SECOND AMENDATORY ENERGY PERFORMANCE AGREEMENT

This **SECOND AMENDATORY ENERGY PERFORMANCE AGREEMENT** is made between the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado (the "City"), and **MCKINSTRY ESSENTION, LLC**, a Washington limited liability company with an address of 5005 3rd Ave South, Seattle, WA 98134 (the "Contractor"), jointly ("the Parties").

WHEREAS, the Parties entered into an Energy Performance Agreement dated December 9, 2021, and an Amendatory Energy Performance Agreement dated June 24, 2022 (collectively, the "Agreement") to implement the energy performance measures provided in **Schedule B**, the Description of Work;

WHEREAS, due to the need to extend the Term to correct the date of the completion of measurement and verification services and to realign the lease equipment schedule with work occurring in the field, the Parties wish to amend the Agreement to extend the Term, increase the Maximum Contract Price and to make such other Amendments as are herein set forth.

NOW THEREFORE, in consideration of the mutual covenants and agreements hereinafter set forth and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties incorporate the recitals set forth above and amend the Agreement as follows:

1. All notices to Contractor required by the terms of the Agreement shall hereafter be sent to Contractor's new address set forth in the opening paragraph of this Second Amendatory Energy Performance Agreement, and in compliance with the provisions of Section 42 of the Agreement, entitled "<u>NOTICES</u>:".

2. Section 6, entitled "<u>**TERM**</u>:", is hereby deleted in its entirety and replaced with the following:

"6. <u>**TERM**</u>: The Agreement will commence on the date set forth on the City's signature page and will expire on September 1, 2027 (the "Term"). Contractor shall complete the Work and its other obligations described herein on or before September 1, 2027. The City shall not be liable to compensate Contractor for any Work performed prior to the Effective Date or after the expiration or earlier termination of this Agreement. The term of this Agreement ("Contract Term") shall be divided into three (3) separate components.

"a. Planning Term. The "Planning Term" shall commence on the Effective Date, which shall be defined as the date as set forth on the City's signature page, and upon delivery by the Principal Representative to Contractor of a Notice to Proceed to Commence Design Phase under Article 8.i. and terminate upon delivery by the Principal Representative to Contractor of a Notice to Proceed to Commence Construction Phase for the last improvement per the Construction and Installation Article 10.b.

"b. Construction Term. The "Construction Term" shall commence upon delivery by the Principal Representative to Contractor of a Notice to Proceed to Commence Construction Phase under Article 10.e. and terminate no more than 907 calendar days after the Construction Commencement Date, unless sooner terminated as provided in this Agreement.

"c. M&V Term. The "M&V Term" shall begin on the M&V Commencement Date and continue until no later than September 1, 2027. The M&V Term shall terminate pursuant to Schedule D unless sooner terminated as provided in this Agreement."

3. In Section 8, entitled "<u>COMPENSATION AND PAYMENT</u>:", Subsection a., entitled "<u>Budget</u>.", is hereby deleted in its entirety and replaced with the following:

"8. <u>COMPENSATION AND PAYMENT</u>:

"a. <u>Budget</u>. The City and the Third Party Lessor shall collectively pay, and the Contractor shall accept, as the sole compensation for the Work, through this Agreement, the Escrow Agreement, and the Purchase Order, the amounts set forth below:

"Cost of Services (MCP) via this Agreement:	\$2,526,933
Cost of Equipment (MEP) via the Escrow	\$13,472,685
Cost of Direct Purchase Equipment (MDPEP) via the Purchase Order: (MDPEP):	\$735,094
Total Project Value to be Paid to Contractor:	
	\$16,734,712"

4. In Section 8, entitled "<u>COMPENSATION AND PAYMENT</u>:", Subsection d., entitled "<u>Maximum Contract Price</u>:", is hereby deleted in its entirety and replaced with the following:

"d. <u>Maximum Contract Price</u>:

"(1) Notwithstanding any other provision of the Agreement, the City's maximum payment obligation will not exceed Two Million Five Hundred Twenty-Six Thousand Nine Hundred Thirty-Three Dollars and Zero Cents (\$2,526,933.00) (the "Maximum Contract Price"). The City is not obligated to execute an Agreement or any amendments for any further services, including any services performed by Contractor beyond that specifically described in **Schedule B-2**. Any services performed beyond those in **Schedule B-2** are performed at Contractor's risk and without authorization under the Agreement."

5. In Section 8, entitled "<u>COMPENSATION AND PAYMENT</u>:", Subsection f., entitled "<u>Lease Purchase Equipment / Maximum Equipment Price</u>.", Subparagraph (2) is hereby deleted in its entirety and replaced with the following:

The total compensation payable to Contractor **(**(2) for acquiring, installing, and maintaining the Equipment, together with applicable Included Warranties associated with such Equipment, shall not exceed the amount of Thirteen Million Four Hundred Seventy-Two Thousand Six Hundred Eighty-Five Dollars and Zero cents (\$13,472,685.00) ("Maximum Equipment Price"), payable directly to the Contractor by the Third Party Lessor through the Escrow Agent. Payment for all such Equipment, installation, training, and Included Warranties shall be made by the Third-Party Lessor through the Escrow Agent to Contractor within thirty (30) days of Escrow Agent's receipt of the corresponding Certificate of Acceptance and an approved Contractor invoice in a total amount not to exceed the MEP as provided by the Acceptance Certificates attached as Schedule Y-2. The Contractor will forward title to the Equipment within twenty-four (24) hours of receiving payment to the Third-Party Lessor at:

> "JPMorgan Chase Bank, N.A 1111 Polaris Parkway, Suite 4N Mail Suite OH1-1085 Columbus, Ohio 43240 Attn: Operations Managers Account: Chase Equipment Finance"

6. Section 32, entitled "<u>PAYMENT OF CITY MINIMUM WAGE</u>:", is hereby deleted in its entirety and replaced with the following:

"32. <u>COMPLIANCE WITH DENVER WAGE LAWS</u>: To the extent applicable to the Contractor's provision of Services hereunder, the Contractor shall comply with, and agrees to be bound by, all rules, regulations, requirements, conditions, and City determinations regarding the City's Minimum Wage and Civil Wage Theft Ordinances, Sections 58-1 through 58-26 D.R.M.C., including, but not limited to, the requirement that every covered worker shall be paid all earned wages under applicable state, federal, and city law in accordance with the foregoing D.R.M.C. Sections. By executing this Agreement, the Contractor expressly acknowledges that the Contractor is aware of the requirements of the City's Minimum Wage and Civil Wage Theft Ordinances and that any failure by the Contractor, or any other individual or entity acting subject to this

Agreement, to strictly comply with the foregoing D.R.M.C. Sections shall result in the penalties and other remedies authorized therein."

7. Section 43, entitled "<u>NO EMPLOYMENT OF A WORKER WITHOUT</u> <u>AUTHORIZATION TO PERFORM WORK UNDER THE AGREEMENT</u>:", is hereby deleted in its entirety and replaced with the following:

"43. <u>INTENTIONALLY OMITTED</u>."

8. Schedule B is hereby deleted in its entirety and replaced with Schedule B-2 Detailed Scope of Work, attached and incorporated by reference herein. All references in the Agreement to Schedule B are changed to Schedule B-2.

9. Schedule C is hereby deleted in its entirety and replaced with Schedule C-2 Guarantee, attached and incorporated by reference herein. All references in the Agreement to Schedule C are changed to Schedule C-2.

10. Schedule D is hereby deleted in its entirety and replaced with Schedule D-2 Measurement and Verification Plan, attached and incorporated by reference herein. All references in the Agreement to Schedule D are changed to Schedule D-2.

11. Schedule F is hereby deleted in its entirety and replaced with Schedule F-2 Schedule of Values, attached and incorporated by reference herein. All references in the Agreement to Schedule F are changed to Schedule F-2.

12. Schedule G is hereby deleted in its entirety and replaced with Schedule G-2 **Proposed Financial Cost and Cash Flow Analysis**, attached and incorporated by reference herein. All references in the Agreement to Schedule G are changed to Schedule G-2.

13. Schedule H is hereby deleted in its entirety and replaced with Schedule H-2 Certification that Cost-weighted Average Service Life of Equipment Exceeds Financing Term, attached and incorporated by reference herein. All references in the Agreement to Schedule H are changed to Schedule H-2.

14. In **Schedule Y / Y-1**, the following Forms of Acceptance Certificates are hereby deleted in their entirety and replaced with revised Forms of Acceptance Certificates, attached hereto and incorporated by reference herein:

Form of Acceptance Certificate No. No. 59 of 141; Form of Acceptance Certificate No. No. 70 of 141; and Form of Acceptance Certificate No. No. 76 of 141.

15. As herein amended, the Agreement is affirmed and ratified in each and every particular.

16. This Second Amendatory Energy Performance Agreement will not be effective or binding on the City until it has been fully executed by all required signatories of the City and County of Denver, and if required by Charter, approved by the City Council.

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK; SIGNATURE PAGES FOLLOW.]

Contract Control Number:	GENRL-202473002-02 [GENRL-202161179-02]
Contractor Name:	MCKINSTRY ESSENTION, LLC

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of:

SEAL

CITY AND COUNTY OF DENVER:

REGISTERED AND COUNTERSIGNED:

ATTEST:

By:

APPROVED AS TO FORM:

Attorney for the City and County of Denver

By:

By:

By:

Contract Control Number: Contractor Name:

GENRL-202473002-02 [GENRL-202161179-02] MCKINSTRY ESSENTION, LLC

1 april By: E41AF7BDBA7E403

Leslie Larocque

Name:

(please print) Sr. Vice President, Energy & Technical Services Title: _____

(please print)

ATTEST: [if required]

By: _____

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EXCLUSIONS AND CLARIFICATIONS

The following exclusions and clarifications apply to all scopes of work.

EQUIPMENT SELECTIONS

The Guaranteed Maximum Price is based on the following scopes of work, exclusions, and clarifications. Some scopes of work reference particular equipment selections. The selections are a basis of design and may change during the design period as needed to accomplish the stated objectives. Final equipment selections may vary from the scopes below. Modifications to selections (the basis of design) may result in cost changes.

GENERAL

- 1. Correction of deficiencies not explicitly listed in the scope of work are not included; if existing equipment or components are reused, repairs to existing equipment or components are not included unless specifically noted in the scopes of work.
- 2. Prices are valid until December 31, 2021. After this, McKinstry reserves the right to update pricing based on changes in labor rates, equipment, and material.
- 3. Refrigerant and equipment that is recovered during demolition will not be returned to the City for salvage or reuse. It is recycled under the scope of work.
- 4. Demolition work not specified in the scopes of work is excluded.
- 5. Pricing assumes that Certified Payroll is not required. If required, project contingency can be used to cover any pricing increases due to Certified Payroll.
- 6. City and County of Denver taxes at 5.91% are included. All other taxes, including state tax, are excluded.
- 7. This is an outcome-based scope based on preliminary design. McKinstry has included all parts, components, and repairs <u>known</u> to be necessary to meet the stated outcomes. In the event that unforeseen, unknown, or conditions different from the initial audit arise contingency has been included in the project for this purpose. McKinstry will notify the City of the need to use contingency to address these conditions and at its discretion use contingency as needed. Contingency use is not a change order to the contract and is subject to the fee structure, including overhead and profit, described in Schedule G the Energy Performance Contract, Contractor Proposal.
- 8. Should the City request change orders, they are subject to the fee structure, including overhead and profit, described in Schedule G of the Energy Performance Contract, Contractor Proposal.
- 9. Contractor shall schedule and conduct (1) warranty walk per CCD Facility Team.
- 10. All work (less lighting retrofits which are typically done after hours) is scheduled during normal business hours. Any requests to do work after hours may result in additional costs and project contingency can be used to cover these additional costs.

- 11. Cost allowances are used in this project for scopes where insufficient information was available in the audit stage to fully define the project cost.
- 12. It is understood that Textura will not be required. Textura fees are not included. If required project contingency can be used to cover these additional costs.

EXISTING CONDITIONS

- 1. It is assumed that the existing utility services are operational and adequately sized to accommodate new equipment.
- 2. It is assumed that the existing structures is adequate to accommodate new and existing equipment. Preliminary assessments have been performed at sites for new rooftop equipment.
- 3. Correction of any existing code violations not identified in the scope of work is excluded.
- 4. It is assumed that existing systems are adequate to meet the building load and in serviceable condition. Repair or replacement of these items not addressed in the scope of work is excluded. Examples of these systems include, but are not limited to: boilers, chillers, cooling towers, heat exchangers, piping, coils, pumps, valves, air handling units, rooftop units, unit ventilators, terminal VAV boxes, unit heaters, exhaust fans, ductwork, diffusers, dampers, and other associated appurtenances.
- 5. Furnishing or installing any access panels or doors not specifically identified is excluded.
- 6. Repair of any pre-existing roof or roof deck damage is excluded from this scope.
- 7. Systems will be drained and refilled as needed using existing isolation and air bleeding as shown on the City provided as-built documentation.
- McKinstry shall not be responsible for any re-inspection fees or other costs that are a direct result of failed inspections due to other work being performed in or around McKinstry's work that are not explicitly stated in our scope of work.
- 9. McKinstry is not responsible for delays in start-up, or additional start-ups, that are caused by other contractors outside of McKinstry's scope of work.
- 10. New ceiling tiles, removal and replacement of ceiling tile grid, and any repairs to existing ceiling tile and grid conditions are excluded.
- 11. Repair, replacement, or refurbishment of any existing equipment upstream or downstream of the specified equipment in scope shall be excluded unless specifically identified in the construction documents.
- 12. Missing lens replacement is not included. Lenses only to be replaced if broken or damaged during install
- 13. It is assumed isolation valves are in working condition. Unless specifically noted in the scope of work replacement of failed isolation valves is excluded.

- 14. It is assumed that the chimney at Fire Station 24 is functional. This scope does not include chimney inspections or a new chimney liner.
- 15. Chlorine treatment of entire domestic water distribution system is excluded from the steam condensate scope of work as the piping replaced is minimal.
- 16. Glycol levels on existing systems will be measured prior to construction. After construction glycol will be added to the systems to bring them back up to the measured pre-construction levels.
- 17. If roofing manufacturer warranty information is not provided to McKinstry, the roof manufacturer warranty may not be upheld after installation.

DESIGN

- The GMAX documents are assumed to be the 'Design Development' documents and as such the final design deliverables shall follow standards associated with the 'Construction Documents'. The construction documents will not include sections or specifications as neither deliverable is necessary for the scope of work to be performed.
- Costs are based on design input from the individual maintenance teams and McKinstry design standards and any deviation from these standards at the request of City that require additional costs shall be addressed via the change order process outlined in the EPC contract and Schedule A.
- 3. Screening and painting of new equipment is excluded.
- 4. Repair of existing duct leakage and blowouts is excluded.
- 5. Modifying and/or adding seismic restraint components to existing mechanical equipment and lighting fixtures is excluded.
- 6. Updating lighting controls to meet current code requirements is excluded.
- 7. There is no guarantee that post-installation sound levels will not be higher than current levels.
- 8. BIM (3-D building modeling) is excluded.
- 9. The City is not considering this project a New Construction Project but a Retrofit Project. Therefore, no specific CCD design/construction standards have been provided, followed in design or included in pricing. If design/construction standards are provided post contract signature any deltas from the current design to the CCD provided design/construction standards will be covered by project contingency.

CONSTRUCTION AND SCHEDULE

- The construction schedule has been built around a one (1) week turn-around time between the City receiving and responding to each submittal. McKinstry reserves the right to extend construction timelines as required to account for any delays in submittal reviews by the City.
- 2. The project schedule may be extended by inclement weather.

- 3. It is assumed that McKinstry will have full unrestricted access twenty-four hours a day seven days a week to City buildings during the construction period while adhering to Customer required security protocols.
- 4. Temporary heating, cooling, and ventilation is excluded from all scope items. It is assumed that McKinstry will not provide services (hot water, heating, cooling, electricity, light, refrigeration) to building tenants during the construction period, providing these services is excluded. The building may not meet the City's comfort standards during the construction periods mentioned above.
- 5. It is not expected to damage tree roots during crane pick activities. If any crane pick damages tree roots nearby the site, McKinstry will not be responsible for tree replanting or any other remediation to trees.
- 6. Costs are based on prompt and safe access to all areas necessary to complete these scopes of work.
- 7. Moving of facility equipment or furniture is excluded. The City is responsible for heavy moving of furniture in offices and other spaces to accommodate work in these spaces as needed.
- 8. City to provide special inspections as required by the AHJ for all scopes of work.

SCHEDULED SHUT-DOWNS

- 1. The scopes of work require periodic mechanical and electrical system shutdowns. McKinstry will provide one-week notice of temporary shutdowns. The City and McKinstry will coordinate with relevant stakeholders in a timely fashion to develop a shut-down schedule.
- The City shall de-energize buildings for electrical shutdowns. McKinstry will verify absence of voltage and perform work. The City shall then re-energize buildings after electrical work. McKinstry shall give (1) weeks' notice prior to shutdowns.

NETWORK CONNECTIVITY & REMOTE ACCESS CLARIFICATIONS

- Client has requested McKinstry's assistance to provide technical support, services, and/or analysis through the Client's Intelligent Building Management System (BMS) or Building Automation System (BAS) (the "System(s)"). McKinstry's Work requires that Client makes the System(s) accessible via TCP/IP connection, Remote Desktop Protocol (RDP), or other pre-approved method for accessing the System(s) reliably. For clients without existing access using these methods, other options will need to be explored.
- The City is responsible for providing any network drops required for the scope of work. McKinstry to give at least (2) weeks' notice for when data drops need to be installed. McKinstry must meet all of the Customer's safety and security requirements for network connectivity.
- 3. The City represents that all facilities and System(s) within the scope of services are pre-existing and have Direct Digital Controls (DDC) that are web-enabled (or other equivalent remote access) to allow

for continued remote connectivity for troubleshooting and issue investigation, and these System(s) have capability to deliver alarms via email to external recipients.

