

DIVISION 23 05 05

HVAC BASIS OF DESIGN SYSTEMS NARRATIVE

PART 1 GENERAL

1.01 INTRODUCTION

- A. The purpose of this section is to define the design and delivery approach upon which the Contractor is to base a budget and bid for preconstruction and construction services. Specifically the services for the mechanical work, including but not limited to: general provisions, applicable codes, coordination requirements, submittal requirements, shop drawing requirements, quality assurance, testing adjusting balancing requirements, commissioning requirements, completion requirements, and the warranty requirements.
- B. All work under this section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions, and Division 01 – General Requirements, and shall include all mechanical sections specified herein.
- C. This section includes a general narrative description of Division 23 systems with specific equipment and component criteria that are to be included in the project.
- D. Specific conflicts between drawings, this specification section, and other specification sections will not be used to define project or cost exclusions. Exclusions based on document conflicts will be accepted or rejected in the Engineer of Record's formal response to bid clarification requests or Requests for Information (RFIs).

1.02 APPLICABLE CODES AND STANDARDS

- A. Wherever an International, National, or Uniform Code is referenced in this Narrative, it means the 2021 WA State version of that code, including any local amendments, is the design standard for this Project. For example where the IFC is referenced, the 2021 WA State Fire Code will be used.
- B. Design and installation shall comply with rules and regulations of the following:

APPLICABLE WASHINGTON STATE BUILDING CODES			
ENERGY CODE	2021 WASHINGTON STATE ENERGY CODE (SEC) FOR COMMERCIAL BUILDINGS	WAC 51-11C	EFFECTIVE MARCH 15, 2021
BUILDING CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-50	EFFECTIVE MARCH 15, 2021
ACCESSIBILITY CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS CHAPTER 11 AND ICC A117.1-2009	WAC 51-50	EFFECTIVE MARCH 15, 2021
SEISMIC CODE	ASCE 7-2016 AS REFERENCED BY 2018 INTERNATIONAL BUILDING CODE	WAC 51-50	EFFECTIVE MARCH 15, 2021
FIRE CODE	2021 INTERNATIONAL FIRE CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-54A	EFFECTIVE MARCH 15, 2021
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-52	EFFECTIVE MARCH 15, 2021
PLUMBING CODE	2021 UNIFORM PLUMBING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-56	EFFECTIVE MARCH 15, 2021
BOILER CODE	WASHINGTON STATE BOILER CODE	WAC 296-104	
ELECTRICAL CODE	2020 NATIONAL ELECTRICAL CODE WITH 2020 WASHINGTON AMENDMENTS (NFPA 70)	WAC 296-46B	EFFECTIVE NOVEMBER 1, 2020
ELECTRICAL	ELECTRICIANS AND ELECTRICAL INSTALLATIONS	RCW CHAPTER 19.28	
NFPA STANDARDS	NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS AS REFERENCED BY THE CODES ABOVE OR AS SPECIFICALLY LISTED BELOW		

1.03 ORDER-OF-PRECEDENCE PROVISIONS

- A. In the case of inconsistency or ambiguities in design documents (all specifications and documents), compliance with the more stringent design requirement among conflicting criteria is required.
- B. If provided, alternate pricing for compliance with less stringent criteria will be evaluated in addition to the mandatory baseline most stringent criteria.
- C. Provide notice upon discovering potential design conflicts prior to bid where possible.

1.04 PROJECT DELIVERY

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- A. ~~IMEG is the Engineer of Record for this project. This project is to be delivered design build. The Design Build Contractor will be the Engineer of Record and will create and stamp fully coordinated design documents for the project. The design build Engineer of Record is solely responsible for reviewing and vetting all design decisions with the Owner and Architect prior to installation.~~

B. Pricing Set Bid Notes

1. The intent is to procure MEP pricing packages that cover the full project though the documents are not at 100% CD level.
2. Reference current MEP narratives as well as architectural and structural drawings.
3. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
4. Pricing is to include all MEP provisions as needed to completely buildout the project as defined in all referenced documents.

