered to each area will be metered with integrated flow measurement and controlled via CO_2 space or return/exhaust duct sensors.

.6 Ventilation rates for each space shall be calculated as per International Mechanical Code Section 403. Calculations to be provided to Client for review.

.5 Vibration Isolation

.1 Ensure the provision of adequate vibration and sound control equipment for all mechanical equipment and ductwork.

.2 For each piece of equipment to be isolated, select the vibration isolation mounts on the basis of 90% vibration isolation efficiency at the lowest operating speed.

.6 Duct

.1 Ductwork shall be constructed and installed in accordance with the International Mechanical Code 2012 and International Energy Conservation Code 2012.

.2 All supply and return air ducts and plenums shall be insulated with a minimum of R6 insulation where located in unconditioned spaces and a minimum of R8 insulation where located outside the building.

.1 Where ductboard is used as duct material, the combined R value of the assembly (consisting of ductboard and external insulation, if applicable) shall be R6 in unconditioned spaces and R8 where located outside the building.

.7 Rooftop equipment brackets and framing to be constructed of hot dipped galvanized steel, marine grade stainless steel or other approved corrosion resistant material.

.8 Duct and Ductwork Accessories

.1 All exposed intake ductwork and dampers and exposed building exhaust ductwork, louvers and grilles to be stainless steel or other approved corrosion resistant material. Include for all stainless steel or manufacturers best recommendation for highly corrosive marine environment materials.

.9 Drip Pans

.1 Provide continuous galvanized sheet metal or plastic/composite drip pans under all concealed fan coils located in ceiling plenums where external condensation is likely, or where condensation is likely to cause unacceptable damage to ceiling finishes, stored materials, equipment or similar.

.2 Drip pans are to be complete with a drain pipe connection and drain piping is to be extended to the closest drain.

.10 Terminals Registers and Grilles

.1 Unless specific direction is received from the Client, all new air terminals, registers and grilles are to match the type and style of existing hardware in each space where possible.

.2 All proposed air terminals to be provided for Client review.

.3 All air terminals to be equipped with manual balancing dampers installed in accessible locations.

.11 Automatic Control Systems

.1 Zone Controls

.1 The supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls capable of responding to temperature within the zone. Where dehumidification is provided, at least one humidity control device shall be provided for each humidity control system.

.2 Each zone shall be provided with programmable thermostatic setback control functionality through the central controller for the relevant system.

.2 Building Automation

.1 A central controller (or where required, multiple central controllers) shall be provided.

.2 Automatic start controls shall be provided for each HVAC system. The controls shall be capable of automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy.

.12 Other

.1 All equipment, insulation, piping, or cabling/controls wiring used in conditioned air streams, spaces or return air plenums shall be "plenum-rated" complying with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0.

.2 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminum ductwork, copper or stainless steel pipe, etc.

.3 Items of material & equipment not specifically noted or mentioned in the specifications but which are necessary to make a complete & operating installation shall be included in the scope of works.

3.2 ELECTRICAL

.1 General

.1 Contractor or Subcontractor to provide all electrical equipment (including conduits, wiring and all other associated electrical equipment) and works as to provide a full and working installation.

.2 Power (by Contractor or Subcontractor)

.1 Provide all power wiring to mechanical equipment.

.2 Provide motors, starters, contactors, disconnect switches and control devices

.3 Controls (by Contractor or Subcontractor)

.1 Provide and install control wiring for all equipment provided or supplied.

.2 Provide all relays and interlock connections to building fire alarm system.

.4 Other

.1 Items of material & equipment not specifically noted or mentioned in the specifications but which are necessary to make a complete & operating installation shall be included in the scope of works.

3.3 ARCHITECTURAL AND INTERIOR FINISHES

3.4 SUBMITTALS

.1 Submittals to include schedules and a tabular list of products, materials, equipment, or components to be used in the work, and other pertinent information regarding locations, features or similar. Submittals to be provided to Owner for written approval.

.2 Shop Drawings

.1 Submit drawings for written approval from Owner. Shop drawings to show:

.1 Mounting arrangements and locations of equipment.

.2 Operating and maintenance clearances.

.2 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves, where applicable.

.4 Manufacturer to certify current model production.

.3 Closeout Submittals

.1 Provide operation and maintenance data for incorporation into Owner's manual.

.2 Operation and maintenance manual approved by, and final copies deposited with, Owner before final inspection.

.3 Operation data to include:

.1 Control schematics for systems.

.2 Description of systems and their controls.

.3 Operation instruction for systems and components.

.4 Description of actions to be taken in event of equipment failure.

.4 Maintenance Information

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency and tools required.

.5 Approvals

.1 Submit two (2) copies of draft Operation and Maintenance Manual to Owner for approval. Submission of individual data will not be accepted unless directed by Owner.

.2 Make changes as required and re-submit as directed by Owner.

.6 As-Built Drawings

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

3.5 QUALITY ASSURANCE

.1 Contractor's Quality Control

.1 Contractor is solely responsible for the quality of Work. Contractor shall ensure that products, services, workmanship and site conditions comply with requirements of the Drawings and Specifications by coordinating, supervising, testing and inspecting the Work and by utilizing only suitably qualified personnel.

.2 Quality Requirements

.1 Work shall be accomplished in accordance with quality requirements of the Drawings and Specifications, including, by reference, all Codes, laws, rules, regulations and standards. When no quality basis is prescribed, the quality

shall be in accordance with the best accepted practices of the construction industry for the locale of the Project, for projects of this type.

.3 Field Quality Control

.1 Conduct following tests and submit report(s) as required.

.1 Submit tests as specified in other sections of this specification.

.2 Schedule site visits, to review Work, as required.

.4 Standards, Code Compliance and Manufacturer's Instructions and Recommendations

.1 Unless more stringent requirements are indicated or specified, comply with manufacturer's instructions and recommendations, reference standards and building code research report requirements in preparing, fabricating, erecting, installing, applying, connecting and finishing Work. Document and explain all deviations from reference standards and building code research report requirements and manufacturer's product installation instructions and recommendations, including acknowledgement by the manufacturer that such deviations are acceptable and appropriate for the Project.

.5 Building Code Requirements

.1 Comply with requirements for testing and inspections, as interpreted by authorities having jurisdiction. Additional requirements for inspection, as adopted by authorities having jurisdiction, shall be included in the Contract Sum and Contract Time.

.6 Requirements of Fire Regulations

.1 Comply with testing and inspection requirements of the Fire Marshal having jurisdiction. All inspections shall be included in Contract Sum and Contract Time.

.7 Health and Safety Requirements

.1 Carry out construction occupational health and safety in accordance with Health and Safety Requirements.

3.6 WARRANTY

.1 Contractor's Warranty

.1 Provide details of warranty for works by all contractors, including subcontractors.

.2 Equipment Warranty

.1 System as installed must qualify for manufacturer's commercial warranty. Contractor to apply for commercial warranty on behalf of the Client.

.2 Maintain As-Built Record of Equipment and Materials List for warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Warranties and terms of warranty.

.5 Starting point and duration of warranty period.

.6 Summary of maintenance procedures required to continue the warranty in force.

.7 Cross-reference to specific pertinent Operation and Maintenance manuals.

.8 Organization, names and phone numbers of persons to call for warranty service.

End of document