- 4. The above requirements for McKinstry to be able to reliably connect to customer DDC systems through the specified contract performance period.
- 5. McKinstry Responsibilities
 - a) Set up necessary trends for performance analytics objectives.
 - b) Establish automated export system (if included in scope) using a simple export script to send trend reports to McKinstry FTP site, scheduled to minimize impact on the System(s).
 - c) Maintain all log in credentials in a secure password management system.
- 6. City Responsibilities:
 - a) Integrity and security of, and access to, all Systems and associated building automation technology components, including hardware and software will be the sole responsibility of the City.
 - b) The City will provide notice to McKinstry prior to upgrades, changes, or modifications to the System(s) and will assume associated costs related to maintaining connectivity to McKinstry monitoring technologies.
 - c) The City will provide and maintain reasonable web-enabled open access network for remote connectivity to Systems for authorized McKinstry personnel and must support external network connectivity. McKinstry relies on the City's knowledge of its own internal network and System(s) to determine the appropriateness of the access granted.
 - d) Connectivity needs to be accessible without the use of Key-FOB's or other VPN client software that may limit or disrupt local connectivity which would interfere with McKinstry's ability to properly setup, tune and diagnose alarms.
 - e) The City will provide secure remote access to dedicated System(s) primary servers, such as Niagara servers, as required by McKinstry. Remote Desktop protocol or other similar methods are typically acceptable. Remote access to the Niagara and JCI servers is required by McKinstry for continuous data upload of raw trend archives to McKinstry's servers. McKinstry requires VPN access to the District's intranet through the contractual performance period.
 - f) The City is solely responsible for safe guarding its Systems, information, networks, data, and associated components. The City acknowledges that McKinstry has no access or knowledge of the City's IT network, System(s) and/or security protocols and has no practical way of monitoring the operational activities of those systems.
 - g) If alarming will be included in the scope of services the City will provide an exchange email account capable of receiving alarms from the System(s) and sending these alarms to external addresses.
 - h) It is assumed that existing network drops will be reused.

FIRE/LIFE SAFETY SYSTEM EXCLUSION

- 1. Testing of the Fire/Life Safety system, modifications to the system/associated components and test and balance of smoke control systems are excluded from scope.
- 2. Furnishing, installing, or wiring to any combination fire/smoke, fire dampers or smoke dampers is excluded.
- 3. Any changes to fire and life safety systems not noted in the scopes below, are excluded.
- 4. Any changes to existing lightning protection systems are excluded.

COMMISSIONING SPECIFIC EXCLUSIONS

Commissioning is provided by McKinstry commissioning staff. Third party commissioning is excluded.

Beyond the components and systems not specifically included in this scope of work, all other components and systems are excluded, including but not limited to the following items:

- 1. Fire/Life Safety System, except as noted above.
- 2. Elevators
- 3. Back-up Generators
- 4. Electrical services/devices not associated with McKinstry scope items
- 5. Controls modifications to buildings other than specifically listed in the following scope of work.
- 6. HVAC equipment not specifically called out in the scope of work

PLUMBING SPECIFIC EXCLUSIONS

Plumbing systems not specifically called out in the scope of work are excluded.

TEST AND BALANCE EXCLUSIONS AND CLARIFICATIONS

Test and Balance work will follow standard TAB or NEBB standards for the specified pieces of equipment called out in the scope below only. Equipment downstream of the specified equipment shall be excluded unless specifically called out in the scope above. An example is control valves and circuit setters downstream of pumping systems being changed per the scope of work. This exclusion is not limited to this example.

PHOTOVOLTAIC CLARIFICATIONS AND EXCLUSIONS

- 1. McKinstry has shown estimated third-party inverter replacement costs in the project cashflow. The City is responsible for this work being executed.
- 2. For the installation of PV systems on built up roofs, spudding is excluded.
- 3. De-installation and re-installation of any PV systems or portions thereof are excluded.

- 4. Project payback is, in part, contingent on renewable energy credits (RECs), incentives from Xcel Energy. McKinstry will make best efforts to capture solar incentives from utility on the City's behalf. In the event the incentives are not available the payback is subject to increase.
- 5. Costs have been included for standard solar utility grid tie interconnections. Additional engineering studies or upgrades required by Xcel Energy are excluded.
- 6. Generators are not included for the necessary full building shutdowns for solar PV interconnection.
- 7. Roof protection underneath solar PV pallets on the roof shall be OSB board or equal equivalent.
- 8. McKinstry will perform pre-installation roof inspections prior to solar PV installation. The city shall be responsible for correcting any roofing deficiencies found during these inspections prior to construction mobilization.
- 9. It is assumed that the solar canopies will be complete in one phase. There are no costs included for temporary parking or transportation.
- 10. It is assumed there are no easements or other encumbrances interfering with the solar canopies at relevant sites.
- 11. Any fees required by the AHJ for tree removal, replanting and/or mitigation to prepare the site for the solar installation are excluded.
- 12. Ongoing fees beyond Year 5 for DAS subscriptions are not included in the initial construction cost. Such ongoing fees include both Cell Service and Data Subscription Monitoring fees.
- 13. Extended Warranties for equipment are excluded.
- 14. Except as may be noted in the scopes of work, accommodations for Americans with Disabilities Act (ADA) compliance are excluded.
- 15. Parking canopy decking, gutters, surveillance equipment, and controls/sensors for included undercanopy lighting are excluded.
- 16. Snow removal is excluded.
- 17. Favorable soil and subsurface conditions are assumed at parking canopy sites. Any additional costs incurred by poor subsurface conditions requiring de-watering, pre-drilling, slurrying, hard-digging, bell/socketed piers, caissons, perched water tables, rebar cages or spread footers are excluded.
- 18. Aluminum wire is specified for long solar PV electrical runs. EMT conduit is specified for solar PV conduit runs.
- 19. Painting of exterior solar conduit is excluded.
- 20. Loss in energy savings due to the items listed below are excluded from the McKinstry savings guarantee:
 - a) Damage from storms, vandalism, and accidents
 - b) Solar monitoring system data collection outages
 - c) Utility loss of power due to utility outage or customer caused outage
 - d) Utility required curtailment of power/energy

e) City change in facility load creating change in savings

REVEAL CLARIFICATIONS

Use of the cloud-based Reveal[™] software service is provided for the term of this contract and will terminate at its conclusion.

City and County of Denver has requested McKinstry's assistance to provide technical support, service and/or analysis (herein "Work") through a remote connection to the City's intelligent building management system. To provide this Work, the City understands and acknowledges that they will be providing McKinstry with access to the City's network as reasonably required to perform the service.

The use of this access is in accordance with the following disclaimer. By accepting this, the City acknowledges that they are solely responsible for safeguarding the City's own information systems. McKinstry relies on the City's knowledge of their own internal systems to determine the appropriateness of the access granted and to monitor the system as appropriate. McKinstry has no access to or knowledge of the City's networks, systems, and/or security protocols and has no practical way of monitoring the operational activities of the computer systems or network so cannot be held responsible for the performance therein. Specifically, the:

- 1. City agrees to assume all responsibilities for the operations and security of the network and systems.
- 2. City acknowledges and agrees that McKinstry cannot warranty and/or guarantee the safety of the network, software, systems, data, data exchange or other information.
- 3. City acknowledges and agrees that McKinstry will not be responsible for loss of data or loss of use for the network. McKinstry strongly advises that City safeguard critical data by backing up said data prior to any services performed by McKinstry.
- 4. City acknowledges and understands that Work may be subject to limitations, security risks, delays, and other problems inherent in the use of the internet and electronic communications. McKinstry is not responsible for any delays, delivery failures, security breaches or other damage resulting from such problems. The Work contains technology that is not fault tolerant and is not designed, manufactured, or intended for use in environments or applications in which the failure of the Work could lead to death, personal injury, or severe physical, property or environmental damage.

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SCOPE OF WORK

PROJECT LOCATIONS

Building Name*	ID	Team	Area (ft^2)	Address
City and County Building	CCB	Α	419,387	1431 Bannock St
Denver Municipal Animal Shelter	DAS	А	36,476	1241 W Bayaud Ave
Police Admin Building	PAB	А	149,804	1331 Cherokee St
Police District #3	PD3	В	41,765	1625 S University Blvd
S. Osage Fleet Maintenance - Garage	OFM	В	17,050	2013 S Osage St
Police Academy	POA	С	50,546	8895 Montview Blvd
Police District #2	PD2	С	40,228	3921 Holly St
Police Traffic Operations Bureau	PTO	С	50,546	3375 Park Ave West
S. Cherry Creek Transfer Station	CTS	С	25,646	7300 Cherry Creek S Dr
CPC - Fleet Maintenance – Bldg. 5	FM5	CPC	39,546	1271 W Bayaud Ave, Bldg. 5
Police District #1*	PD1	С	40,131	1311 W 46th Ave
CPC - Gary Price Ops – Bldg. 2	GPO	CPC	29,056	1271 W Bayaud Ave, Bldg. 2
Denver Crime Lab	DCL	D	71,646	1371 Cherokee St
Lindsey-Flanigan Courthouse	LFC	D	318,000	520 W Colfax Ave
Rose Andom Center	RAC	D	46,037	1330 Fox St.
Van Cise-Simonet Detention Ctr	VDC	D	438,411	490 W Colfax Ave
Permit Building	PMB	E	79,208	200 W 14th Ave
The Commons on Champa	CMP	E	45,000	1245 Champa St
Fire Station #2	FS2	FS	24,372	5300 Memphis St
Fire Station #21	FS21	FS	5,791	1580 E Virginia Ave
Fire Station #22	FS22	FS	10,719	3530 S Monaco Pkwy
Fire Station #24	FS24	FS	7,183	2695 S Colorado Blvd
Fire Station #26	FS26	FS	15,758	7934 Martin Luther King Blvd

* Police District #1 added post IGA contract for a single ECM (new roof top chiller)

SCOPE SUMMARY

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
22.01 - CCD Controls Optimization/RCx	Team A, B, C, CPC, D, E, and Fire Stations	CCD All	Controls optimization, utility dashboard and tracking, on-going RCx	\$610,331 \$556,331	-	-
CCD Controls Optimization/RCx		CCD All		\$610,331	-	-
01.06-CCB Steam Condensate Heat Recovery	Team A	City and County Building	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	\$12,897	\$148,377	-
02.01-CCB Chilled Water Pump Replacement	Team A	City and County Building	Replace existing chilled water pumps and VFDs. This will save electrical energy and reduce maintenance requirements.	\$18,560	\$217,758	-
04.01-CCB BAS Controls Upgrade/ Replacement	Team A	City and County Building	Upgrade outdated Siemens APOGEE controls to a BACnet compatible system and install new BACnet compatible controls on remaining standalone air handling units. Integrate new controls with the existing Building Automation System.	\$84,486	\$754,093	-
09.01-CCB Interior LED Lighting Upgrades	Team A	City and County Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$31,522	\$374,635	-
20.01-CCB Rate Analysis	Team A	City and County Building	Investigate the district chilled water utility agreements and negotiate better rates.	-	-	-
01.06-PAB Steam Condensate Heat Recovery	Team A	Police Administration Building PAB	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	\$9,623	\$114,551	-
03.07-PAB MZU to VAV Unit	Team A	Police Administration Building PAB	Convert existing multi-zone unit (MZU) to a variable air volume (VAV) unit to allow for better temperature control and energy savings.	\$10,261	\$130,805	-
04.01-PAB BAS Controls Upgrade/ Replacement	Team A	Police Administration Building PAB	Upgrade the existing standalone pneumatic controls and convert to electronic signals through the addition of E-P transducers. Integrate new E-P controls with the existing BAS.	\$72,739	\$793,231	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
04.02-PAB Occupancy Based HVAC Control	Team A	Police Administration Building PAB	Install occupancy temperature sensors and interlock with fan coil unit control to setback temperatures during unoccupied periods.	\$11,532	\$132,676	-
09.01-PAB Interior LED Lighting Upgrades	Team A	Police Administration Building PAB	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$19,313	\$225,736	-
09.02-PAB Exterior LED Lighting Upgrades	Team A	Police Administration Building PAB	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$4,149	\$48,813	-
20.01-PAB Rate Analysis	Team A	Police Administration Building PAB	Investigate the district chilled water utility agreements and negotiate better rates.	-	-	-
Team A Total		City and County Building, Police Administratio n Building PAB		\$275,083	\$2,940,675	-
09.01-DAS Interior LED Lighting Upgrades	Team B	Denver Municipal Animal Shelter	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$8,462	\$112,516	_
09.02-DAS Exterior LED Lighting Upgrades	Team B	Denver Municipal Animal Shelter	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$244	\$3,030	_
03.13-PD3 Upgrade Air Cooled Chiller	Team B	Police District #3	Replace air cooled chiller with a high efficiency air cooled chiller, this will replace ASHRAE end of life equipment	\$46,205	\$631,886	-
08.05-PD3 Add VFDs to Building Pumps	Team B	Police District #3	Add variable frequency drives (VFDs) with motor replacements to pumps.	\$9,209	\$109,173	-
09.01-PD3 Interior LED Lighting Upgrades	Team B	Police District #3	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$5,658	\$67,802	-
10.01-PD3 Solar Photovoltaic- Roof	Team B	Police District #3	Surface parking lot canopy solar PV system	\$77,221	\$908,603	_
09.01-OFM Interior LED Lighting Upgrades	Team B	South Osage Fleet Maintenance Garage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,528	\$29,689	-
09.02-OFM Exterior LED Lighting Upgrades	Team B	South Osage Fleet Maintenance Garage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$489	\$6,199	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
Team B Total		Denver Municipal Animal Shelter, South Osage Fleet Maintenance Garage, Police District #3		\$150,016	\$1,868,898	-
03.04-POA VVT to VAV Unit Replacement	Team C	Denver Police Academy	Current roof top unit is VVT, refurbish existing VVT damper controls to allow better occupant control and comfort. Add zone based occupancy sensor control.	\$28,630	\$392,086	-
04.01-POA BAS Controls Upgrade/ Replacement	Team C	Denver Police Academy	Upgrade/ replace existing BAS controls on HVAC systems. Upgrade to modern controls and best-in-class control sequence	\$22,768	\$138,145	-
09.01-POA Interior LED Lighting Upgrades	Team C	Denver Police Academy	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$4,155	\$50,107	-
09.02-POA Exterior LED Lighting Upgrades	Team C	Denver Police Academy	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$719	\$9,040	-
10.02 - POA Solar Photovoltaic - Canopy	Team C	Denver Police Academy	Surface parking lot canopy solar PV system	\$67,947	\$805,274	-
03.13-PD1 Upgrade Air Cooled Chiller	Team C	Police District 1	Replace roof top air cooled chiller with a new chiller that has a better turndown. Existing chiller on roof is reaching end of life and should be replaced soon	\$52,104	\$699,564	-
08.05-PD1 Add VFDs to Building Pumps	Team C	Police District	Add variable frequency drives (VFDs) with motor replacements to pumps.	\$10,689	\$125,456	-
09.01-PD2 Interior LED Lighting Upgrades	Team C	Police District 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$4,485	\$53,819	-
09.02-PD2 Exterior LED Lighting Upgrades	Team C	Police District 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,005	\$25,750	-
10.02-PD2 Solar Photovoltaic - Canopy	Team C	Police District 2	Surface parking lot canopy solar PV systems	\$103,925	\$1,218,836	=
10.02-PD2 Solar Photovoltaic - Canopy	Team C	Police District 2	Surface parking lot canopy solar PV systems	\$103,925	\$1,157,667	-
09.01-CTS Interior LED Lighting Upgrades	Team C	South Cherry Creek Transfer Station	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$3,275	\$38,932	-
09.02-CTS Exterior LED Lighting Upgrades	Team C	South Cherry Creek Transfer Station	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$957	\$11,580	-
09.01-PPS Interior LED Lighting Upgrades	Team C	Police Property Storage	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	Included with PTO	_	Included with PTO

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
09.01-PRC Interior LED Lighting Upgrades	Team C	Parks and Rec Center	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	Included with PTO	-	Included with PTO
09.01-PTF Interior LED Lighting Upgrades	Team C	Police Training Facility/ Shooting Range	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	Included with PTO	-	Included with PTO
09.02-PPS Exterior LED Lighting Upgrades	Team C	Police Property Storage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	Included with PTO	-	Included with PTO
09.02-PRC Exterior LED Lighting Upgrades	Team C	Parks and Rec Center	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	Included with PTO	-	Included with PTO
09.02-PTF Exterior LED Lighting Upgrades	Team C	Police Training Facility/ Shooting Range	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	Included with PTO	-	Included with PTO
04.02-PTO Occupancy Based HVAC Control	Team C	Police Traffic Operations Bureau	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	\$3,081	-	\$35,451
09.01-PTO Interior LED Lighting Upgrades	Team C	Police Traffic Operations Bureau	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$13,894	-	\$165,776
09.02-PTO Exterior LED Lighting Upgrades	Team C	Police Traffic Operations Bureau	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,699	-	\$31,700
10.01-PTO Solar Photovoltaic- Roof	Team C	Police Traffic Operations Bureau	Roof mounted solar PV system	\$41,662	-	\$497,936
13.01-PTO Air Sealing and Weather Stripping	Team C	Police Traffic Operations Bureau	Add weather stripping and spray foam to better seal building envelope, reduce infiltration and improve occupant comfort	\$14,415	-	\$1,410
13.02-PTO Ceiling and Wall Insulation	Team C	Police Traffic Operations Bureau	Add insulation to ceiling and walls, reduce leakage and improve on temperature control	\$61,686	_	\$2,820