5. Provide specific scope clarification requests through the Owner's bid clarification request process.

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6. ~~Bids will include a detailed list of scope exclusions.~~
7. ~~Provide breakout additive pricing for specific scope as required to address perceived scope gaps in the project documents.~~
8. ~~IMEG will participate in the Subcontractor selection process by reviewing proposals, interviewing, and strategizing with the team. Primary goals are to thoroughly identify potential gaps and contingency requirements and to build a strong partnership with the Subcontractors and GC.~~

- C. IMEG scope includes delivery of this Division 23 - HVAC Basis of Design Systems Narrative. Design efforts beyond this milestone are by Mechanical Contractor (MC).
- D. The Design Build Engineer of Record will create Construction Document drawings starting at the end of Design Development phase using Revit and Level 100 per AIA Level of Development (LOD) Document 2014 at a minimum beginning with the design development phase effort. Level 200 and 300 LOD are to be provided where needed for detailed coordination during the CD phase (mechanical rooms, typical constricted ceiling spaces, other space constrained areas). Shared model coordination with architectural, structural, and all trades is required.
 1. Utilize the BIM model to print 2D Design development and CD phase drawings
 2. Use the 3D BIM model throughout the design by the entire project team to facilitate collaboration and coordination. The information contained in the model will be used to create Construction Documents.
 3. Give the 3D BIM design model to the Owner as a record model of the original design at the end of the project. Any modifications to the model to accommodate facilities management or other purposes are at the discretion of the Owner and outside the scope of this contract.
- E. Detailing coordination: The MC will produce a 3D model of all systems. The Contractors will coordinate their shop drawings with other trades. The MC will be lead in this effort and will get signed agreements on shop drawings from MEP and other Subcontractors prior to starting work. The MC is responsible for all trade coordination effort as required for shop drawing completion.

- F. Detailing coordination: There will be no change orders for field interference coordination modifications.
- G. If there is a conflict between design documents and the request for proposal (RFP), the Contractor will identify the discrepancy and request a clarification prior to RFP response.
- H. Submittals
 - 1. Transmittal Form indicating the following: project, Contractor, Subcontractor, Vendor, Supplier, specification section, submittal number, and submittal revision number.
 - 2. Complete equipment and materials submittals shall be provided in electronic format. PDFs should be searchable and bookmarks are required for each submitted product. Submittals shall be complete with all components included and customized to this Project's requirements. Include warranty provisions for all equipment. All submittals require Owner team approval prior to purchase.
 - 3. Equipment Submittals: Include only submittal information for equipment and products being used in Project scope. Consistent manufacturer should be used for similar products (i.e. all dampers from a single manufacturer, all GRDs from a single manufacturer, etc.).
 - 4. Materials Submittals: Include only submittal information for materials being used in Project scope. Identify the system and/or application in which each material is being used.
 - 5. Product submittals will all be subject to review under the requirements of ESDS submittal review requirements.
- I. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
- J. The budget/estimate response proposals will identify scope gaps the Contractor perceives and provide breakout pricing to cover these gaps.
- K. The MC shall submit final electronic as-built drawings to the General Contractor (GC) for submittal to Owner within agreed upon time frames.
- L. O&Ms: Provide hard copy if requested by Owner and electronic copies of O&Ms for all systems within two weeks of substantial completion.

- M. The mechanical systems will be designed to include scope of work for full standalone compliance with the Energy Code. This includes the Energy Code mandatory provisions.
- N. Codes, Permits, Inspections, and Fees:
1. All work and materials shall be in accordance with requirements of all applicable local and state codes, statutes, standards, and other regulations.
 2. The codes shall be construed as establishing a minimum or base level of requirements. Contract Documents shall not be construed to permit or direct work not in conformance with codes, statutes, standards, and other regulations. Where provisions of the various regulations conflict with each other, or with the Contract Documents, the more stringent provisions shall be included in contract pricing. Conflict shall be resolved with the Architect and Authorities Having Jurisdiction (AHJ) prior to completing the design.
 3. Where the Contract Documents call for material or construction of a better quality or higher capacity than required by the codes, statutes, standards, and other regulations, the provisions of the Contract Documents shall take precedence over the requirements of the codes and standards.
 4. Material and equipment within the scope of the UL Testing Laboratory Service shall be listed by the Underwriters Laboratories for the purpose for which they are used and shall bear their listing mark. ETL or CSA shall be allowed if acceptable to the AHJs.
 5. Mechanical, Electrical, and Plumbing Subcontractors are to include all permit fees and are responsible for document intake.
 6. MC shall call for all inspections by the local AHJs when they become due and shall not cover any work until approved by these authorities.