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
Team C Total		Police District 1, South Cherry Creek Transfer Station, Police Property Storage, Parks and Rec Center, Police Training Facility/ Shooting Range, Denver Police Academy, Police District 2, Police Traffic Operations Bureau	_	<mark>\$439,093</mark>	\$3,568,590	\$735,093
Team C Total		Police District 1, South Cherry Creek Transfer Station, Police Property Storage, Parks and Rec Center, Police Training Facility/ Shooting Range, Denver Police Academy, Police District 2, Police Traffic Operations Bureau		\$439,093	\$3,507,421	\$735,093
09.01-FM5 Interior LED Lighting Upgrades	Team CPC	Fleet Maintenance Building #5	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$3,225	\$39,223	-
09.02-FM5 Exterior LED Lighting Upgrades	Team CPC	Fleet Maintenance Building #5	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,766	\$35,529	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
10.02-FM5 Solar Photovoltaic - Canopy	Team CPC	Fleet Maintenance Building #5	Flush mount system on existing structural canopy	\$40,772	\$480,338	-
09.01-GPO Interior LED Lighting Upgrades	Team CPC	Gary Price Operations Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	8,343	\$102,945	-
09.02-GPO Exterior LED Lighting Upgrades	Team CPC	Gary Price Operations Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	1,875	\$24,251	-
Team CPC Total		Gary Price Operations Building, Fleet Maintenance Building #5		\$56,980	\$682,287	-
01.06-DCL Steam Condensate Heat Recovery	Team D	Denver Crime Lab	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	\$12,793	\$147,175	-
09.01-DCL Interior LED Lighting Upgrades	Team D	Denver Crime Lab	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$14,145	\$167,516	-
09.02-DCL Exterior LED Lighting Upgrades	Team D	Denver Crime Lab	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$1,081	\$13,155	-
09.01-LFC Interior LED Lighting Upgrades	Team D	Lindsay- Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$71,689	\$862,211	=
09.01-LFC Interior LED Lighting Upgrades	Team D	Lindsay- Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$71,689	\$779,868	-
09.02-LFC Exterior LED Lighting Upgrades	Team D	Lindsay- Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$1,942	\$23,542	-
20.01-LFC Rate Analysis	Team D	Lindsay- Flanigan Courthouse	Investigate the district chilled water utility agreements and negotiate better rates.	-	-	-
02.12-RAC Chiller Replacement	Team D	Rose Andom Center	Replace roof top air cooled chiller with a new chiller that has a better turndown.	\$49,228	\$667,108	-
04.07-RAC Ventilation Control	Team D	Rose Andom Center	Reconnect the energy recovery ventilator (ERV) enthalpy wheels to their associated VFDs and re-enable heat recovery. Integrate ERV into the control system. Provide full test and balance on outdoor air system.	\$6,376	\$73,976	-
09.01-RAC Interior LED Lighting Upgrades	Team D	Rose Andom Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$5,353	\$65,394	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
09.02-RAC Exterior LED Lighting Upgrades	Team D	Rose Andom Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$626	\$7,692	-
13.01-RAC Air Sealing and Weather Stripping	Team D	Rose Andom Center	Seal crack and gaps in walls and exterior doors	10,914	-	-
09.01-VDC Interior LED Lighting Upgrades	Team D	Van Cise- Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$52,277	\$620,559	-
09.01-VDC Interior LED Lighting Upgrades	Team D	Van Cise- Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$52,277	\$402,159	
09.02-VDC Exterior LED Lighting Upgrades	Team D	Van Cise- Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,248	\$28,518	-
Team D Total		Rose Andom Center, Denver Crime Lab, Lindsay- Flanigan Courthouse, Van Cise- Simonet Detention Center	-	\$228,672	\$2,676,846	-
Team D Total		Rose Andom Center, Denver Crime Lab, Lindsay- Flanigan Courthouse, Van Cise- Simonet Detention Center		\$228,672	\$2,376,103	-
04.02-CMP Occupancy Based HVAC Controls	Team E	The Commons on Champa	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	\$6,055	\$69,661	-
09.01-CMP Interior LED Lighting Upgrades	Team E	The Commons on Champa	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$19,662	\$242,408	-
09.02-CMP Exterior LED Lighting Upgrades	Team E	The Commons on Champa	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$284	\$3,556	-
13.04-CMP Replace Single Pane Windows	Team E	The Commons on Champa	Replace single pane windows with high performance double pane windows with vinyl/ fiberglass frames	\$28,617	\$345,463	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
20.01-CMP Rate Analysis	Team E	The Commons on Champa	Investigate the district chilled water utility agreements and negotiate better rates.	-	-	-
04.02-PMB Occupancy Based HVAC Controls	Team E	Permit Building	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	\$5,275	\$60,684	-
09.01-PMB Interior LED Lighting Upgrades	Team E	Permit Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$25,054	\$307,958	-
09.02-PMB Exterior LED Lighting Upgrades	Team E	Permit Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$230	\$2,817	-
20.01-PMB Rate Analysis	Team E	Permit Building	Investigate the district chilled water utility agreements and negotiate better rates.	-	-	-
Team E Total		The Commons on Champa, Permit Building		\$85,175	\$1,032,549	-
09.01-FS2 Interior LED Lighting Upgrades	Team Fire	Fire Station #2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,614	\$30,794	-
09.02-FS2 Exterior LED Lighting Upgrades	Team Fire	Fire Station #2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$543	\$6,911	-
10.01-FS2 Solar Photovoltaic - Roof	Team Fire	Fire Station #2	Roof mounted solar PV systems	\$33,359	\$398,261	-
01.01-FS21 Boiler Replacement	Team Fire	Fire Station #21	Replace end of life boiler with high efficiency boiler capable of staging/modulating to efficiently heat the building during the winter months.	\$27,708	\$320,994	-
09.01-FS21 Interior LED Lighting Upgrades	Team Fire	Fire Station #21	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$1,476	\$17,027	-
09.02-FS21 Exterior LED Lighting Upgrades	Team Fire	Fire Station #21	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$73	\$869	-
09.01-FS22 Interior LED Lighting Upgrades	Team Fire	Fire Station #22	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$1,117	\$13,397	-
09.02-FS22 Exterior LED Lighting Upgrades	Team Fire	Fire Station #22	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$12	\$145	-
01.02-FS24 Boiler Replacement	Team Fire	Fire Station #24	Replace end of life boiler with high efficiency boiler capable of staging/modulating to efficiently heat the building during the winter months.	\$19,043	\$221,305	-
09.01-FS24 Interior LED Lighting Upgrades	Team Fire	Fire Station #24	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$843	\$10,005	-

ECM Name and Reference Number	Team	Facility	ECM Description	Cost of Services	Cost of Equipment	Cost of Direct Purchase Equipme nt
09.02-FS24 Exterior LED Lighting Upgrades	Team Fire	Fire Station #24	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$310	\$3,941	-
09.01-FS26 Interior LED Lighting Upgrades	Team Fire	Fire Station #26	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$2,679	\$31,706	-
09.02-FS26 Exterior LED Lighting Upgrades	Team Fire	Fire Station #26	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	\$755	\$9,396	-
Team Fire Total		Fire Station #21, Fire Station #22, Fire Station #24, Fire Station #26, Fire Station #2		\$90,530	\$1,064,752	-
Contingency				\$399,903	-	-
Solar O&M (First Year)				\$11,000	-	-
Total - For All Measures by Category		-	-	\$2,346,783	\$13,834,597	\$735,09 4
Total - For All Measures by Category				\$2,526,933	\$13,472,685	\$735,094

GENERAL

The following items, where applicable, apply to all measures.

- Site altitude: Equipment shall be sized and rated for specified performance at site altitude of 5,600' ASL.
- 2. Supplemental Documentation: The following documents support this Scope of Work and shall be considered part of the Contractor's requirements. Where discrepancies exist among referenced documents, the more stringent shall apply.
 - a. Owner's Construction Design Guidelines and Specifications
 - b. Codes
 - i. 2018 International Building Code with City of Denver amendments per 2019 Denver Building and Fire Code.
 - ii. 2018 International Existing Building Code with City of Denver amendments per 2019 Denver Building and Fire Code.

- iii. 2018 International Fire Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- iv. 2018 International Plumbing Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- v. 2018 International Mechanical Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- vi. 2018 International Fuel Gas Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- vii. 2018 International Energy Conservation Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- viii. 2020 National Electric Code with City of Denver amendments per 2019 Denver Building and Fire Code.
- c. Industry Standards (Latest edition, unless noted otherwise)
 - i. NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
 - ii. SMACNA HVAC Duct Construction Standards, Metal and Flexible
 - iii. National Fire Protection Association Standards (NFPA)
- d. McKinstry Standards & Specifications
 - i. Controls Provider Performance Standards
 - ii. TAB Provider Performance Standards
 - iii. BACnet control point naming convention

PRELIMINARY COMMISSIONING PLANS

The following ECMs include commissioning efforts at the end of the implementation phase. The commissioning plan for each ECM will be based on the standard commissioning plan below. Any variations from the standard commissioning plan are described with each individual ECM below.

The following preliminary commissioning plan is designed as a framework from which the final commissioning plan will be developed. The presence of owner personnel may be requested during the commissioning process.

The McKinstry commissioning team will:

- Review submittals to ensure that controls protocols and system performance align with the energy savings guarantees and design intentions.
- Review and approve control sequences with M&V and energy engineer.
- Review and approve contractor plan for equipment pre-startup and startup activities. Document
 that Necessary procedures are followed to ensure the integrity and performance of the physical
 systems.

- Supervise, review, and approve test and balance procedures and reports. Spot check readings as
 necessary to ensure systems are performing correctly and the final conditions of the systems are
 properly documented.
- Create and distribute pre-functional test to the various responsible contractors and oversee the execution of the contractor's QA/ QC program.
- Perform functional testing (where applicable) to validate equipment performance and verify that control sequence programming is correct and meets intent.
- Verify the necessary trends are in place within the BAS.
- Analyze trend data to review performance.
- Review, approve, and coordinate contractor training programs with the City. Where necessary the commissioning agent will attend and supplement contractor training sessions with training on system interactions.
- Provide final commissioning report with all findings and supporting documents.

Asset Management Program

The asset management scope is focused on supporting a successful transition from design and construction into operations. We understand that there are significant challenges to managing and integrating new assets into an existing city's infrastructure and management systems, including the following:

- Systems, processes, and resources must be aligned so that the operations of an individual facility match the overall facilities management program.
- Occupancy changes, retrofits, and equipment degradation inevitably test systems in ways any modeling process couldn't anticipate.
- Change and innovation, especially within technology, often outpace the systems and resources in place to operate and maintain these changes.
- Increasingly complex building systems and emerging technologies, while integral to an occupant experience, put strain on building operators and often surpass technical experience, training or abilities.
- Building operators must work across an enormous range of equipment types, system types, and technologies when operating and maintaining MEP assets in a city.

Closing this gap requires a disciplined process and approach to capture critical

knowledge and transfer that knowledge to operations staff. Our asset management services will do just that, allowing for an optimized and sustainable transition of all new EPC assets into operations. Additionally, this scope will set the policies, procedures, and templates in place for the city to successfully transition all facilities in the future. A few highlighted benefits of this component of the program include the following:

- Equipment will be accurately documented, equipment will be easily serviced, and asset information will be readily available for the facility operations team.
- Warranties from recent project work will be fully documented and maximized.

- Equipment and systems will be optimized for ongoing performance.
- Some operational practices will successfully transition from reactive maintenance to preventive maintenance practices, resulting in significant operational cost savings.
- Data will be easily located and accessed.
- Successful transfer of data, and critical facility knowledge, will enable the operations team with the right information to correct systems failures or communicate with occupants why the building functions the way it does.

While most teams were interested in this scope, there is a small amount of variation across teams of what is included for asset management support. Below is a summary by team.

Team	Detailed Baseline Analysis	Provide EPC Installed Asset Data	Preventing Maintenance Planning	Install QR tags & Train Staff	Enhanced Warranty Management Support*
Team E	x	Х	x	x	x
Team D	~	~	~	~	\checkmark
Team C	~	\checkmark	\checkmark	x	\checkmark
Team B	~	\checkmark	\checkmark	x	\checkmark
Fire	~	\checkmark	\checkmark	x	\checkmark
СРС	~	\checkmark	\checkmark	x	\checkmark
Team A	~	\checkmark	\checkmark	x	\checkmark

ASSET MANAGEMENT DETAILED SCOPE OF WORK

The following section outlines the proposed scope of work to successfully transition the new EPC assets into operations. In more detail, this proposal is structured around three main scopes of work: asset inventorying, warranty management, and operating procedure development. Prior to completing each scope of work item below, McKinstry will conduct a detailed baseline analysis of operational practices for each team. McKinstry will review the utilization of Infor, shadow the teams, and interview various stakeholders across the

city. Through this process, McKinstry will map out what is working well for each team, what areas of support would be valuable to each team, and how existing practices compare to industry best practices. This baseline assessment will set the framework and roadmap for building out the scope items defined below.

I. ASSET INVENTORYING

Asset inventorying is a foundational component of the EPC and is necessary for a successful transition to operations for each team. This section outlines the scope necessary to develop an asset inventory and transition assets to Infor. These steps are outlined below.

a. Develop systems and processes for bringing new assets into Infor

The first step of asset inventorying is to develop systems and processes for bringing new MEP building equipment assets into Infor. This step includes defining location and storage structure standards, asset naming conventions, and asset hierarchies for all new EPC assets. McKinstry will focus on standardizing these items across each team as much as possible to create universal standards for the city, but it will be important to ensure that each team's individual needs are met.

b. Transfer new assets and asset data into Infor

McKinstry will work closely with each maintenance team and the Infor team to transfer all new EPC assets into Infor. These new assets will follow the standards described above and will serve as a pilot for these new processes. McKinstry will continue to work with each team as these standards roll out and adjust as needed.

c. Train the teams to access asset data for maintenance tasks

This scope of work includes installing QR tags for the new EPC assets for Team D as a pilot program for the city. The goal of the tags are to better associate assets in the field with assets in Infor, allow maintenance staff to easily pull up relevant information on an asset when in the field, and to ensure assets are tagged appropriately to work orders to allow for improved analysis and optimization of maintenance activities. For example, with assets tagged appropriately to work orders, the team will be able to determine the total corrective maintenance costs for each asset, the total preventive maintenance costs for each asset, make more informed capital planning decisions, and perform a more thorough root cause analysis.

II. ENHANCED WARRANTY MANAGEMENT STANDARDIZATION

The goal of the warranty management standardization scope in this proposal is to help ensure that manufacturer warranties for all new EPC assets are documented, easily accessed, and fully utilized. While McKinstry will include a standard one year GC warranty period where all warranty items route

through McKinstry, the scope items below aid in the transition period after 1 year in which each team will still have extended manufacturer warranties available to them. This scope ensures that each team has what they need readily available to fully utilize those additional warranties. This scope includes the following steps:

a. Review existing warranty management system capabilities in Infor and existing warranty management practices

This step focuses on reviewing the existing warranties within Infor to develop a baseline understanding of capabilities. This includes an analysis of which warranties are being documented and how all these warranties are being utilized by staff. This baseline analysis will be compared against industry best practices to develop a more robust set of plans and standards for storing and accessing warranties.

b. Build a warranty management standard

After completing the baseline assessment, McKinstry will work with each team to define a warranty management standard that aids in storage and access of warranty data. This will include improved methods for collecting warranty data, attaching warranty documentation to assets in Infor or another tool, storing the correct information by warranty, and effectively labeling assets on site and in Infor as under warranty. Overall, the goal of these new standards is to ensure maintenance teams are utilizing the manufacturer extended warranties and have the information well tracked and readily available.

c. Train staff in utilizing warranty management standards

Finally, McKinstry will provide training the teams on these new warranty processes. The goal of these trainings is to ensure proper utilization of the warranty management standards and provide the staff with the right tools to manage and operate the system. Additionally, these new warranty standards will be piloted for the new EPC assets. Once these standards are set and prove value for these new assets, they can be utilized by each team for the transition of future projects.

III. OPERATING PROCEDURE DEVELOPMENT

A core component of a successful transition to sustainable operations is the development and utilization of standard operating procedures (SOPs) and maintenance operating procedures (MOPs). An SOP is defined as a set of detailed instructions for facility personnel to efficiently and successfully perform facility operations. MOPs are operating procedures related to preventive or proactive maintenance that occur on a regular frequency. This scope focuses on developing all recommended MOPs to properly maintain the new EPC assets. Each team will also receive 0-5 SOPs that are required to support the MOPs. For example, if teams

do not have a "lockout tag out" or "maintenance shutdown and restart" procedures, McKinstry will provide these along with the MOPs.

a. Finalize the List of Operating Procedures & Operating Procedures Template

McKinstry will work closely with each team to develop a list of operating procedures that will be included in this project. We will also provide an SOP and an MOP template for each team to review, ahead of developing the procedures. The goal with these steps is to ensure that the program is meeting the unique needs of each team, the applicable staff, and the corresponding buildings before developing the procedures.

b. Build out the Operating Procedures

Once the list and templates are finalized, McKinstry will build out each operating procedure, customized for the equipment and systems in place in these buildings. The teams are responsible for completing the safety sections of the procedures and ensuring staff always have the correct personal protective equipment (PPE), complete a hazard assessment, and meet the city's confined space standards and other policies while carrying out procedures.

McKinstry will work closely with the shops to review the list of procedures, the template, and all the procedures to allow for a proper transition. McKinstry will conduct a review process for all necessary stakeholders. The review process will include one session to review the procedures in written form, and a 90% review/training session at a sample unit for each type of procedure.

c. Train Staff on Operating Procedures

As noted above, McKinstry will train the operators and technicians on how to carry out the operating procedures during the 90% review task. These trainings will occur at the unit, and McKinstry will point to each component and explain the steps necessary to carry out the procedure. This step is crucial for ensuring that these operating procedures are successfully implemented and carried out and that procedures are fully reviewed and optimized. While there will be a written review process as noted above, McKinstry anticipates that each team will have additional small changes to the procedures once the training is conducted at the unit. Thus, McKinstry will address any final requested changes from these changes and subsequently turn the procedures over to the Infor team for upload to Infor or another preferred storage solution.

ASSET MANAGEMENT PROJECT TIMELINE

The asset management component of the EPC will commence at the start of the EPC contract, and it will last one year from project substantial completion. Prior to equipment startup, the project will be focused on the baseline assessment and the building of new standards, templates, and processes. Once equipment start up occurs and the project reaches substantial equipment, McKinstry will continue to work with each team for

one year to ensure that these new tools are effectively implemented and adequately support each team. At the completion of that one-year mark, the goal is that each team will utilize these processes moving forward for other construction projects. McKinstry will provide a short summary report at the end of the asset management program that outlines the successes and lessons learned from the process, the benefits of these new tools, and a framework for transition construction projects in the future.