1.05 MISCELLANEOUS SCOPE ITEMS

- A. The MC is to review the Energy, Div 21, 22, 26, 27, and 28 narratives for scope impacts.
1. IMEG has attempted to delineate the scope of work between Contractors. Where there are questions or inconsistencies in scope delineation or scope overlap, please notify IMEG so this can be resolved prior to bid. The GC is responsible for final

verification of Contractor scope delineation based on the most cost-effective approach for the Project.

2. Below is a list of typical items that need to be coordinated between Contractors:
 - a. Condensate piping and connections – provided by PC
 - b. Controls wiring
 - c. Electric heaters – calculated by MC, provided by PC
 - d. Heat tracing with controller
 - e. Heat tracing insulation
 - f. Freeze protection
 - g. Smoke detectors
- B. The Contractor is to provide complete pricing based on the scope described herein, the architectural drawings, and the other indicated references.
- C. Property line and interior acoustical calculations will be by the architectural design team's Acoustical Consultant prior to permit submittal. Acoustical Consultant to provide the requisite analysis to assure the team of acceptable acoustical performance of each system.
- D. The Structural Engineer is responsible for all structural design and calculations required for the supporting structure of all mechanical equipment and systems for permit intake.
- E. MC shall include structural tie-down calculations for all equipment as required by the IBC and ASCE 7. This is a deferred permit submittal.
- F. MC is to provide fire stopping of all through and membrane penetrations as required by the IBC and other applicable codes. Floor penetrations to include fire rated sleeves with either a 2" stand off water dam (Holdrite Pro Series Water Dam, Hilti-CFS-CID MD or approved equal), or a sleeving system with a built-in mid body waterproofing seal with a factory-provided W rating (Hilti CFS-680).
- G. All ductwork, piping, plumbing, and equipment are to be seismically restrained as required by the IBC.
- H. The Contractors will provide phenolic tags identifying each specific piece of equipment. Final tagging is to be approved by the Owner.

- I. All piping will be labeled extensively in compliance with accepted industry standards and building standards. Final labeling is to be approved by the Owner.

1.06 COORDINATION

- A. Installation will be in full compliance with acoustical specifications. The acoustical specification is to be fully followed regardless of conflicts with statements herein.
- B. The clear height per IBC 406.2.2 for each floor level is 7'-0", but other applicable ADA and code criteria require installation at no less than 7'-0". Vehicle pedestrian areas accommodating van-accessible parking required by Section 1106.5 of the IBC shall conform to ICC A117.1. Verify all ADA clearance requirements.
- C. All duct routing and equipment locations shall be coordinated with full design team.
- D. MC shall coordinate a minimum 42" clearance or more in front of mechanical equipment access panels for servicing as required by applicable code, NEC, and the AHJ.
- E. Cutting, framing, patching and painting of wall, ceiling, and floor openings shall be by Others.
- F. Final painting of grilles, registers, and diffusers, as may be required by the Architect, shall be done in the field by Others.
- G. Electrical Contractor (EC) shall provide magnetic motor starters for all equipment $\frac{3}{4}$ HP and greater unless an electrically commutated motor (ECM) is provided. Provide service and disconnect per code, and do all power wiring, including connecting to equipment. Holding coil circuit shall be powered by EC (120/1 unless indicated otherwise).
- H. Duct smoke detectors are not all shown on the mechanical plans. Duct smoke detectors are furnished by the EC. The Fire Alarm Engineer of Record is responsible for determining all duct smoke detector requirements. The MC is responsible for installing the duct detectors in the ductwork.
- I. Access panels are not yet shown. All access panels in walls and/or ceilings are furnished by the MC and installed by Others. MC to coordinate required locations and sizes with the Architect and GC.
- J. A fire and/or smoke detection and alarm system, as may be required by the Owner, Architect, or AHJs, is the responsibility of the EC.