01.02 – FS21 Boiler Replacement

1. Mechanical - Demolish

- A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope, and as indicated in the above supported documents.
- B. Isolate, disconnect, and remove (1) boiler, (1) heating water circulation pump, (1) chilled water circulation pump, and (1) three-way changeover valve (see attached reference drawings).
 - 1) Cut back and isolate existing heating water and gas piping to extent needed to facilitate this scope of work.
 - 2) Drain system to extent needed to facilitate this scope of work.
- C. Demolish and remove existing boiler flue vent through the roof penetration and disconnect from existing hot water heater flue. The existing flue roof penetration shall be reused.
- D. Demolish existing combustion air louvers (2) to mechanical room. Leave high opening to reuse for hot water heater combustion air.
 - 1) Ensure the water heater flue is disconnected and rerouted to the roof through existing flue penetration. Terminate per manufacturer instructions.
- E. Properly dispose of existing chilled water and hot water pumps, boiler, expansion tank, backflow preventer, and associated isolation/control valves.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. All equipment shall be installed in same location as old equipment, and have new house keeping pads installed as referenced in design drawings.
 - C. Furnish & Install Condensing Boiler
 - 1) Furnish and install (1) 652,000 BTU/hr output, 97% efficient, gas-fired condensing boiler.
 - (i) Basis of Design: Lochinvar FTXL 850N, or equivalent. Provide unit with the following:
 - New exhaust and combustion air vents
 - (i) Furnish and install new 6" flue vent from boiler up through the existing exhaust terminal in roof. Provide new flashing and seal to be weather tight. Ensure manufacturer flue pitch requirements are met to allow proper drainage of condensate.

- (ii) Furnish and install new 4" combustion air vent from the existing combustion air intake terminal located in the mechanical room and ducted to the boiler connection. Provide flashing and seal the remainder of the air intake opening to be weather tight. Terminate intake with rain cap and bird screen, or as otherwise recommended by the manufacturer.
- (iii) Vent material shall be 316L stainless steel or other UL 1738 listed material approved by the manufacturer.
- Ensure manufacturer minimum clearance requirements are met on all sides of the boiler.
- Motorized modulation firing with a minimum 15:1 turndown.
- Include manufacturer start-up of boiler.
- Provide condensate neutralization system with PVC piping routed to appropriate floor drain in mechanical room. Ensure manufacturer drainage requirements met.
- Provide and install new boiler isolation valves to meet code requirements.
- D. Furnish & Install Heating Water Circulation Pump
 - 1) Furnish and install (1) new heating water circulation pump with an ECM motor.
 - (i) Basis of Design: Bell and Gossett e-60 series in-line pump, or equivalent.
 - (ii) Existing pumps have the following specifications (new pump shall be in-kind):
 - (E) P (Chilled Water): Bell & Gossett Series 60, 15 gpm at 23' head, 1750 rpm, 1/3 hp.
 - (E) P (Heating Hot Water): Bell & Gossett Series 60, 34 gpm at 23' head, 1750 rpm, 1/2 hp.
 - (iii) Furnish and install (1) Bell & Gossett Series e-80 and e-90
 - P-1: e-80, 15 GPM, 23' head, 1578 rpm, 1/2 hp
 - P-2: e-90, 34 GPM, 23' head, 1656 rpm, 1/2 hp
 - (iv) Existing pump isolation valves shall be replaced to meet code requirements.
 - (v) Ensure boiler manufacturer minimum flow requirements are met with pump selection.
- E. Install 3-Way Changeover Valve
 - 1) Install new 3-way changeover valve, furnished by controls.
 - 2) Provide piping modifications as required to accommodate new valve size.
- F. Furnish & Install Air Separator
 - 1) Furnish and install air separator. Basis of Design: Spirovent VDT-200, or equivalent.
 - (i) Provide unit with the following: 50 gallons per minute capacity.
- G. Furnish & Install Expansion Tank
 - 1) Furnish and install new expansion tank. Basis of Design: Bell & Gossett B-300 bladder tank, or equivalent.
- H. Furnish & Install Unit Heater
 - 1) Provide and install new heating water unit heater and two-way heating water control valve with
120V actuator in existing boiler room. Also include a new line voltage thermostat.

- 2) Basis of Design: Modine HC-18, or equivalent.
- I. Reconnect heating water and gas piping. Provide all piping appurtenances as required.
 - 1) Ensure all heating water piping is properly insulated per state codes and install new insulation as needed.
- J. Controls Demo
- K. Demolish and dispose of all existing control components (including sensors, actuators, controls enclosures, and conduit) not intended to be re-used. Remove pneumatic tubing serving devices removed back to the branch tap from the piping main and cap at that location.
- L. Controls
 - 1) Provide all necessary programmable controllers, low voltage wiring to control panels, conduit, sensors, transformers, and actuators for a complete and functioning control system for the boiler.
 - (i) All boiler plant control components shall be new. Replace all sensors and instrumentation.
 - (ii) New boiler shall have self-contained factory controls with BACnet communication capability.
 - (iii) Furnish new 3-way changeover valve to mechanical for install
 - Three-way, 2 position 1-1/2" diverting valve, include DDC actuator with no spring return required.
 - 2) Control strategy:
 - (i) Existing heating water system is a primary, constant volume loop with one heating water pump that circulates water to (6) fan coil units and (1) air handling unit. New heating water system orientation shall remain the same.
 - (ii) Program a heating water reset schedule as follows based on the outside air temperature:
 - OAT = 20°F (adj.), HWST = 180°F (adj.)
 - OAT = 60°F (adj.), HWST = 110°F (adj.)
 - Boiler shall be disabled when OAT > 70°F (adj.)
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability, and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit

conductors, starter, disconnect, and related accessories all in compliance with NEC.

- 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
- 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of (1) boiler and associated components.
 - 1) Metering: Project will result in a net increase in electrical load. 30-day metering data will be required.
 - 2) Reference PDF mark-ups for existing equipment locations.
- E. Demolition:
 - 1) Existing boiler is 120V, 12 FLA.
 - (i) Disconnect and safe off power to boiler for demolition.
 - (ii) If applicable, remove existing toggle switch disconnect.
 - (iii) Existing conduit and conductors shall remain for re-use (assumed 3/4"C, 2#12, #12 GND CU.).
 - (iv) Existing 20A/1P breaker in serving panelboard shall remain.
 - 2) Existing pump 'P-1' shall be removed (120V, 1/3 HP).
 - (i) Disconnect and safe off power to pump.
 - (ii) Disconnect and remove existing relay and safety switch serving pump.
 - (iii) Existing conduit and conductors shall remain for re-use (assumed 3/4"C, 2#12, #12 GND CU.).
 - 3) Existing pump 'P-2' shall be removed (120V, 1/2 HP).
 - (i) Disconnect and safe off power to pump.
 - (ii) Disconnect and remove existing relay and safety switch serving pump.
 - (iii) Existing conduit and conductors shall remain for re-use (assumed 3/4"C, 2#12, #12 GND CU.).
- F. New Work:
 - 1) New boiler 'B-1' (Single-point connection, 120V, 15 FLA).
 - (i) Provide and install new toggle switch disconnect for boiler (NEMA 1, 20A/1P).
 - (ii) Extend existing conduit and conductors to new boiler control panel and connect power to unit.

- (iii) Provide and install new 3/4" conduit from boiler control panel to EPO switch. EPO switch and control wiring by others.
- 2) New pump 'P-1' (120V, 1/2 HP, 9.8 FLA).
 - (i) Provide and install new 20A/1P RIB (relay in a box) rocker switch disconnect for pump.
 - (ii) Extend existing conduit and conductors to new pump and connect power.
- 3) New pump 'P-2' (120V, 1/2 HP, 9.8 FLA).
 - (i) Provide and install new 20A/1P RIB (relay in a box) rocker switch disconnect for pump.
 - (ii) Extend existing conduit and conductors to new pump and connect power.
- 4) New unit heater for boiler room (120V, 1/60 HP)
 - (i) Provide and install new motor rated toggle switch for unit heater (NEMA 1, 15A/1P).
 - (ii) Provide and install new conduit and conductors from nearest 208Y/120V panelboard to unit (3/4", 2#12, #12 GND CU.).
 - a) Provide and install new 20A/1P breaker in panelboard. Breaker AIC rating shall meet the AIC rating of the panelboard.
 - (iii) Provide and install 3/4" conduit from unit heater down to wall mounted thermostat. Thermostat and control wiring by others.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Provide complete pre-construction test and balance for existing boiler and heating water pump.
 - D. Provide complete post-construction waterside test and balance for proposed boiler and heating water pump.

01.02 – FS24 Boiler Replacement

- 1. Mechanical Demolish
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Isolate, disconnect, and remove (1) boiler and (1) heating water circulation pump (see attached reference drawings).
 - Cut back and isolate existing heating water and gas piping to extent needed to facilitate this scope of work.

- 2) Drain system to extent needed to facilitate this scope of work.
- C. Demolish and remove existing boiler flue vent to chimney vent. The existing flue vent within chimney and roof penetration shall be reused.
- D. Demolish, and remove (12"x18") combustion air louver air intake to mechanical room near hot water heater and cap and seal entire opening within window well.
- E. Demolish duct work connected to existing (22"x30") combustion air louver
 - 1) Leave enough louver free area open to meet combustion air code requirements of 1 sq.in/3,000 BTU/h for the existing to remain atmospheric hot water heater.
 - 2) Remaining space to be used to create a plenum box for attaching new boiler combustion air vent.
- F. Properly dispose of existing hot water pump, boiler, expansion tank, backflow preventer, and associated isolation/control valves.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. All equipment shall be installed in same location as old equipment, and have new house keeping pads installed as referenced in design drawings.
 - C. Furnish & Install Non-Condensing Boiler
 - 1) Furnish and install (1) 873,000 BTU/hr output, 85% efficient, gas-fired non-condensing boiler.
 - (i) Basis of Design: Lochinvar Power-Fin PB-1302, or equivalent. Provide unit with the following:
 - New exhaust and combustion air vents.
 - (i) Furnish and install new 8" flue vent from boiler up through the existing exhaust terminal at the peak of the tower. Ensure manufacturer flue pitch requirements are met to allow proper drainage of condensate. Secure vent as needed.
 - (ii) Furnish and install new 6" combustion air vent from a <u>new</u> intake terminal and ducted to the boiler connection. Secure vent to wall as needed.
 - 1. Provide new horizontal wall penetration that is sealed weather tight and terminate with rain cap and bird screen, or as otherwise recommended by the manufacturer.
 - 2. Contractor shall select appropriate location for penetration on the north facing wall of building with design input from McKinstry.

(iii) Vent material shall be Type "B".

- Ensure manufacturer minimum clearance requirements are met on all sides of the boiler.
- Motorized modulation firing with a minimum 20:1 turndown.
- Include manufacturer start-up of boiler.
- Provide condensate neutralization system with PVC piping routed to appropriate floor drain in mechanical room. Ensure manufacturer drainage requirements met.
- Provide and install new boiler isolation valves to meet code requirements.

- D. Furnish & Install Heating water Circulation Pump
 - 1) Furnish and install (1) new heating water circulation pump. See reference drawing for location.
 - (i) Basis of Design: Bell and Gossett e-60 series in-line pump, or equivalent.
 - New pump shall be rated for 60 GPM, 60' head, 1568 rpm, 3 hp, 240V 1PH
 - (ii) Existing pump isolation valves shall be replaced to meet code requirements.
 - (iii) Ensure boiler manufacturer minimum flow requirements are met with pump selection.
- E. Furnish & Install Air Separator
 - 1) Furnish and install air separator. Basis of Design: Spirovent VDT-250, or equivalent.
 - (i) Provide unit with the following: 60 gallons per minute capacity.
- F. Furnish & Install Expansion Tank
 - 1) Furnish and install new expansion tank. Basis of Design: Bell & Gossett B-200 bladder tank, or equivalent.
- G. Reconnect heating water and gas piping. Provide all piping appurtenances as required.
 - 1) Ensure all heating water piping is properly insulated per state codes and install new insulation as needed.
- 3. Controls-Demo
 - A. Demolish and dispose of all existing control components (including sensors, actuators, controls enclosures, and conduit) not intended to be re-used. Remove pneumatic tubing serving devices removed back to the branch tap from the piping main and cap at that location.
 - B. Demo existing outside air lockout and associated wiring.
- 4. Controls
 - Provide all necessary programmable controllers, low voltage wiring to control panels, conduit, sensors, transformers and actuators for a complete and functioning digital controls system for the boiler.
 - (i) All boiler plant control components shall be new. Replace all associated sensors and instrumentation where they already exist.
 - (ii) New boiler shall have self-contained factory controls with BACnet communication capability.
 - (iii) Provide new outside air temperature sensor and wire back to boiler controls.
 - 2) Control strategy:
 - (i) Existing heating water system is a primary, constant volume loop with one heating water pump that circulates water to radiation elements throughout the perimeter. New heating water system orientation shall remain the same.
 - (ii) Program a heating water reset schedule as follows based on the outside air temperature:
 - OAT = 20°F (adj.), HWST = 180°F (adj.)
 - OAT = 60°F (adj.), HWST = 110°F (adj.)
 - Boiler shall be disabled when OAT > 70°F (adj.)
- 5. Electrical

- A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
- B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories all in compliance with NEC.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
 - 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of (1) boiler and associated components.
 - 1) Metering: Project will result in a net increase in electrical load. 30-day metering data will be required.
 - 2) Reference PDF mark-ups for existing equipment locations.
- E. Demolition:
 - 1) Existing boiler is 120V, 12 FLA.
 - (i) Disconnect and safe off power to boiler for demolition.
 - (ii) Remove and dispose of existing toggle switch disconnect.
 - (iii) Existing conduit and conductors shall remain for re-use (assumed 3/4"C, 2#12, #12 GND CU.).
 - (iv) Existing 20A/1P breaker in serving panelboard shall remain.
 - (v) Disconnect and remove existing EPO wall switch. Retain for re-use.
 - 2) Existing circ. pump shall be removed (120V, 1/2 HP).
 - (i) Disconnect and safe off power to pump.

- (ii) Disconnect and remove existing relay and safety switch serving pump.
- (iii) Remove existing conductors back to panel 'A'. Existing conduit shall remain for re-use (assumed 3/4"C).
- (iv) Remove (2) poles worth of spare breakers in panel 'A' for new circ. pump.
- F. New Work:
 - 1) New boiler 'B-1' (Single-point connection, 120V, 15 FLA).
 - (i) Provide and install new toggle switch disconnect for boiler (NEMA 1, 20A/1P).
 - (ii) Extend existing conduit and conductors to new boiler control panel and connect power to unit.
 - (iii) Install existing EPO switch on interior of boiler room, next to door. Provide and install new 3/4" conduit from boiler control panel to EPO switch. EPO switch and control wiring by others.
 - 2) New circ. pump (240V/1PH, 3 HP, 17 FLA).
 - (i) Provide and install new 30A/2P motor rated toggle switch disconnect for pump.
 - (ii) Provide and install new 25A/2P breaker in panel 'A'. Breaker AIC rating shall meet the AIC rating of panelboard.
 - (iii) Provide new conductors (2#10, #10 GND CU.) in existing 3/4" conduit from panel 'A' to new pump location and connect power.
- 6. Testing and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Provide complete pre-construction test and balance for existing boiler and heating water pump.
 - D. Provide complete post-construction waterside test and balance for proposed boiler and heating water pump.

01.06 – CCB Steam Condensate Heat Recovery

- 1. Mechanical Demolish
 - 1) Isolate and drain hydronic lines at domestic water inlet to existing steam domestic water heater. Demolish small section of domestic water piping to allow for series install of new heat exchanger.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Install New Condensate Pump

- 1) Furnish and install new condensate receiver and pump
 - (i) BOD Shipco AC
 - Capable of pumping 40 gpm at 12 ft of head and storing 20 gallons of condensate.
 - Elevate unit on a metal stand so overflow outlet is above top of existing pipe.
 - (ii) Isolate condensate lines and drain down as necessary to facilitate installation.
 - (iii) Tap into condensate line just upstream of existing condensate cooler with new 2" piping and route to condensate receiver inlet.
 - (iv) Pipe pump discharge to inlet of newly installed heat exchanger.
 - (v) Furnish and install isolation valves and unions at inlet and outlet of condensate receiver.
 - (vi) Route vent piping to combine with existing vent piping coming out of condensate cooler.
 - (vii) Insulate all piping (vent and condensate) and equipment with 1" insulation and label.Support piping per industry standards.
- C. Install new heat exchanger
 - 1) Furnish and install new plate and frame heat exchanger
 - (i) BOD Alfa Laval AQ2-MDFG
 - Capable of 1,755 MBH heat transfer. Stainless steel plates and EPDM gaskets.
 - 2) Pour new 4" housekeeping pad and mount heat exchanger to pad.
- D. Connect domestic water side of the heat exchanger in series with and upstream of existing steam domestic water heater. Ensure connection points are downstream of hot water recirculation inlet so water always circulates through heat exchanger.
 - 1) New piping to be 2" copper and insulated with 1" insulation.
 - 2) Install normally closed isolation valve in existing piping to allow maintenance of new heat exchanger without loss of hot water.
- E. Route condensate piping from condensate receiver, through heat exchanger, and back to condensate cooler.
 - 1) Condensate piping to be 2" schedule 80 seamless carbon steel and insulated with 1" insulation.
 - Furnish and install 2" 3-way self-acting, diverting temperature regulating control valve with external temperature sensor in condensate piping to bypass heat exchanger and maintain domestic water temperature. BOD Samson 43-3
- F. Furnish and install isolation valves, strainers, unions, P/T ports, pressure gauges, and temperature gauges at all four heat exchanger connections. See detail in sketch.
- G. Furnish and install low point drains and high point vents in domestic and condensate connection lines.
- H. Install valve temperature sensor in domestic water leaving heat exchanger to control three-way valve.
 Set temperature setpoint to 120F per manufacturer requirements.
- I. Flush and clean all new piping prior to system startup. Provide bypasses and isolation to avoid flushing heat exchanger.
 - 1) Chlorine treatment is required on domestic piping and domestic side of heat exchanger.

- 3. Controls
 - 1) Not applicable.
- 4. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - C. Furnish and install new 120V circuit to condensate pump from nearest 120V panel with availability. Provide disconnecting means within 50' of pump and clearly label.
- 5. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Provide post construction test and balance for the condensate pump and heat exchanger. Document and provide pressure drops, flow rates, and temperatures at condensate pump and all four connections to heat exchanger.

01.06 – DCL Steam Condensate Heat Recovery

- 1. Mechanical Demolish
 - Isolate and drain hydronic lines at domestic water inlet to existing steam domestic water heater. Demolish small section of domestic water piping to allow for series install of new heat exchanger.

- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Install New Condensate Pump
 - 1) Furnish and install new condensate receiver and pump
 - (i) BOD Shipco AC
 - Capable of pumping 40 gpm at 12 ft of head and storing 20 gallons of condensate.
 - Elevate unit on a metal stand so overflow outlet is above top of existing pipe.
 - (ii) Isolate condensate lines and drain down as necessary to facilitate installation.
 - (iii) Tap into condensate line just upstream of existing condensate cooler with new 2" piping and route to condensate receiver inlet.
 - (iv) Pipe pump discharge to inlet of newly installed heat exchanger.
 - (v) Furnish and install isolation valves and unions at inlet and outlet of condensate receiver.
 - (vi) Route vent piping to combine with existing vent piping coming out of condensate cooler.
 - (vii) Insulate all piping (vent and condensate) and equipment with 1" insulation and label. Support piping per industry standards,
 - C. Install new heat exchanger
 - 1) Furnish and install new plate and frame heat exchanger
 - (i) BOD Alfa Laval AQ2-MDFG
 - Capable of 1,755 MBH heat transfer. Stainless steel plates and EPDM gaskets.
 - 2) Pour new 4" housekeeping pad and mount heat exchanger to pad.
 - D. Connect domestic water side of the heat exchanger in series with and upstream of existing steam domestic water heater. Ensure connection points are downstream of hot water recirculation inlet so water always circulates through heat exchanger.
 - 1) New piping to be 2" copper and insulated with 1" insulation.
 - 2) Install normally closed isolation valve in existing piping to allow maintenance of new heat exchanger without loss of hot water.
 - E. Route condensate piping from condensate receiver, through heat exchanger, and back to condensate cooler.
 - 1) Condensate piping to be 2" schedule 80 seamless carbon steel and insulated with 1" insulation.
 - Furnish and install 2" 3-way self-acting, diverting temperature regulating control valve with external temperature sensor in condensate piping to bypass heat exchanger and maintain domestic water temperature. BOD Samson 43-3
 - F. Furnish and install isolation valves, strainers, unions, P/T ports, pressure gauges, and temperature gauges at all four heat exchanger connections. See detail in sketch.
 - G. Furnish and install low point drains and high point vents in domestic and condensate connection lines.

- H. Install valve temperature sensor in domestic water leaving heat exchanger to control three-way valve.
 Set temperature setpoint to 120F per manufacturer requirements.
- I. Flush and clean all new piping prior to system startup. Provide bypasses and isolation to avoid flushing heat exchanger.
 - 1) Chlorine treatment is required on domestic piping and domestic side of heat exchanger.
- 4. Controls
 - 2) Not applicable.
- 5. Electrical
 - D. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - E. General circuiting requirements
 - Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - F. Furnish and install new 120V circuit to condensate pump from nearest 120V panel with availability. Provide disconnecting means within 50' of pump and clearly label.
- 6. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Provide post construction test and balance for the condensate pump and heat exchanger. Document and provide pressure drops, flow rates, and temperatures at condensate pump and all four connections to heat exchanger.

01.06 – PAB Steam Condensate Heat Recovery

- 1. Mechanical Demolish
 - Isolate and drain hydronic lines at domestic water inlet to existing steam domestic water heater. Demolish small section of domestic water piping to allow for series install of new heat exchanger.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Install New Condensate Pump
 - 1) Furnish and install new condensate receiver and pump
 - (i) BOD Shipco AC
 - Capable of pumping 40 gpm at 12 ft of head and storing 20 gallons of condensate.
 - Elevate unit on a metal stand so overflow outlet is above top of existing pipe.
 - (ii) Isolate condensate lines and drain down as necessary to facilitate installation.
 - (iii) Tap into condensate line just upstream of existing condensate cooler with new 2" piping and route to condensate receiver inlet.
 - (iv) Pipe pump discharge to inlet of newly installed heat exchanger.
 - (v) Furnish and install isolation valves and unions at inlet and outlet of condensate receiver.
 - (vi) Route vent piping to combine with existing vent piping coming out of condensate cooler.
 - (vii) Insulate all piping (vent and condensate) and equipment with 1" insulation and label. Support piping per industry standards.
 - C. Install new heat exchanger
 - 1) Furnish and install new plate and frame heat exchanger
 - (i) BOD Alfa Laval AQ2-MDFG
 - Capable of 1,755 MBH heat transfer. Stainless steel plates and EPDM gaskets.
 - 2) Pour new 4" housekeeping pad and mount heat exchanger to pad.
 - D. Connect domestic water side of the heat exchanger in series with and upstream of existing steam domestic water heater. Ensure connection points are downstream of hot water recirculation inlet so water always circulates through heat exchanger.
 - 1) New piping to be 2" copper and insulated with 1" insulation.
 - 2) Install normally closed isolation valve in existing piping to allow maintenance of new heat exchanger without loss of hot water.
 - E. Route condensate piping from condensate receiver, through heat exchanger, and back to condensate cooler.
 - 1) Condensate piping to be 2" schedule 80seamless carbon steel and insulated with 1" insulation.
 - 2) Furnish and install 2" 3-way self-acting, diverting temperature regulating control valve with

external temperature sensor in condensate piping to bypass heat exchanger and maintain domestic water temperature. BOD Samson 43-3

- F. Furnish and install isolation valves, strainers, unions, P/T test ports, pressure gauges, and temperature gauges at all four heat exchanger connections. See detail in sketch.
- G. Furnish and install low point drains and high point vents in domestic and condensate connection lines.
- H. Install valve temperature sensor in domestic water leaving heat exchanger to control three-way valve.
 Set temperature set point to 120F per manufacturer requirements.
- I. Flush and clean all new piping prior to system startup. Provide bypasses and isolation to avoid flushing heat exchanger.
 - 1) Chlorine treatment is required on domestic piping and domestic side of heat exchanger.
- 6. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - C. Furnish and install new 120V circuit to condensate pump from nearest 120V panel with availability. Provide disconnecting means within 50' of pump and clearly label.
- 7. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Provide post construction test and balance for the condensate pump and heat exchanger. Document and provide pressure drops, flow rates, and temperatures at condensate pump and all four

connections to heat exchanger.

02.01 – CCB Chilled Water Pumps Replacement

- 1. Mechanical Demolish
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Isolate and drain existing hydronic lines as necessary to complete the scope of work. Pump power disconnection to be completed by electrical.
 - C. Demolish and remove (2) existing 75 HP chilled water pumps. Remove and salvage existing motors and return to City & County Building maintenance staff, if desired.
 - D. Properly dispose of associated equipment.
 - E. Existing curbs/housekeeping pads shall remain in place to be re-used.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Furnish and Install Chilled Water Pumps
 - C. Chilled water pump basis of design: Bell & Gossett series e-1510 model 5GB.
 - 1) Furnish and install (2) new chilled water pumps with the following specifications:
 - a) Base mounted end suction pump
 - b) 1200 gpm of flow at 160 ft of head (system has no propylene glycol)
 - c) Suction diffusers and discharge check valves
 - d) Provide pressure gauges and PT test ports on each side of each pump
 - e) 1800 rpm rated motor speed
 - f) Inverter ready NEMA premium-efficiency motor for variable flow
 - g) Existing chilled water piping shall be reused to extent possible
 - h) Insulate all new fittings, pipe, and pumps to code minimum
 - B. Furnish Chilled Water Pump VFDs
 - 1) Furnish (2) variable frequency drives for the chilled water pumps.
 - A. Drives shall be ABB ACH580, or equivalent, with onboard default BACNET card as default option, see below for HP and power connection requirements.
 - B. Provide VFDs to electrical contractor for installation.
 - Contractor shall deliver VFDs to the final location in the pump mechanical room and electrical contractor will mount VFDs in the final location and make final connections.
 - C. Include manufacturer start-up and programming of VFD

- 2) This work shall be done for the following pumps:
 - A. CHWP-1: 75 HP, 208V/3P (FLA to be verified on-site)
 - B. CHWP-2: 75 HP, 208V/3P (FLA to be verified on-site)
- 3. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Reference the Control Contractor Performance Specifications for additional requirements.
 - 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
 - 5) Existing building automation systems and graphics shall be used and updated for new functionality.
 - 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
 - C. Disconnect control devices and wiring from the existing chilled water pumps (see list in Mechanical Contractor section), reconnect and reprogram controls integration for the replacement pumps and variable frequency drive.
 - D. Field survey existing pump controllers for spare points. Integrate (2) new chilled water pumps and VFDs into BAS with the following points labeled as hardwired. Provide communication cable from BAS to the VFD on-board BACNET card for information access.
 - 1) Pump start/stop (DO) (hardwired)
 - 2) Pump status (DI) (hardwired)
 - 3) Pump alarm (DI) (hardwired)
 - 4) Pump VFD enable/disable (DO) (hardwired)
 - 5) Pump VFD speed (AO) (hardwired)
 - 6) Pump VFD alarm (DI) (hardwired)
 - 7) Pump VFD status (DI) (hardwired)
 - 8) Pump VFD kW (AI) (network card)
 - E. Pump Control Strategy:

- 1) The chilled water pumps shall operate with a lead/lag configuration. The BAS shall enable the lead chilled water pump when any air handling unit or fan coil unit is proven on and calling for cooling. Lead pump designation shall be rotated weekly (adj.) in accordance with the BAS.
- Once enabled the pump speed shall be modulated to maintain the calculated remote differential pressure setpoint. The differential pressure setpoint shall reset based on control valve positions.
 - A. Pump VFD speed shall modulate between a minimum of 50% (adj) and a maximum of 100%.
- 3) Differential Pressure Reset Sequence:
 - A. The objective will be to always have one chilled water control valve 80% open, so the pump operates at the lowest speed and pressure possible to satisfy the load. Every 5 minutes (adj.) the chilled water valves will be polled. When at least one chilled water valve is more than 80% open, the BAS shall reset the differential pressure up by 0.5 psi (adj.). When all chilled water valves are 60% (adj.) open or below, the BAS shall reset the differential pressure down by 0.25 psi.
 - B. The remote differential pressure setpoint shall be maintained between maximum and minimum pressures. The maximum pressure limit is the pressure required to provide full flow to all chilled water valves simultaneously (per TAB). The minimum pressure limit is the pressure correlating to the lowest speed the pump motor can operate at (per manufacturer).
- 4. Electrical Demolish
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. Disconnect and safe off power to (2) 75 HP CHW pumps (208V/3P) and their associated variable frequency drives.
 - 1) Pump removal and replacement to be completed by mechanical contractor.
 - C. Demolish and properly dispose of (2) variable frequency drives associated with the chilled water pumps.
 - D. Existing conduit, conductors, and breaker shall remain for re-use. Contractor shall survey the condition of these items and report any recommended replacements to McKinstry.
- 5. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements

- Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
- 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
- 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
- 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- C. Install Chilled Water Pump VFDs & Connect Power
 - 1) Install (2) new variable frequency drives with integral disconnects (VFDs to be furnished by mechanical).
 - a) VFDs will be delivered to the final location in the pump mechanical room by the mechanical contractor. Electrical contractor shall mount the VFDs in the final location and make final connections.
 - b) VFD basis of design is ABB ACH580 rated for 75 HP, 208V/3P motors.
 - 2) Extend existing conduit and conductors to new VFDs and connect power.
 - 3) Provide minimum clearance and working space in front of and above the VFDs per NEC 2020 requirement.
- B. Extend existing conduit and conductors to new pumps installed by mechanical contractor and connect power.
- 6. The electrical disconnect for CHWP-2 can remain in place. Testing, Adjusting and Balancing (TAB)
 - A. Full pre and post construction test and balance on any equipment touched by this scope.
 - B. For Pumps with VFD retrofit:
 - 1) Provide measurements of the existing pump flow rate and pressure drop prior to construction.
 - 2) Provide flow measurements at (2) flow conditions, to be determined by McKinstry commissioning personnel, to correlate against pump performance.

02.12 - RAC Chiller Replacement

- 1. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Isolate chiller and drain and capture glycol solution for reuse.

- 1) Existing isolation values are not located in a location that will allow new chiller piping to be installed. The top 12" of the system will need to be drained to allow for installation.
- C. Demolish and properly dispose of the existing air-cooled chiller on the roof including all accessories and piping from disconnect location shown in the drawings. Evacuate and properly dispose of refrigerant.
 - 1) All other chilled water plant components (pumps, expansion tank, air separator, etc) are to remain in place.
- D. Furnish, receive, offload, and provide crane and rigging for new chiller.
 - 1) Install one (1) new air-cooled chiller. BOD: Daikin AGZ150E
 - (i) Capable of 140 tons at 55/45 EWT/LWT, 355 gallons per minute of 30% propylene glycol, and 95F ambient temperature.
 - (ii) 208V/3Ph, two electrical connections, and SCCR Rating of 40 kA or higher.
 - (iii) Condenser fan motors shall be premium efficient with integral VFDs for speed control or electrically commutated.
 - (iv) Chiller shall meet ASHRAE 90.1 efficiency standard and 2018 IECC.
 - (v) Chiller shall be capable of minimum flow 50% of design flow and 30% minimum cooling capacity with at least two independent refrigeration circuits.
 - (vi) BACnet MSTP communication card shall be included.
 - (vii) Provide new structural support plates over double tees with two bolts through flanges on either side.
 - (viii) Chiller shall be supported on eight (8) spring isolators at support plates per manufacturer recommendations.
 - 2) ALTERNATE #1: Provide a chiller capable of all the above requirements and also integral waterside economizing capability. BOD Carrier 30XV160H
- E. Extend chilled water piping to newly installed chiller. Replace all piping appurtenances associated with the chiller.
 - 1) Furnish and install piping insulation, jacketing, and labeling to match existing outdoor piping.
 - 2) Install piping wells and taps necessary for controls contractor. Coordinate.
- F. Clean and flush all newly installed piping before startup.
- G. Fill piping with captured glycol solution. Fill with new glycol and water solution matching existing concentration as necessary.
- H. Provide any assistance necessary for startup including nitrogen or any other gasses needed.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope and supporting documents.
 - B. General requirements

- Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
- 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
- 3) Reference the Control Contractor Performance Specifications for additional requirements.
- 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
- 5) Existing building automation systems and graphics shall be used and updated for new functionality.
- 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
- C. Furnish and install all programming necessary to operate the systems per the sequence of operations in the design documents.
- D. Controls contractor is responsible for low voltage wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- E. Existing building automation system is a BACnet based Delta controls system. All new controls shall tie into existing system. Update existing graphics accordingly.
- F. Chiller control shall be added to the existing chilled water system controller. Confirm availability and programming capability. Furnish and install new controller or I/O expansion module as required.
- G. Integrate new chiller into the BAS with MS/TP connection. See drawings for control points and sequences.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.

- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- C. Electrical panels and disconnects serving mechanical equipment shall comply with the service clearance requirements of the NEC. Furnish and install remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of (1) chiller and associated components.
 - 1) Metering: Project will result in a net increase in electrical load. 30-day metering or 12-month utility demand data will be required.
 - (i) All panels with net increase in load will need 30-day metering. Equipment tying into main switchboard can use utility demand data instead.
 - 2) Reference PDF mark-ups for existing equipment locations.
- E. Demolition:
 - 1) Existing chiller is 208V/3Ph, 660 MCA, 800 MOCP.
 - (i) Disconnect and safe off power to chiller for demolition.
 - (ii) Remove existing NEMA 3R, 800A disconnect.
 - (iii) Remove conductors from existing (2) sets of 3" conduit between 800A disconnect and chiller.
 - (iv) Remove (1) 3" conduit and all conductors between existing junction box and 800A disconnect being removed. Cap and seal 3" knockout in junction box.
 - (v) Existing 800A fused switch in `MDP-1' serving `DP-1' and chiller shall remain. `MDP-1' is located in parking garage.
 - 2) Disconnect and remove existing heat trace from piping to be demolished.
- F. New Work:
 - New roof mounted Chiller 'CH-1' (3-point connection, 208V/3Ph, 338 MCA, 450 MOCP, 65 KA SCCR; 208V/3Ph, 351 MCA, 450 MOCP, 65 KA SCCR; 120V, 30 MOCP for controls):
 - (i) Provide and install new 400A/3P circuit breaker in 3rd Floor equipment board 'DP-1'. Breaker AIC rating shall meet the AIC rating of the equipment board.
 - (ii) Provide and install new disconnect switch for chiller module 1 of 2 (NEMA 3R, 400A/3P, heavy duty).
 - (iii) Utilize existing (2) sets of 3" conduit. Provide and install all new conductors for chiller module
 1 of 2 (new feed (2) 3"C, 4#3/0, #3 GND CU.) and connect power to module control panel.
 Provide phenolic label on chiller indicating equipment fed from.
 - (iv) Level 1, Main Electrical Room: Provide and install new 400A/3P fused switch in existing main distribution board 'MDP-1A'. Switch AIC rating shall meet the AIC rating of the equipment board.
 - (v) Provide and install new disconnect switch for chiller module 2 of 2 (NEMA 3R, 400A/3P, heavy duty).

- (vi) Provide and install new conduit and conductors from 'MDP-1A' to roof for chiller module 2 of 2
 ((2) sets of 2"C, 4#3/0 KCMIL, #3 GND CU.) and connect power to module control panel.
 Provide phenolic label on chiller indicating equipment fed from.
- (vii) If necessary, provide and install new 120V, GFCI, weather-proof service outlet within 25ft for new chiller. Connect to existing circuit serving current rooftop service outlets.
- (viii) 120V controls circuit for new chiller: Provide and install new 30A/1P breaker in panel 'D3' located in 3rd floor electrical room. Breaker AIC rating shall meet the AIC rating of the equipment board. Provide and install new conduit and conductors (3/4"C, 2#10, #10 GND CU.) from panel 'D3' up to chiller control panel and connect power.
- 2) Furnish and install heat trace for exterior piping. BOD: Raychem XL-Trace. Provide controller with output alarm to BAS. BOD: Tracon FPT 130
 - (i) Coordinate Heat Trace controller power requirements with supplier. Connect to existing or spare circuit in panel 'D3'.
 - (ii) Field verify final piping lengths.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Perform TAB procedures for the following systems/equipment, as specified in spc230593 and as noted below:
 - 1) Provide full post construction TAB on chiller including flow and pressure drop and 3 different load conditions.
- 5. Training
 - A. Provide training as required for this FIM.

03.04 – POA VVT to VAV Unit Replacement

- 1. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Existing RTUs System Removal
 - 1) Isolate, disconnect, remove and properly dispose of existing (4) DX cooling, gas heating rooftop units.