- K. All conduit, line voltage, and low voltage smoke and fire alarm wiring for interlocks on all makeup air units, fire smoke dampers, exhaust systems, etc. are by the EC.
- L. Unit nameplate short circuit current rating (SCCR) to meet or exceed ampere interrupting capacity (AIC) rating of panel served. All small packaged equipment to be listed for a minimum of 5,000 AIC. Large equipment to be listed for a minimum of 64,000 AIC unless noted otherwise. Final rating is per EC coordination study.
- M. During ensuing design phases, it is the responsibility of the project Acoustical Consultant to provide the requisite analysis of mechanical systems to assure the team of acceptable acoustical performance of each system. The MC is required to submit all systems information in a timely manner to the Acoustical Consultant as needed to assure designs comply with criteria. The MC will coordinate in a timely manner to incorporate acoustical recommendations prior to building permit submittal.

1.07 ENERGY CODE COMPLIANCE PATH

- A. The project is pursuing Energy C406 Prescriptive Compliance Path. See the 2021 WSEC Stand Alone Energy Narrative for further details.
- B. No C406 options related to mechanical systems are being pursued as part of the C406 compliance strategy for the project.

1.08 2021 ENERGY CODE C409.1 ENERGY METERING AND ENERGY CONSUMPTION MANAGEMENT

- A. The building is less than 25,000 SF and therefore does not require a meter and data procurement system.

1.09 2021 ENERGY CODE C411 RENEWABLE ENERGY

- A. Refer to the 2021 WSEC Energy Compliance Requirements Narrative for information related to C411 Renewable Energy Requirements.

1.10 SUSTAINABILITY PROTOCOLS

- A. Evergreen Sustainable Development Standard (ESDS)
 - 1. The project will achieve ESDS v4.1 certification. MC shall be involved in coordination efforts required for which points are to be achieved.
- B. The project is not pursuing any other green rating system.

PART 2 PRODUCTS

2.01 HVAC SYSTEMS GENERAL

- A. All ductwork is to be constructed and installed to appropriate SMACNA standards.
- B. All ductwork is to be insulated per Energy Code requirements.
- C. A complete engineered seismic restraint, hanger, and vibration isolation package will be provided by the MC. Fully stamped and engineered packages provided by a single vendor (such as ISAT) is preferred.
- D. All air intakes and exhaust outlets are to be located with no less than code minimum required separations from openings, intakes, grade, property lines, etc. Some project specific minimum distance requirements may be greater than code minimum if identified within this document. Final locations are subject to approval through the shop drawing submittal review process prior to construction.
- E. HVAC fan motors are to be selected so that normal operation is not in the motor service factor.
- F. Per Energy Code Section C403.8.4, all fractional HP fan motors for fans that are 62 watts or greater shall have electronically commutated motors or shall have a motor efficiency of at least 70% when rated in accordance with Department of Energy (DOE) 10 Code of Federal Regulations (CFR) 431. These motors shall also have the means to adjust the motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.
- G. Fan power for Dedicated Outdoor Air Systems (DOAS) will comply with Energy Code Section C403.3.5.2. Total combined fan power is the sum of the fan power for each supply, exhaust, and other fans used for ventilation. For DOAS with one or more fan or fan arrays with fan electrical input power < 1 kW, the total combined fan power will not exceed 1 W per CFM of outdoor air.
- H. Per Energy Code Section C403.3.5.1 ERVs not serving Group R-2 dwelling units or other DOAS with energy recovery ventilation will have minimum 68% sensible recovery effectiveness or minimum 60% enthalpy effectiveness.
- I. Per Energy Code Section C403.8.4 and Table C403.8.4 Heat Recovery Ventilators (HRVs) and ERVs with an input power less than 1 HP will meet minimum 1.2 CFM/W efficacy where the CFM is outdoor air CFM and the watts are the total of all fans in the unit.