- 2) Cut back gas piping and condensate drain lines to extent necessary to facilitate the scope of work.
- 3) Disconnect the supply and return ductwork. Existing roof curbs adapter shall be replaced. Existing roof curb shall remain in place.
- 4) <u>Add Alternate</u>: Provide temporary cooling and heating.
- C. RTU System Replacement
 - Furnish and install (4) replacement rooftop units with DX cooling and gas heating. Design Basis: TRANE YSC. Approved Equal: Carrier.
 - (i) RTU-1 & 2 located on the north wing roof: 12.5ton cooling, min 160MBH gas heating output at altitude; 5,000CFM at 1.50 in wg external static pressure
 - (ii) RTU-3 & 4 located on the west wing roof: 7.5ton cooling, min 133 MBH gas heating output at altitude; 3,000CFM at 1.50 in wg external static pressure
 - (iii) Unit efficiency shall exceed the minimum ASHRAE 90.1-2016.
 - 2) Provide the following accessories on the RTUs
 - (i) Curb adapter
 - (ii) Modulating natural gas heat, with high altitude kit
 - (iii) Low-leak outside air dampers
 - (iv) Supply fan with VFD
 - (v) Power exhaust with VFD
 - (vi) Stainless steel or aluminum steel gas heat exchanger
 - (vii) Hail guard
 - (viii) Dirty filter switch
 - (ix) Electrical convenience outlet
 - (x) Open terminal strip for field mounted controller
- D. Provide new gas regulator for the RTUs and reconnect gas piping. Provide proper support on gas piping. Reconnect condensate piping with proper trap.
- E. Reconnect supply and return ductwork.
- F. VVT dampers
 - Existing damper shall remain for reuse. Actuators and controls will be upgraded by Controls Contractor.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - 1) Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment,

software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.

- 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
- 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 50% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
- 4) Reference the Control Contractor Performance Specifications for additional requirements.
- C. Refer to FIM 4.01 POA BAS Controls Upgrade for controls scope.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability, and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
 - 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
 - 8) Prior to installing smoke detectors, contractor shall coordinate with City Police Academy Fire Alarm Contractor and Field Investigate and pre-test the existing smoke detector and fire alarm system to ensure both are functioning properly.
 - C. Electrical panels and disconnects serving mechanical equipment shall comply with the service clearance requirements of the NEC. Provide remote mounted panels and disconnects where required

by the NEC.

- D. General Scope: Electrical work to support the replacement of (4) rooftop units and associated components.
 - 1) Metering: Project will result in a net increase in electrical load. 30-day metering or 12-month utility demand data will be required.
 - 2) Reference GMAX Mech drawings for existing equipment locations.

E. Demolition:

- 1) Roof (4) existing roof mounted HVAC units
 - (i) RTU-1 and 2 (Single-point connection, 208V/3PH, 60.6 MCA, 70 MOCP, each)
 - Disconnect and safe off power to units for removal.
 - Remove existing NEMA 3R, 100A disconnect switch at each unit.
 - Remove existing conduit and conductors from units down to serving switchboard.
 - Existing 100A/3P fused switches in 600A Main Switchboard shall remain for re-use.
 - Safe off existing 120V circuit(s) serving duct smoke detectors. Detectors and circuit shall remain.
 - (ii) RTU-3 and 4 (Single-point connection, 208V/3PH, 46 MCA, 50 MOCP, each)
 - Disconnect and safe off power to units for removal.
 - Remove existing NEMA 3R, 60A disconnect switch at each unit.
 - Existing conduit and conductors shall remain for re-use (assumed 1"C, 3#6, #10 GND CU.).
 - Existing 60A/3P fused switches in 400A Switchboard shall remain for re-use.
 - Safe off existing 120V circuit(s) serving duct smoke detectors. Detectors and circuit shall remain.

F. New Work:

- 1) Roof (4) new roof mounted HVAC units
 - (i) RTU-1 and 2 (Single-point connection, 208V/3PH, 67 MCA, 90 MOCP, 10 KA SCCR, each)
 - Provide and install new fused disconnects for each unit (NEMA 3R, 100A/3P, 90A fuses, heavy duty).
 - Provide and install new conduit and conductors (1-1/4"C, 3#3, #8 GND CU., each) from existing 600A Main Switchboard up to each unit and connect power.
 - Provide and install new 120V, GFCI, weather-proof service outlet within 25ft of units. Connect to existing circuit serving current rooftop service outlets.
 - Coordinate any modifications to existing duct smoke detectors with M.C..
 - (ii) RTU-3 and 4 (Single-point connection, 208V/3PH, 43 MCA, 50 MOCP, 10 KA SCCR, each)
 - Provide and install new fused disconnects for each unit (NEMA 3R, 60A/3P, 50A fuses, heavy duty).

- Extend existing conduit conductors (assumed 1"C, 3#6, #10 GND CU.) to new units and connect power.
- Provide and install new 120V, GFCI, weather-proof service outlet within 25ft of units. Connect to existing circuit serving current rooftop service outlets.
- Coordinate any modifications to existing duct smoke detectors with Mechanical Contractor.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems
 - C. Perform specified TAB activities for the following systems/equipment and demonstrate to McKinstry Cx engineer:
 - Existing RTU supply, return and outside air flow, static pressure profile, and room diffuser air flows (28 square 4-way diffusers and 35 linear diffusers.)
 - 2) Replacement RTU
 - (i) Follow TAB procedure for the proposed air distribution system with outside, supply and return air flow and pressure measurements on the (4) new RTUs
 - 3) Test and balance air flow at each grille and diffuser served by these systems.

03.07 - PAB MZU to VAV Unit Conversion

- 1. Mechanical Demolish
 - Isolate, drain, and cut back hydronic lines at MZU coils. Disconnect and remove existing 2" chilled water valve, 2" hot water preheat valve, and 2" primary hot water valve associated with the multizone unit hydronic coils. All valves are 3-way control valves.
 - Disconnect and remove the existing pneumatic damper actuators. These pneumatic damper actuators include 1 supply zone, the mixed air, and exhaust air actuators (see drawings for location). Dampers shall remain in place.
 - 3) Cut the common shaft linkage rod between each of the individual hot and cold deck dampers in each of the four zones, so the dampers can operate independently. Ensure there is proper bearing support for each damper, and if not notify McKinstry* (see note below in section 3.E).
 - 4) Demolish and properly dispose of two (2) existing fan motors for the multizone unit. See below in section 3.C.4 for motor sizes & ratings.

- 5) Properly dispose of associated equipment.
- 2. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Install New HW & CHW Control Valves
 - 1) Isolate chilled water and hot water multizone unit take offs and drain down lines to facilitate installation of new control valves as necessary.
 - 2) Install one (1) two-way 2" chilled water valve and two (2) two-way 2" hot water valves (see drawings for locations). New control valves shall be furnished by controls contractor.
 - 3) Cut and cap bypass leg of three-way valves previously installed.
 - 4) Any equipment without isolation valves and unions shall be provided with valves and unions.
 - 5) Reconnect chilled water and hot water piping and re-insulate as needed.
 - C. Replace Fan Motors & Furnish Fan VFDs
 - 1) Provide complete inspection to McKinstry of the existing supply and return fans in the multizone unit.
 - Furnish and install two (2) new fan motors that are NEMA premium-efficiency, inverter-ready motors. Basis of Design = Baldor-Reliance (or equivalent). See below for HP and power connection requirements.
 - Furnish two (2) variable frequency drives for the electrical contractor to install. Drives shall be ABB ACH580 (or equivalent) with onboard default BACNET card as default option, see below for HP and power connection requirements.
 - 4) This work shall be completed for the Multizone Unit AC-A6 in the Police Administration Building. The fan power ratings are as follows:
 - (i) Supply Fan = 7.5HP 480V/3PH and 11 FLA
 - (ii) Return Fan = 2HP 480V/3PH and 3.3 FLA
 - D. Install two (2) air flow monitoring/metering stations (furnished by controls). One in 36"x36" common outside air duct to unit, and one in 36"x36" exhaust air duct. Basis of Design = EBTRON HTx104-PE (or equivalent).
 - E. Add Alternate 1: If it is determined that there is not proper bearing support for the hot deck and cold deck dampers to modulate independently after the linkage is broken or the dampers are not two independent dampers that are interlocked, then the contractor shall furnish and install new dampers with separate linkage and bearing support. Contractor shall verify all existing zone duct sizes.
 - 1) For pricing purposes, assume zones are 24x40, 24x16, 24x16, and 24x14
- 3. Controls
 - B. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - C. General requirements

- Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
- 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
- Provide capability to store and archive a minimum of one-year trend data for 40% of control points on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
- 4) Reference the Control Contractor Performance Specifications for additional requirements.
- D. Demolition
 - 1) Demolish and dispose of all existing control components (including sensors, actuators, controls enclosures, and conduit) not intended to be re-used.
 - 2) Remove pneumatic tubing serving control valves and damper actuators back to the branch tap from the piping main and cap at that location. Where tubing is routed within walls, demo to the wall penetration and cap at that point if removal from wall is not practical.
 - 3) Remove four (4) existing thermostats in space.
- E. Controls contractor is responsible for all low voltage wiring and all required 120 V for control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- F. McKinstry approved naming convention shall be used for all BACnet Object Names.
- G. Existing building automation systems and graphics shall be used and updated for new functionality.
- H. Furnish and install all programming necessary to operate the multizone unit per the Design Intent set forth by McKinstry.
- Provide all necessary programmable controllers, low voltage wiring to control panels, conduit, sensors, transformers and actuators for a complete and functioning digital controls system for the multizone unit.
- J. Provide onsite CX support as required by McKinstry CX agent for Point to Point and Functional Performance testing.
- K. Integrate DDC Controls with existing Delta BAS
 - Multizone unit controls have already been upgraded to DDC (except for the control valves and three remaining dampers). Contractor shall integrate existing DDC controls with the building automation system.
 - 2) Furnish and install static pressure sensor for the discharge air upstream of the deck dampers in each zone duct if one does not currently exist. Verify sensor is in a viable location and move if necessary. A total of 4 sensors.
 - 3) Furnish and install four (4) dedicated zone level temperature sensors with integral occupancy sensors (one in each zone) where thermostats were demolished. Patch wall opening as required.

- 4) Furnish and install (4) space CO2 sensors (one in each zone) and route back to the AHU control panel. Basis of design = Telaire T8100 (or equivalent).
- 5) Furnish two air flow metering stations (each for 36'x36" duct) to mechanical for install and wire to unit controller. BOD EBTRON HTx104-PE.
- 6) Integrate new fan VFDs and DDC controls into the Delta building automation system with the following points.
 - (a) Four (4) static pressure sensor (AI)
 - (b) Eight (8) zone damper commands (AO)
 - (c) Eight (8) zone damper positions (AI)
 - (d) Four (4) zone temperature sensors (AI)
 - (e) Hot deck temperature (AI)
 - (f) Cold deck temperature (AI)
 - (g) Chilled water control valve command (AO)
 - (h) Chilled water control valve position (AI)
 - (i) Hot water control valve command (AO)
 - (j) Hot water control valve position (AI)
 - (k) Pre-heat control valve command (AO)
 - (I) Pre-heat control valve position (AI)
 - (m) Supply fan VFD enable/disable (DO)
 - (n) Supply fan VFD speed (AO)
 - (o) Supply fan VFD alarm (DI)
 - (p) Supply fan VFD status (DI)
 - (q) Supply fan VFD kW (AI)
 - (r) Return fan VFD enable/disable (DO)
 - (s) Return fan VFD speed (AO)
 - (t) Return fan VFD alarm (DI)
 - (u) Return fan VFD status (DI)
 - (v) Return fan VFD kW (AI)
 - (w) Outside air flow (AI)
 - (x) Exhaust air flow (AI)
 - (y) Exhaust air damper command (AO)
 - (z) Exhaust air damper position (AI)
 - (aa) Mixed air damper command (AO)
 - (bb) Mixed air damper position (AI)
- 7) Provide communication cable from BAS to the VFD on-board BACNET card for information access.
- 8) Air handler control sequence:
 - (i) Air handling unit AC-A6 shall have fan speed and mixing damper control modified to serve

ventilation air and provide heating/cooling to (4) zones on the 1st floor. The outside air damper shall modulate in concert with the return air and exhaust air dampers to meet a space CO_2 setpoint of 800ppm (adj.). The supply and return fans shall be enabled based on occupancy conditions and modulate VFD speed to maintain the supply air duct static pressure (adj. setpoint TBD). The CHW and HW control valves will modulate to maintain the SA temperature setpoint. The SA temperature setpoint shall reset based on outside air temperature as follows: (a) If OAT \leq 55°F, then cold deck SAT SP = 60°F (adj.)

- (a) if $OAT = 55^\circ$, then cold deck $SAT ST = 00^\circ$ (ddj.)
- (b) If OAT \geq 65°F, then cold deck SAT SP = 55°F (adj.)
- (c) If OAT \leq 45°F, then hot deck SAT SP = 95°F (adj.)
- (d) If OAT \geq 70°F, then hot deck SAT SP = 70°F (adj.)
- L. Furnish and Install Electronic Damper Actuators
 - Remove any E-P transducers and replace existing pneumatic damper actuators with electronic actuators. The new electronic actuators shall match the existing electronic damper actuators. Basis of Design = Belimo.
 - 2) Design intent is to have all existing pneumatic damper actuators replaced and hot deck and cold deck dampers separated to operate independently. Mechanical contractor shall break linkages between deck dampers, controls contractor to install new actuators on uncontrolled deck dampers.
 - Furnish and install the following new damper actuators to replace the pneumatic damper actuators:
 - (i) One (1) replacement electronic zone control damper actuator to fit a damper size of 24" x 40"
 - (ii) One (1) replacement electronic exhaust air damper actuator to fit a damper size of 34" x 48"
 - (iii) One (1) replacement electronic mixing air damper actuator to fit two linked dampers of 36" x 36" each
 - (iv) One (1) new electronic zone control damper actuator to fit a damper size of 24" x 16"
 - (v) One (1) new electronic zone control damper actuator to fit a damper size of 24" x 16"
 - (vi) One (1) new electronic zone control damper actuator to fit a damper size of 24" x 14"
- M. Furnish Control Valves
 - Furnish new control valves to mechanical contractor for installation. Include two (2) 2" two-way hot water control valves and one (1) 2" two-way chilled water control valve. Basis of Design = Belimo.
- 4. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - 1) Contractor shall survey existing facility drawings and power distribution system to determine available space and capacity to support this scope of work. If existing space or capacity is

insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.

- 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
- 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories.
- 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- C. Install VFDs for Fans
 - 1) Disconnect power from the two (2) existing fan motors listed in section 3.C.4 of the mechanical scope to allow for removal and replacement by mechanical.
 - 2) Remove motor starters for the fans and install two (2) variable frequency drives. The power ratings for the existing motors are as follows:
 - (i) Supply Fan = 7.5HP 480V/3PH and 11 FLA
 - (ii) Return Fan = 2HP 480V/3PH and 3.3 FLA
 - 3) Provide minimum clearance and working space in front of and above the VFD per NEC 2020 requirement.
- 5. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Balance minimum OA for multizone unit at three different fan speeds.
 - D. Tune supply air pressure setpoint so all zones get design flow.
 - E. Perform TAB procedures for the following systems/equipment, as specified in spc230593 and as noted below:
 - 1) Provide preconstruction test and balance for the following items:
 - (i) Airflows (OA, minimum OA, SA, RA), supply & return fan pressure drop, hot water flow rate, pre-heat hot water flow rate, and chilled water flow rate at full flow.
 - (ii) Provide flow measurements for each of the four (4) zones at full flow.
 - 2) Provide post construction test and balance for the following items:
 - (i) Airflows (OA, minimum OA, SA, RA), supply & return fan pressure drop, hot water flow rate,

pre-heat hot water flow rate, and chilled water flow rate at three different flow conditions.(ii) Provide flow measurements for each of the four (4) zones at three flow conditions.

03.13 - PD1 Air Cooled Chiller Replacement

1. Mechanical

- A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
- B. Existing Air-Cooled Chiller Removal
 - 1) Sample existing chilled water chemical content with full spectrum analysis and notify McKinstry if flushing is required.
 - 2) Isolate, drain, disconnect, remove and properly dispose of existing (1) air cooled chiller. Cut back chilled water supply and return lines with insulation, pipe fitting and appurtenances to extent necessary to facilitate the scope of work. Remove existing isolation valves. Additional drain down will be required that includes piping on the second floor that is at higher hydraulic point than the drain down point. Cap chilled water piping at roof opening and prepare for future connection.
 - 3) Evacuate and properly dispose of refrigerant. Salvage drained glycol solution for reuse.
 - 4) Existing chiller concrete sleepers and wire mesh guard in between sleepers shall remain.
- C. New Air-Cooled Chiller Replacement
 - 1) Provide (1) air cooled chiller (Basis of Design: Trane). The air-cooled chiller shall include the following:
 - (i) Single point 460V/3phase, factory mounted disconnect.
 - (ii) Minimum performance shall exceed IECC 2018 requirement
 - (iii) Minimum load control down to 25% and (2) refrigerant circuits
 - (iv) Integral strainer and flow switch and chilled water supply and return temperature sensors
 - (v) Evaporator heat trace furnished by manufacturer
 - (vi) BACNET MS/TP communications card with remote start/stop option
 - (vii) Lower wire mesh guards
 - Site coordinate with existing chilled water connections and unit mounting. Add additional concrete sleepers with sheet metal and flashing to accommodate the new chiller. Ensure proper center of gravity support. Extend wire mesh around the new sleepers added.
 - 3) Reconnect to existing chilled water supply and return piping with new 4" isolation valves as shown on drawings. Provide propylene glycol to bring the entire system to the existing glycol solution concentration level. Notify McKinstry if the existing glycol solution level is not meeting 35%.
 - 4) Furnish and install piping insulation, jacketing, and labeling.

- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 40% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
 - 4) Reference the Control Contractor Performance Specifications for additional requirements.
 - C. Disconnect control wiring/tubing from existing chiller.
 - D. Provide chilled water supply and return temperature sensors and connect to existing Siemens BAS chilled water plant terminal controller.
 - E. Provide BAS integration for the proposed air-cooled chiller with BACnet MS/TP. Existing control sequence and control points on CHWS/R temperatures shall remain. Refer to P&ID diagram.
 - F. Reference controls P&ID diagram for proposed control points.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability, and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories all in compliance with NEC.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits,

existing components may be reused where in compliance with current NEC.

- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
- 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of (1) roof top chiller and associated components.
 - 1) Metering: Project will result in a net reduction in electrical load. 30-day metering or 12-month utility demand data will not be required.
 - 2) Reference GMAX drawings for existing equipment locations.
- E. Demolition:
 - 1) Existing roof mounted chiller is 480V/3Ph, 235 MCA, 300 MOCP.
 - (i) Disconnect and safe off power to chiller for demolition.
 - (ii) Existing NEMA 3R, 400A/3P disconnect shall remain for re-use.
 - (iii) Existing conduit and conductors shall remain for re-use (2-1/2"C, 3#250, #3 GND CU.).
 - (iv) Existing breaker in serving switchboard 'MDS' (1st Floor, Elec 145) shall remain.
 - (v) Disconnect existing 120V controls/ lighting circuit for chiller (panel `L1M', 1st Floor, Mech 146). Retain existing conduit and conductors for re-use.
 - (vi) Disconnect and remove existing 120V heat trace controller (panel `L2A', 2nd Floor, Elec 229). Retain existing conduit and conductors for re-use.
- F. New Work:
 - New roof mounted chiller 'CH-1' (Single-point connection, 480V/3Ph, 215 MCA, 300 MOCP, 30 KA SCCR).
 - (i) Provide and install new 300A fuses in existing NEMA 3R disconnect switch serving chiller.
 - (ii) Extend existing conduit and conductors to new chiller (2-1/2"C, 3#250, #3 GND CU.) and connect power to unit.
 - (iii) Field verify existing 120V, GFCI, weather-proof service outlet within 25ft of unit.
 - 2) Furnish and install heat trace for exterior piping. BOD: Raychem. Provide controller with output alarm to BAS.
 - (i) Coordinate power requirements for Heat Trace controller with supplier. Connect to existing 20A circuit in panel 'L2A' (2nd Floor, Elec 229).
 - (ii) Field verify final piping lengths.

- 4. Testing, Adjusting and Balancing (TAB)
 - 1) Not applicable. Refer to TAB scope specified in 08.05- PD3 Add VFD to Building Pumps.

03.13 - PD3 Air Cooled Chiller Replacement

1. Mechanical

- A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope, and as indicated in the above supported documents.
- B. Existing Air-Cooled Chiller Removal
 - Isolate, drain, disconnect, remove and properly dispose of existing (1) air cooled chiller. Cut back chilled water supply and return lines to extent necessary to facilitate the scope of work. Remove existing isolation valves and associated chilled water supply and return piping, fitting and insulation jacket above roof. Additional drain down will be required that includes piping on the second floor that is at higher hydraulic point than the drain down point. Cap chilled water piping at roof opening and prepare for future connection.
 - 2) Evacuate and properly dispose of refrigerant. Salvage drained glycol solution for reuse.
 - 3) Existing chiller housekeeping pad shall remain.
 - 4) No temporary cooling is required without adequate roof clearance.
- C. New Air-Cooled Chiller Replacement
 - (i) Furnish, receive, offload, and provide crane and rigging for the new chiller.
 - (ii) Provide (1) air cooled chiller (Basis of Design: Trane). Refer to GMAX drawing M001 for schedule. The air-cooled chiller shall include the following:
 - Single point 460V/3phase, factory mounted disconnect.
 - Minimum performance shall exceed minimum IECC 2018 requirement
 - Minimum load control down to 25% and (2) refrigerant circuits
 - Integral strainer and flow switch and chilled water supply and return temperature sensors
 - Evaporator heat trace furnished by manufacturer
 - BACNET MS/TP communications card with remote start/stop option
 - Low ambient kit down to -4°F cooling operation
 - Convenience outlet
 - Lower wire mesh guards
 - Hail Guards
 - (iii) Site coordinate with existing chilled water connections and unit clearance prior to equipment purchase and installation. Extend existing concrete pad as dimensioned on the drawing for the new chiller.
 - (iv) Reconnect to existing chilled water supply and return piping with new isolation valves as

shown on drawings. Provide hydronic system flush, fill, and chemical treatment for the existing drained down and newly installed piping. Provide propylene glycol to bring the entire system to the existing glycol solution concentration level. Notify McKinstry if the existing glycol solution level is not meeting 35%.

- (v) Properly insulate and support the new chilled water piping on roof as specified on drawings.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 40% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
 - 4) Reference the Control Contractor Performance Specifications for additional requirements.
 - C. Disconnect control wiring/tubing from existing chiller.
 - D. Provide chilled water supply and return temperature sensors and connect to existing Siemens chilled water plant terminal controller.
 - E. Provide BAS integration for the proposed air-cooled chiller with BACnet MS/TP. Existing control sequence and control points on CHWS/R temperatures shall remain. Refer to P&ID diagram to be provided at GMAX.
 - F. Reference controls P&ID diagram for proposed control points to be provided by GMAX.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability, and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor

shall immediately notify McKinstry.

- 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
- 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories all in compliance with NEC.
- 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
- 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of (1) chiller and associated components.
 - 1) Metering: Project will result in a net reduction in electrical load. 30-day metering or 12-month utility demand data will not be required.
- E. Demolition:
 - 1) Reference GMAX mechanical plans for existing equipment locations.
 - 2) Existing roof mounted chiller is 480V/3Ph, 290 MCA, 400 MOCP.
 - (i) Disconnect and safe off power to chiller for demolition.
 - (ii) Existing conduit and conductors shall remain for re-use (3-1/2"C, 4#350, #3 GND CU.).
 - (iii) Existing 400A/3P breaker in Main Distribution Board 'MDS' shall remain.
- F. New Work:
 - 1) Reference GMAX mechanical plans for existing equipment locations.
 - New roof mounted chiller 'CH-1' (Single-point connection, 480V/3Ph, 251 MCA, 400 MOCP, 30 KA SCCR).
 - (i) Provide and install new fused disconnect for chiller (NEMA 3R, 400A, 300A fuses, heavy duty).
 - (ii) Extend existing conduit and conductors to new chiller (3-1/2"C, 4#350, #3 GND CU.) and connect power to unit.
 - 3) Furnish and install heat trace for exterior piping. BOD: Raychem. Provide controller with output alarm to BAS.
 - (i) Coordinate Heat Trace controller power requirements with supplier. Connect to existing or spare circuit in panelboard `L2A'.
(ii) Field verify final piping lengths.

4. Testing, Adjusting and Balancing (TAB)

Not applicable. Refer to TAB scope specified in 08.05- PD3 Add VFD to Building Pumps.

04.01 – CCB BAS Controls Upgrade/Replacement

- 1. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - Provide capability to store and archive a minimum of one-year trend data for 40% of control points on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
 - 4) Reference the Control Contractor Performance Specifications for additional requirements.
 - C. Demolition
 - 1) Demolish and dispose of all existing control components (including wiring, sensors, actuators, controls enclosures, and conduit) not intended to be re-used.
 - 2) Demolish existing stand-alone thermostats and their associated components for fan coil unit temperature control.
 - Provide baseplates to cover existing wall openings where thermostats were removed as needed.
 - b) Patch and touch up paint for wall if applicable.
 - 3) Existing air compressor shall remain as-is.
 - 4) Properly dispose of associated equipment following customer guidelines for E-Waste.
 - D. Connect all new controllers to existing Siemens Desigo Building Automation System front end if reusing, otherwise demo system.
 - E. If ethernet drops are required, the City & County of Denver staff shall provide them. Coordinate for locations.
 - F. Provide all necessary programmable controllers, control panels, conduit, sensors, transformers and

actuators for a complete and functioning controls system.

- 1) Provide enough controller I/O for 15% expansion capacity.
- G. All controllers shall be native BACnet and BTL listed.
- H. All BACnet IP and BACnet MSTP devices shall be discoverable by supervisor.
- I. McKinstry and City and County of Denver approved naming convention shall be used for all BACnet Object Names.
- J. Provide onsite CX support as required by McKinstry CX agent for Point to Point and Functional Performance testing.
 - 1) The Controls Contractor shall have a pre-CX plan to ensure the system is ready for final McKinstry CX work.
- K. Provide all low voltage wiring and all required 120 V power for control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- L. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- M. Provide all necessary programmable controllers, low voltage wiring to control panels, conduit, sensors, transformers, and actuators for a complete and functioning controls system.
 - 1) Provide enough controller I/O for 15% expansion capacity.
- N. Provide all temperature sensors, switches, pressure sensors, actuators and other components as required for a complete controls system.
- O. Existing DDC system served by Siemens APOGEE controllers as well as standalone controls for some HVAC equipment. Replace or convert the existing controls to be BACnet compatible DDC controls following the three pricing options listed below.
- P. If reusing the existing control system, integrate all new DDC controls and sensors with the existing Building Automation System. Update the graphical user interface, automation management, scheduling, and programming of all networked devices to meet the design intent of McKinstry.
 - Controls contractor can reuse any existing hardware, but it needs to be functional. Provide a detailed list to McKinstry of what will be reused and what will be replaced for each option listed below.
- Q. If replacing the control system, provide a web-based application software for graphical user interface, automation management, scheduling, and programming of all networked devices. Application software shall be capable of access by multiple users one of which shall be accessible via an outside network. Provide programming and implementation for this project to meet the design intent of McKinstry.
- R. Pricing Options: Contractor shall price out the following three options in their bid.
 - 1) <u>Base Case (INCLUDED IN FINAL SCOPE)</u>: Convert or replace all existing equipment on the Siemens Desigo BAS to be BACnet compatible and integrate into the BAS.
 - a) Heating Water System:
 - (a) Two (2) Heating Water Pumps with VFDs
 - (i) Integrate factory provided VFD BACnet controller, if available
 - (ii) Include the following control points:

- a. Pump Status (DI)
- b. Pump Enable (DO)
- c. Pump Speed (AO)
- d. Pump Alarm (AO)
- (b) Loop differential pressure sensor signal reuse existing sensor
- (c) For two (2) hot water heat exchangers reuse the existing control valves & actuators:
 - (i) Water side control valve
 - (ii) Steam side control valve
- (d) Replace the following temperature sensors:
 - (i) Heating water supply/return temperature sensors
 - (ii) Domestic heating water supply/return temperature sensors
- b) Chilled Water System:
 - (a) Two (2) Chilled Water Pumps with VFDs
 - (i) Integrate factory provided VFD BACnet controller, if available
 - (ii) Include the following points:
 - 1. Pump Enable (DO)
 - 2. Pump Speed (AO)
 - 3. Pump Status (DI)
 - 4. Pump Alarm (AO)
 - (b) Loop differential pressure sensor signal reuse existing sensor
 - (c) Replace the following temperature sensors:
 - (i) Chilled water supply/return temperature sensors
- c) Twenty (20) Air Handling Units with Hot Water & Chilled Water Coils
 - (a) Eighteen (18) economizer damper actuators reuse the existing actuators(i) Note: The remaining two units do not have OSA damper actuators.
 - (b) Replace the following temperature sensors:
 - (i) Twenty (20) return air temperature sensors
 - (ii) Twenty (20) mixed air temperature sensors
 - (iii) Twenty (20) supply air temperature sensors
 - (iv) Space temperature sensors
 - (c) Twenty (20) hot water control valves reuse existing valves and actuators(i) Note: Fifteen (15) of these hot water coils also have coil pumps
 - (d) Twenty (20) chilled water control valves reuse existing valves and actuators(i) Note: One (1) of the chilled water coils has a coil pump
 - (e) Low limit temperature switches replace existing temperature switches
 - (f) Include the following control points:
 - (i) Economizer damper actuator position/command (AI/AO)
 - (ii) Supply fan status/enable (DI/DO)
 - (iii) Fan VFD speed (AO) only applicable for 2 AHUs
 - (iv) Return air temperature (AI)
 - (v) Mixed air temperature (AI)
 - (vi) Supply air temperature (AI)
 - (vii) Hot water control valve position/command (AI/AO)
 - (viii) Chilled water control valve position/command (AI/AO)
 - (ix) Coil circulation pump status/enable (DI/DO) only applicable for 16 coils
 - (x) Space temperature (AI)
- d) One (1) Chilled Water Air Handling Unit

- (a) Replace the following temperature sensors:
 - (i) One (1) return air temperature sensor
 - (ii) One (1) mixed air temperature sensor
 - (iii) One (1) supply air temperature sensor
 - (iv) Space temperature sensors
- (b) One (1) chilled water control valve reuse existing valve and actuator
- (c) Include the following control points:
 - (i) Supply fan status/enable (DI/DO)
 - (ii) Return air temperature (AI)
 - (iii) Mixed air temperature (AI)
 - (iv) Supply air temperature (AI)
 - (v) Chilled water control valve position/command (AI/AO)
 - (vi) Space temperature (AI)
- e) Four (4) Variable Volume Exhaust Fans
 - (a) Building static pressure sensor replace sensor
 - (b) Include the following control points:
 - (i) Exhaust fan status/enable (DI/DO)
 - (ii) Exhaust fan speed (AO)
 - (iii) Exhaust fan alarm (AO)
 - (iv) Building static pressure (AI)
- f) Ten (10) Constant Volume Exhaust Fans
 - (a) Include the following control points:(i) Exhaust fan status/enable (DI/DO)
- g) Three (3) Radiant Heating Zones
 - (a) Space temperature sensors replace sensors
 - (b) Hot water control valves reuse existing valves & actuators
- h) Four (4) Computer Room Air Conditioning (CRAC) Units
 - (a) Space temperature sensors replace sensors(i) Monitor room temperature for BAS alarming
- i) One Hundred Twenty-Six (126) 4-Pipe Fan Coil Units (assuming all 1st floor FCUs are DDC)
 - (a) (126) Hot water control valves reuse existing valves & actuators
 - (b) (126) Chilled water control valves reuse existing valves & actuators
 - (c) (126) Discharge air temperature sensors replace sensors
 - (d) Space temperature sensors replace sensors
 - (e) Include the following control points:
 - (i) Fan status/enable (DI/DO)
 - (ii) Hot water control valve position/command (AI/AO)
 - (iii) Chilled water control valve position/command (AI/AO)
 - (iv) Discharge air temperature (AI)
 - (v) Space temperature (AI)
- 2) <u>Add Alternate #1 (INCLUDED IN FINAL SCOPE)</u>: Convert remaining air handling units from standalone controls to BACnet compatible controls and integrate into the BAS.
 - a) Five (5) Air Handling Units with Hot Water & Chilled Water Coils
 - (a) One (1) economizer damper actuator reuse the existing actuator(i) Note: The remaining units do not have OSA damper actuators.
 - (b) Replace the following temperature sensors:
 - (i) Five (5) return air temperature sensors

- (ii) Five (5) mixed air temperature sensors
- (iii) Five (5) supply air temperature sensors
- (iv) Space temperature sensors
- (c) Five (5) hot water control valves reuse existing valves and actuators
- (d) Five (5) chilled water control valves reuse existing valves and actuators
- (e) Low limit temperature switches replace existing temperature switches
- (f) Include the following control points:
 - (i) Economizer damper actuator position/command (AI/AO) only applicable for 1 unit
 - (ii) Supply fan status/enable (DI/DO)
 - (iii) Return air temperature (AI)
 - (iv) Mixed air temperature (AI)
 - (v) Supply air temperature (AI)
 - (vi) Hot water control valve position/command (AI/AO)
 - (vii) Chilled water control valve position/command (AI/AO)
 - (viii) Space temperature (AI)
- b) Seven (7) Chilled Water Air Handling Units
 - (a) One (1) economizer damper actuator reuse the existing actuator(i) Note: The remaining units do not have OSA damper actuators.
 - (b) Replace the following temperature sensors:
 - (i) Seven (7) return air temperature sensors
 - (ii) Seven (7) mixed air temperature sensors
 - (iii) Seven (7) supply air temperature sensors
 - (iv) Space temperature sensors
 - (c) Seven (7) chilled water control valves reuse existing valves and actuators(i) Note: Two (2) of these chilled water coils have coil pumps
 - (d) Include the following control points:
 - (i) Economizer damper actuator position/command (AI/AO) only applicable for 1 unit
 - (ii) Supply fan status/enable (DI/DO)
 - (iii) Return air temperature (AI)
 - (iv) Mixed air temperature (AI)
 - (v) Supply air temperature (AI)
 - (vi) Chilled water control valve position/command (AI/AO)
 - (vii) Coil circulation pump status/enable (DI/DO) only applicable for 2 coils
 - (viii) Space temperature (AI)
- c) One (1) DX Cooling Air Handling Unit Serving Mayor's Office
 - (a) One (1) economizer damper actuator reuse the existing actuator
 - (b) Replace the following temperature sensors:
 - (i) Return air temperature sensor
 - (ii) Mixed air temperature sensor
 - (iii) Supply air temperature sensor
 - (iv) Space temperature sensor
 - (c) Include the following control points:
 - (i) Economizer damper actuator position/command (AI/AO)
 - (ii) Supply fan status/enable (DI/DO)
 - (iii) Return air temperature (AI)
 - (iv) Mixed air temperature (AI)
 - (v) Supply air temperature (AI)

(vi) Space temperature (AI)