- J. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
- K. HVAC motors shall meet the NEMA premium efficiency standard.
- L. All exterior ductwork is to be completely coated on all sides with RCD Corp. #15 weather barrier coating by MC. Ductwork to be prepared and weather barrier coating to be installed per manufacturer recommendations.
- M. All equipment attached to structure with isolators will have flex connections to ductwork. For general purpose indoor applications provide Duro Dyne DDFDC Neoprene flex connectors. For general purpose outdoor applications provide Duro Dyne DDFDC Durodon with Hypalon coating flex connectors.

2.02 BACK OF HOUSE AND MISCELLANEOUS SPACES

- A. Water Service Entry Room: Provide complete temperature controlled ventilation system including room intake and exhaust motorized dampers, louvers, thermostat, and exhaust fan to control temperature rise due to continual running and motor heat output from the domestic booster pumps. Provide a wall heater for freeze protection.
- B. Janitor/Maintenance Room: Exhausted via a corridor ERV. Refer to Corridor Supply Air section for more information. Janitor room locations are to be determined.
- C. Trash Room Exhaust System:
 - 1. There are no enclosed trash rooms. Trash containers are located outdoors adjacent to the surface parking lot. No exhaust is required.
- D. Community Laundry Room:
 - 1. There is one Communal Laundry Room on each floor.
 - 2. Dryer exhaust ducts will be routed in a dedicated chase behind the dryers to a common exhaust plenum with motorized damper at the exterior wall exhaust termination louver. Provide a backdraft damper at each dryer exhaust duct prior to common exhaust plenum.
 - 3. MC shall provide secondary dryer vent cleanouts in easily accessible locations to allow for maintenance and cleaning of dryer vent ducts.
 - 4. Dryer exhaust ducts shall have no internal protrusions.

5. Flexible or semi-rigid materials are not permitted for usage in dryer exhaust vents. Per ESDS Section 7.09 all dryer exhaust ductwork must be rigid-type ductwork from the dryer connection point to the exhaust termination.
6. A makeup air exterior louvered opening shall be provided to allow transfer air from outside. Makeup air motorized damper operation shall be interlocked with either a pressure sensor within the laundry room or to a current sensor on each dryer in the laundry room served by the damper. Makeup air for Level 1 Laundry Room is from shared louver on Level 2 and through a vertical chase.
7. The Engineer of Record/Design Build Subcontractor will provide a table in the drawings showing each dryer vent's calculated total equivalent length, standard radius elbow quantity, and long radius elbow quantity.
8. If the MC's dryer vent layouts reflected in the shop drawings exceed the calculated dryer exhaust lengths due to field coordination requirements, the Engineer of Record is to be notified by the MC. Equivalent length calculations are to be modified by the Engineer of Record as needed to reflect the coordinated dryer vent layouts and to comply with the dryer manufacturer's maximum equivalent length.
9. Provide a permanent label within 6' of the dryer per IMC 504.8.5 visible to building maintenance personnel with dryer model and equivalent length allowance for the installed dryer vent.
10. Each Laundry Room has a dedicated ERV to provide room exhaust and supply air. Provide with combination termination fitting (BOD: Broan V14695).

E. Electrical Rooms:

1. Main Electrical Room
 - a. There are no transformers in this room, therefore no cooling is required.

2.03 STAIRWELL SHAFTS

- A. The EC will provide electric cabinet heaters at the bottom level of both stairwells. Integral thermostats will be provided. Cabinet surface mount or recess requirements will be coordinated by the EC. MC will size and schedule the heaters.
- B. Stairs are not pressurized as they do not serve a floor more than 75 feet above the lowest level of Fire Department vehicle access per IBC 403.5.4.

2.04 GARAGE SUPPLY AND EXHAUST

- A. Parking is at a surface lot at the street level and is not enclosed. Exhaust is not required.

2.05 DWELLING UNIT HEATING SYSTEMS – ELECTRIC HEAT

- A. No mechanical cooling is provided to dwelling units.
- B. The EC will provide the heaters and thermostats.
- C. The MC shall size and specify the residential electric heaters and coordinate layouts with the Architect. Heater sizing to comply with WSEC Section C403.1.4 Exception 2 for dwelling and sleep units.
1. Bathrooms located on the perimeter without fenestration will be provided with a 250 W wall heater as allowed per WSEC Section C403.1.4 Exception 2.3. BOD: King PAW Wall Heater
- D. All units shall be heated via electric heating units. Baseline product approach for living areas and bedrooms is King KCV Cove heaters. Manufacturers other than King may be utilized if approved as an equivalent substitution.
1. The Design Building Contractor (EOR) is responsible for all heat load calculations and heater sizing/selections. Heater sizing will comply with Energy Code Section C403.1.4 Exception 2 for Dwelling and Sleeping Units.
- E. Thermostats - Remote mounted 7-day programmable thermostats shall be provided in the primary living space of each residence (King Model ESP MAX22 for 208V). Remote mounted manual digital display thermostats shall be provided in the bedrooms (King Model ES MAX22 for 208V). Thermostats shall be line voltage (208V) and rated for 22 amps.

2.06 DWELLING UNIT VENTILATION: IN-UNIT ERV

- A. Balanced airflow with heat recovery for supply and exhaust system is required per IMC and Energy Code. Provide one energy recovery ventilator (ERV) for each dwelling unit.
- B. All ductwork is to be constructed and installed to appropriate SMACNA standards.
- C. Ductwork shall be a minimum of 26 gauge or as required by IMC.
- D. Ventilation to each dwelling unit will be provided by an individual ERV in each residential unit. The MC will provide an Energy Recovery Ventilator (ERV) in all Residential Dwelling units with a minimum sensible recovery effectiveness of 60% in

accordance with Section C403.7.6 per Energy Code Section C403.3.5.1 Exception 3. Minimum ERV effectiveness will also be sufficient to provide a minimum of 55°F ventilation supply air at winter design conditions.

1. Per the requirements of Energy Code Table C403.8.4, the ERV shall meet the minimum efficacy of 1.2 CFM/W.
- E. Each habitable space within the dwelling unit will be provided with supply ventilation air. Ventilation air to be supplied in parallel with the heating system.
- F. Exhaust the bathroom with the ERV. The code required kitchen exhaust will be from the intermittent range hood ducted exhaust system.
- G. Ducted Dwelling Unit ERV:
1. Manufacturer basis of design: Broan BLP150E75NS-HW
 - a. Approved equal may be submitted with confirming RFI with the understanding that all design changes shall be handled by MC in the shop drawing process.
 2. ERV unit to be installed in last perimeter joist bay. Coordinate joist bay depth with structural.
 - a. ERV unit will be hard-wired.
 - b. Outdoor air and exhaust air will have R-8 insulation. They will be located in the last perimeter joist bay and connect to the combination termination fitting, provided by Others (BOD: Broan V14695). Combination termination fitting location to comply with IMC Section 401.4.3. Inlet and outlet area to be sized to achieve a maximum free area velocity of 500 feet per minute per IMC Sections 403.4.6.1 and 403.4.6.2.
 - c. All ductwork supplying to dwelling unit and exhausting from bathroom is to be routed in joists. Provide ceiling radiation dampers on the supply grilles and exhaust grilles wherever they penetrate a rated floor/ceiling assembly.
 - d. Provide full-size rated access panel below the ERV, minimum dimensions of 36x24.
 - e. Coordinate with structural engineer if mounting ERV in other than last joist bay.

- f. Coordinate any ducts that penetrate beams within floor/ceiling assembly with structural engineer prior to install.
- 3. ERV controls shall include 2-speed operation. The ERV shall operate continuously on low speed to satisfy the whole house ventilation requirements and high speed (boost mode) shall be activated by an occupancy sensor. High speed shall be set to operate for 20 min after the switch is deactivated.
- 4. A whole house fan “off” switch shall be provided. Provide signage adjacent to the fan switch notifying the occupants of 24/7 ventilation operation in accordance with IMC Section 403.4.5. Signage to read “LEAVE ON UNLESS OUTDOOR AIR QUALITY IS VERY POOR.” Fan switch to be located on inside wall of coat closet at unit entry at same mounting height as light switches. Provide fan switch with semicircular toggle switch guard (non-lockable) to prevent accidental switch-off. Switch installation by EC.
- 5. Provide a supply grille for each habitable space and aluminum bathroom exhaust grille.
- 6. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
- 7. The selected model shall comply with Energy Code. Where required motors shall be electronically commutated motors.
- 8. Purchase with factory isolation kit.

2.07 RESIDENCE EXHAUST SYSTEMS

- A. Exhaust ductwork pricing assumptions shall accommodate location changes within the unit floor plan as the architectural plans are not finalized.
- B. All ductwork is to be constructed and installed to appropriate SMACNA standards.
- C. The residence ventilation is by means of ERVs.
- D. Range exhaust ductwork is to be routed through soffits.
- E. Exhaust terminations shall be 3’ minimum from building openings and property lines per IMC Chapter 5.
- F. Duct sizing

1. Range exhaust duct size = 6" minimum
2. Bathroom exhaust duct size = 4" minimum

G. Bathroom Exhaust:

1. The bathroom is exhausted via the in-unit ERV. Refer to Dwelling Unit Ventilation: In-Unit ERV section for more details.

H. Kitchen Range Hood:

1. The kitchen range hood is provided by Others. The Architect will specify the hood as part of the appliance package. The MC will provide a duct system that delivers manufacturer-specified minimum CFM. Per ESDS Section 7.07a, range exhaust hoods must be Energy Star labeled.
2. Ductwork to the perimeter and connection to the range hood is by the MC.
3. Operational exhaust rate and CFM requirements for the range hood vary by kitchen type and range type per IMC Tables 403.4.7 and Table 403.4.7.3.
 - a. Continuous exhaust in an open kitchen is not permitted.
 - b. Continuous exhaust in an enclosed kitchen requires minimum 5 ACH based on the kitchen volume.
 - c. Intermittent exhaust in open kitchens requires:
 - 1) Minimum 65% capture efficiency or minimum 160 CFM for a range hood over an electric range
 - 2) Minimum 80% capture efficiency or minimum 250 CFM for a range hood over a combustion range
4. Per IMC 403.4.7.2.4 range exhaust hoods are limited to maximum sound rating of 3 sones at airflow settings not less than 100 CFM and at intended static pressure per HVI 916 Section 7.2.
5. Range exhaust airflow will be tested and verified in accordance with IMC Section 403.4.7.3.1.

- I. Residential exhaust termination shrouds or louvers will be provided by Others. Backdraft dampers for range exhaust are by MC. Screens for range exhaust are by MC. Termination details within the shroud are by MC. Backdraft dampers will be Famco

with gasketed edge seal for quiet performance. Gravity backdraft dampers for residential exhaust systems shall be provided with a gasketed seal per Energy Code Section C403.7.8.3 Exception 2.

2.08 CORRIDOR SUPPLY AIR

- A. Each corridor will be served by (1) ERV each. ERVs will be located at the far end of each wing.
 - 1. Each ERV will use a combination termination fitting (BOD: Broan V14695) that meets separation requirements per WSMC Section 401.4.
 - 2. ERV BOD: Broan BLP150E75NS-HW
 - 3. The ERV will also exhaust the Janitor Closet on its associated floor.
- B. The MC will provide an Energy Recovery Ventilator (ERV) with a minimum sensible recovery effectiveness of 68% or minimum enthalpy recovery ratio of 60%. Minimum ERV effectiveness will also be sufficient to provide a minimum of 55°F ventilation supply air at winter design conditions.
 - 1. Per the requirements of Energy Code Table C403.8.4, the ERV shall meet the minimum efficacy of 1.2 CFM/W.
- C. The corridor ERVs will shutdown upon any return air smoke detection.
- D. Accessories include supply fan EC motor, local space temperature controller, and standalone controls.
- E. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
- F. Supply grilles will be Titus MCD or equivalent manufacturer's.
 - 1. Include cable operated damper (COD) or electronically operated balancing damper (EOD) at corridor supply for balancing.
 - 2. The supply grille will not include an opposed blade damper (OBD) without approval by the Acoustical Consultant.
- G. Wall heaters will be provided by EC in the corridor at each level and sized to comply with Energy Code Section C403.1.4 Exception 1. See Plans for heater counts.

2.09 CONTROLS

- A. Each HVAC system will be provided with standalone controls. There will be no BMS or DDC controls for the building.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. All work contracted for must be accepted by all applicable inspectors including site Superintendent, GC quality control personnel, Owner's Representative, or their assignees.
- B. As-builts: Provide Owner with electronic as-built drawings within two weeks of substantial completion. As-builts will reflect all changes from the construction drawing set and will comply with Energy Code project completion requirements.
- C. O&Ms: Provide hard copy and electronic copies of O&Ms for all systems within two weeks of substantial completion.

3.02 TESTING AND INSPECTION

- A. All testing, balancing, startup and commissioning is by the MC. All hydronic and air systems including all heat pumps, dwelling ceiling fans, range hoods, etc. will have water and airflow measurement and balancing conducted by the MC.
- B. All commissioning will be in compliance with the methodologies and practices outlined in Energy Code Section C408. Commissioning will also comply with ESDS mandatory commissioning requirements and optional credits being pursued as part of the ESDS compliance path.
- C. A 3rd party commissioning agent (CxA) will execute Commissioning of the MEP systems in accordance with Energy Code Section C408. These requirements apply to all residential and non-residential systems.
- D. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Representative (OR), the designated representative of the Owner's Construction Management firm (CM) (if applicable), the GC, the Architect and Engineer of Record, the MC, the EC, the Testing and Balancing (TAB) representative, and any other installing Subcontractors or Suppliers of equipment. Project Superintendent and Subcontractors, Installers, Suppliers, and Specialists deemed appropriate by the CxA or others. If known, the Owner's building or plant Operator/Engineer is also a member of the Commissioning Team.

- E. The CxA may assist with problem-solving deficiencies, but ultimately that responsibility resides with the A/E, GC, and the Subcontractors. The primary role of the CxA is in regards to Divisions 22, 23, and 26 and is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents.
- F. The MC will fully participate in the commissioning process as follows:
 - 1. The MC will participate in all commissioning meetings.
 - 2. MC will verify that coordination, installation, quality control, and final testing have been completed such that installed systems and equipment comply with Construction Documents.
 - 3. The MC will execute and document complete calibration of sensors and actuators and point-to-point testing of control systems.
 - 4. Provide preliminary and final TAB reports indicating all actual field values recorded to the Commissioning Authority prior to initiation of functional testing. TAB will not be complete until the TAB report is accepted by the A/E/Ownership team.
 - 5. Provide Commissioning Authority with controls system wiring diagrams and narrative sequences of operation in time for use in preparing the functional test procedures.
 - 6. Generate and provide blank pre-functional tests and checklists for review by CxA. Incorporate changes recommended by the CxA.
 - 7. MC is to execute pre-functional performance testing (FPTs) in an effort to eliminate deficiencies prior to final testing and witness witnessing stage and inform CxA that the system(s) are ready for witness testing.
 - 8. Execute final FPTs to be witnessed and documented by the CxA.
- G. The Contractor will be expected to fully execute the Cx process.
- H. Per Energy Code Section C403.10.2.3, all ductwork designed to operate at a static pressure in excess of 3 inches of water column shall be subjected to a high pressure duct leak test. This scope is by MC.
- I. Owner training will be provided by the installing Contractor.

END OF SECTION