	Table 1: Primary Air Handling Equipment In-Scope								
Linit Nama	Level on Floor	Hot Water	HW Control	Chilled Water	CHW Control	Coil Dump2		Outside Air	On Existing
Unit Name	Plan	Line	Valve	Line	Valve	Con Pump?	Outside Air?	Actuator?	Siemens BAS?
(558) Fan Coil Units	Varies	3/4''	2-way	3/4''	2-way	No	No	No	Yes, 1st Floor
AHU-030	Basement	No	No	1/2"	2-way	No	No	No	No
AHU-015	Basement	No	No	1-3/4"	2-way	Yes, on CHW coil	No	No	No
AHU-016	Basement	No	No	1-3/4"	2-way	Yes, on CHW coil	Yes	Yes	No
AHU-02	Basement	1/2"	2-way	1/2"	2-way	No	No	No	No
AHU-028	Basement	No	No	3/4"	2-way	No	Disconnected	No	No
AHU-023	Basement	No	No	1/2"	2 way	No	No	No	No
AHU-029	Basement	3/4"	2-way	1"	2-way	No	Yes	No	Yes
AHU-19	Basement	No	No	1-3/4"	2-way 1-1/2" Valve	No	Yes	No	Yes
AHU-018	Basement	No	No	1-1/2"	2-way	No	Yes	Disconnected	No
AHU-020H	Basement	1-3/4"	2-way	1-3/4"	2 way	No	Yes	Yes	Yes
AHU-027	Basement	3/4"	2-way	3/4"	2-way	No	No	No	No
AHU-RM10	Basement	2-1/2"	2-way	2-1/2"	2-way	Yes, on HW & CHW coils	Yes	Yes	Yes
AHU-009H	Basement	no	no	1-1/2"	2-way	No	Yes	No	No
AHU-17	Basement	1-3/4"	2-way	1-3/4"	2-way	No	Yes	Yes	No
AHU-024	Basement	TBD	2-way	TBD	2-way	No	No	No	No
AHU-025	Basement	TBD	2-way	TBD	2-way	No	No	No	No
AHU-18	2	2-1/2"	2-way	2-1/2"	2-way	No	Yes	Yes	Yes
AHU-14	3	1-1/2"	2-way 1/2" Valve	1-1/4"	2-way	No	Yes	Yes	Yes
AHU-13	3	1-1/2"	2-way 1/2" Valve	1-1/4"	2-way	No	Yes	Yes	Yes
Mayor's AHU	4	No	No	No (DX)	No (DX)	No	Yes	Yes	No
AHU-10	5	2-1/2"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-9	5	3"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-8	5	2-1/2"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-5	5	2-1/2"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-7	5	2-1/2"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-6	5	3"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-11	5	3"	3-way 1-1/2" Valve	2-1/2"	2-way 2" Valve	Yes, on HW coil	Yes	Yes	Yes
AHU-1	5	3"	3-way 1-1/2" Valve	2-1/2"	2-way 2" Valve	Yes, on HW coil	Yes	Yes	Yes
AHU-12	5	2-1/2"	3-way	2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-4	5	2"	3-way 1-1/2" Valve	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
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 AHU-3	5	2"	3-way	2-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-2	5	2-1/2"	3-way 1-1/2" Valve	2-1/2"	2-way 2" Valve	Yes, on HW coil	Yes	Yes	Yes
AHU-15	5	1-1/2"	3-way	1-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes
AHU-16	5	1-1/2"	3-way	1-1/2"	2-way	Yes, on HW coil	Yes	Yes	Yes

- 2. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - 1) Contractor shall use McKinstry Specification 230593 Testing, Adjusting, and Balancing for HVAC as a guide for all TAB activities.
 - B. Test and Balance scope shall include, but is not limited to the following items:
 - 1) Provide pre and post construction test and balance for the following items related to the air handling units:
 - a) Balance minimum OA for all air handling units with outside air damper actuators and ensure economizing capabilities are functioning correctly.
 - b) Airflows (OA, SA, RA), supply & return fan pressure drop, hot water flow rate, and chilled water flow rate.
 - c) Provide flow measurements for each unit at two (2) flow conditions, to be determined by McKinstry commissioning personnel, to correlate against fan performance.
- 3. Training

Provide training as required for this FIM.

04.01 – PAB BAS Controls Upgrade / Replacement

- 1. Mechanical
 - A. Note: Control valves that are found to be non-operational will be replaced as needed on a case-bycase basis. Maximum numbers of valves that will be replaced under this project is 70.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.

- Provide capability to store and archive a minimum of one-year trend data for 40% of control points on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
- 4) Reference the Control Contractor Performance Specifications for additional requirements.
- C. Demolition
 - 1) Demolish and dispose of all existing control components (including transducers, wiring, sensors, actuators, controls enclosures, and conduit) not intended to be re-used.
 - a) Note: There are existing E-P transducers serving the fan coil units throughout the building except for the second floor. Any of these transducers that are not reusable will need to be demolished and replaced.
 - 2) Demolish existing stand-alone wireless thermostats and pneumatic thermostats as well as their associated components for zone temperature control.
 - b) Provide baseplates to cover existing wall openings where thermostats were removed. Leave some wall openings in place where new zone controllers are to be installed.
 - c) Patch and touch up paint for wall if applicable.
- D. If ethernet drops are required, the City & County of Denver staff shall provide them. Coordinate for locations.
- E. Provide all necessary programmable controllers, control panels, conduit, sensors, transformers and actuators for a complete and functioning controls system.
- F. Provide onsite CX support as required by McKinstry CX agent for Point to Point and Functional Performance testing.
- G. Low Voltage Wiring and all required 120 V for control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- H. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- I. Furnish & Install New E-P Transducers:
 - Convert existing pneumatic control valve actuators to use electronic control signals through the installation of electronic-pneumatic (E-P) switches for the fan coil units and duct coil units. The scope of this upgrade shall include the following:
 - a) The one hundred and eighteen (118) perimeter zones served by three hundred and fifteen (315) existing 4-pipe fan coil units (see floor plan markups). The thermostat control of the fan coil units is grouped by zone, so only (118) E-P transducers shall be required.
 - b) Five (5) duct cooling coils located on the 1st and 2nd floors (see floor plan markups)
 - c) Six (6) duct heating coils located on the 1st and 2nd floors (see floor plan markups).
 - 2) Contractor shall verify that existing pneumatic air branch lines running from the main line to each control valve in-scope is in good condition and provides the required air pressure to each valve for heating and cooling modes. They shall replace and/or repair any existing air branch lines as needed to ensure all fan coil unit and duct coil control valves can operate to meet the space load.

- d) Assume all control valves are in working order for this scope of work (valve replacements will be handled separately as needed).
- Connect all new E-P transducers to existing Delta Building Automation System front end. This shall also include the addition of new BAS points for zone temperature and valve commands for the equipment in-scope.
- 4) Provide new zone temperature sensors and occupancy sensors as required for a complete system.
- 5) Note: The following units are excluded from the upgrade since they are already integrated into the existing Delta Building Automation System:
 - a) (2) Primary air conditioning units (4 supply & 4 return fans) in the penthouse
 - b) (2) Building chilled water pumps
 - c) (2) Building hot water pumps
 - d) Steam system valves
 - e) Heat exchangers for steam to hot water conversion
 - f) (7) Fan coil units that are integrated into the BAS.
 - g) Radiation element system on the $1^{\mbox{\scriptsize st}}$ floor
 - h) Multizone unit (this is included in the FIM #45127 controls scope)
- 6) The following photos demonstrate the typical coil layout of all fan coil units in-scope for E-P transducers:

Figure 1: Typical Fan Coil Unit



Figure 2: Typical CHW Valve



Figure 3: Typical HW Valve



- J. Integrate all new E-P transducers and sensors listed above with the existing Delta Building Automation System.
- K. Update the graphical user interface, automation management, scheduling, and programming of all networked devices to meet the design intent of McKinstry.
- 3. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls
 - C. Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - D. Provide pre and post construction test and balance for the following items related to the fan coil units:
 - 1) Hot water flow rate, chilled water flow rate, and control valve function.
 - 2) Provide flow measurements for each coil at two (2) flow conditions, to be determined by McKinstry commissioning personnel, to correlate against performance.
 - E. Provide pre and post construction test and balance for the following items related to the duct coils:
 - 1) Hot water flow rate, chilled water flow rate, and control valve function.

04.01 – POA BAS Controls Upgrade/Replacement

- 1. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 40% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
 - C. Provide all necessary programmable controllers, control panels, conduit, sensors, transformers, and actuators for a complete and functioning controls system.
 - 1) Provide enough controller I/O for 15% expansion capacity.
 - D. Provide onsite CX support as required by McKinstry CX agent for Point to Point and Functional Performance testing.
 - E. Low Voltage Wiring and all required 120 V for control panels. Controls shall be responsible for providing its own transformers and 120 V power.
 - F. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
 - G. Demolition Work:
 - Demolish and dispose of all existing dated Honeywell control components. This includes but not limited to: thermistors, duct sensors, controllers at the existing VVT dampers actuators and RTUs. Local programmable thermostats controlling fan coil units, RTU-3&4, make up air heating unit, evaporative coolers and unit heaters shall also be removed unless indicated on the drawings as remaining. Patch openings or provide cover plate if required for clean finish.
 - H. BAS Controls Upgrade:
 - 1) A wireless network communication shall be provided with the following components:
 - a) BACnet IP wireless communication gateway (Design Basis: Trane Tracer SC+ System Controller) with Zigbee wireless network (Design Basis: Trane Air-Fi WCI Zigbee wireless)
 - b) Compatible wireless RTU and terminal equipment controllers and network thermostats.

Coordinate with City IT department on Ethernet cable drop location.

- c) Ensure adequate signal strength and latency and add repeaters as necessary.
- 2) Control points shall include the following:

Point Names	AO	AI	DO	DI	Network	Virtual Pt
Outside air temperature		1				
Mixed Air Damper Position (% Open)	4					
Economizer Temperature Setpoint						4
Economizer Status		4				
RTU Power Exhaust Start/Stop			4			
RTU Power Exhaust Status				4		
RTU Power Exhaust Alarm				4		
RTU Power Exhaust VFD Speed Command	4					
Building Pressure sensor		2				
RTU Supply Fan Start/Stop			4			
RTU Supply Fan Status				4		
RTU Supply Fan Alarm				4		
RTU Supply Fan VFD Speed Command	4					
RTU Return Air Temperature		4				
RTU Mixed Air Temperature		4				
RTU Discharge Air Temperature		4				
RTU Discharge Air Temperature						4
Setpoint				4		
				4		
				4		
RTU Cooling Enable			4			
RTU Cooling Status				4		
RTU Cooling Output		4				
RTU Furnace Enable			4			
RTU Heating Status						4
RTU Heating Output		4				4

Point Names	40	АТ	DO	DI	Network	Virtual
Point Names	AU	AI	00			Pt
VVT Damper Command	14*					
Duct Static Pressure Setpoint						2
Duct Static Pressure		2				
Space Temperature		21				
Space Temperature Setpoint						21
Space CO2 sensor for RTU-1		2				
Evaporative Cooler Cooling Enable			4			
Evaporative Cooler Cooling Status				4		
Evaporative Cooler Fan Enable			4			
Evaporative Cooler Fan Status				4		
Evaporative Cooler Spray Pump Enable			4			
Evaporative Cooler Spray Pump Status				4		
Evaporative Cooler Fill and Down Enable			4			
Training Camp Relief Damper Command	8					
Training Camp space pressure		1				

*Number does not include the 2 VVT bypass dampers that shall be locked closed.

Test and Balance:

1) Not applicable. Refer to 03.04- POA VVT to VAV Replacement Scope.

04.02 – CMP Occupancy Based HVAC Controls

- 2. Controls
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.

- 3) Reference the Control Contractor Performance Specifications for additional requirements.
- 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
- 5) Existing building automation systems and graphics shall be used and updated for new functionality.
- 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-

minute interval. Provide equipment level graphics for all new equipment added to the new control system.

- C. Demolition
 - 1) Demolish and dispose of all existing control components not intended to be re-used.
- D. Low Voltage Wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- E. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- F. Contractor shall integrate (84) lighting occupancy sensors to be installed by the lighting contractor into the Building Automation System via the VAV controller to communicate with the existing HVAC system and zone temperature controls.
 - 1) This shall be completed for all (84) Variable air volume and Fan Powered Box zones as shown on the schedule and floor plans provided by McKinstry.
 - 2) Update Building Automation Control System with Graphics to show occupancy in space
 - 3) Program zone temperature setpoints as follows for occupied and unoccupied hours with an intermediary condition that will be maintained for 1-hour (adj.) after a space is scheduled to go into unoccupied mode. Existing sequence of operations outside of occupancy and zone setpoint to remain in place.

04.02-CMP Occupancy Based HVAC Controls	The Commons on Champa	A	Unoccupied Temperature Setpoint	Occ Cool: 73F, Occ Heat: 69F Unocc Cool: 80F Unocc Heat: 60F	Occ Cool: 73F, Occ Heat: 69F Unocc Cool 80F Unocc Heat 60F Unocc Cool setback: 75F Unocc Heat setback: 67F
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04.02 – PAB Occupancy Based HVAC Controls

- 1. Mechanical
 - A. Not applicable.
- 2. Controls
 - G. Contractor shall be responsible for equipment, materials, accessories, and other associated

requirements called for in the following scope, and as indicated in the above supporting documents.

- H. General requirements
 - 1) Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Reference the Control Contractor Performance Specifications for additional requirements.
 - 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
 - 5) Existing building automation systems and graphics shall be used and updated for new functionality.
 - 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-

minute interval. Provide equipment level graphics for all new equipment added to the new control system.

I. Demolition

1) Demolish and dispose of all existing control components not intended to be re-used.

- J. Low Voltage Wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- K. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- L. Furnish and install space temperature sensors with integral occupancy sensors for the following HVAC equipment:
 - 1) (315) Fan coil units located throughout the perimeter spaces in the building on floor 1-5. *Note: There are only 118 unique perimeter zones served by the 4-pipe fan coil units (see floor plan markups).*
 - 2) (1) Baseboard heating system on the 6th floor. *Note: The 6th floor is currently demolished and unoccupied.*
 - 3) (32) Radiation heating elements on the 1st floor. *Note: There are only 15 unique perimeter zones served by the radiation elements (see floor plan markups).*
- M. Program temperature control sequences for each zone with the following settings for occupied and unoccupied hours along with an intermediary condition that will be maintained for 1-hour (adj.) after a space is scheduled to go into unoccupied mode.

04.02-PAB Occupancy Based Police Administration A HVAC Control Building PAB A	Unoccupied Occ/ Temperature Occ/ Setpoint Occ/	Unocc Cool: 74F Occ Heat: 72F Unocc Cool: 74F Unocc Cool: 78F Unocc Cool Setback: 76F Unocc Heat: 68F Unocc Heat Setback: 70F
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- 1) The Contractor shall locate the existing fan coil unit and/or air handling unit control panels and the associated spare points for the occupancy sensor connections.
- 2) The following hardwired points via BACnet router shall be provided on each unit/space:
 - (i) Space Occupancy Condition (DI)
 - (ii) Space Temperature (AI)
 - (iii) Space Temperature Setpoint (AI)
- 6. Electrical
 - A. Not applicable
- 7. Structural
 - A. Not applicable.
- 8. Architectural
 - A. Not applicable.
- 9. Specialty
 - A. Not applicable.
- 10. Testing, Adjusting and Balancing (TAB)
 - A. Not applicable.
- 11. Commissioning
 - A. Not applicable.
- 12. Demolition and Removal
 - A. Not applicable.
- 13. Allotments

Not applicable.

04.02 – PMB Occupancy Based HVAC Controls

- 1. Mechanical
 - A. Not applicable.
- 2. Controls
 - N. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - O. General requirements
 - 1) Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment,

software, graphics and programming upgrades.

- 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
- 3) Reference the Control Contractor Performance Specifications for additional requirements.
- 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
- 5) Existing building automation systems and graphics shall be used and updated for new functionality.
- 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-

minute interval. Provide equipment level graphics for all new equipment added to the new control system.

- P. Demolition
 - 1) Demolish and dispose of all existing control components not intended to be re-used.
- Q. Low Voltage Wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- R. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- S. Contractor shall integrate (99) lighting occupancy sensors to be installed by the lighting contractor into the Building Automation System via the VAV controller to communicate with the existing HVAC system and zone temperature controls.
 - 1) This shall be completed for all terminal box variable air volume zones as shown on the schedule and floor plans provided by McKinstry.
 - 2) Program temperature zone setpoints as follows for occupied and unoccupied with an intermediary condition that will be maintained for 1-hour (adj.) after a space is scheduled to go into unoccupied mode. Existing sequence of operations outside of occupancy and zone setpoint to remain in place.

04.02-PMB Occupancy Based HVAC Controls	Permit Building	A	Unoccupied Temperature Setpoint	Occ Heat: 72F Occ Cool:74F Unocc Cool: 80F Unocc Heat: 65F	Occ Cool: 74F Unocc Cool: 80F Occ Heat: 72F Unocc Heat: 65F Unocc Cool setback: 76F Unocc Heat setback: 70F
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04.02 – PTO Occupancy Based HVAC Controls

- 1. Mechanical
 - A. Not applicable.

- 2. Controls
 - T. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - U. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Reference the Control Contractor Performance Specifications for additional requirements.
 - 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
 - 5) Existing building automation systems and graphics shall be used and updated for new functionality.
 - 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-

minute interval. Provide equipment level graphics for all new equipment added to the new control system.

- V. Demolition
 - 1) Demolish and dispose of all existing control components
- W. Low Voltage Wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
- X. Furnish and install all programming necessary to operate the systems per the Design Intent set forth by McKinstry.
- Y. Contractor shall integrate (42) lighting occupancy sensors to be installed by the lighting contractor into the Building Automation System via the VAV controller to communicate with the existing HVAC system and zone temperature controls.
 - 1) This shall be completed for all (42) Variable Air Volume zones as shown on the schedule and Floor Plans provided by McKinstry.
 - 2) Update Mechanical Building Automation System Graphics to show Occupancy in Zones
 - 3) Program zone temperature setpoints as follows for occupied and unoccupied hours with an intermediary condition that will be maintained for 1-hour (adj.) after a space is scheduled to go into unoccupied mode. Existing sequences of operations outside of occupancy and zone setpoint to remain in place.

04.02-PTO Occupancy Based	
HVAC Control	Op

Police Traffic Operations Bureau

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Unoccupied Temperature Setpoint Occ Cool: 75F, Occ Heat: 72F Unocc Cool: 80F Unocc Heat: 70 Occ Cool: 75F Unocc Cool 80F Occ Heat 72F Unocc Heat 70 F Unocc Cool setback: 77F Unocc Heat setback: 68F

4) The Contractor shall locate the existing fan coil unit and/or air handling unit control panels and the associated spare points for the occupancy sensor connections.

04.07 - RAC Ventilation Control

- 1. Mechanical
 - A. Not applicable.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine necessary controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Reference the Control Contractor Performance Specifications for additional requirements.
 - 4) McKinstry approved naming convention shall be used for all BACnet Object Names.
 - 5) Existing building automation systems and graphics shall be used and updated for new functionality.
 - 6) Provide capability to store and archive a minimum of one-year trend data for the new points provided on a 15-minute interval. Provide equipment level graphics for all new equipment added to the new control system.
 - C. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - D. Furnish and install all programming necessary to operate the systems.
 - E. Controls contractor is responsible for all low voltage wiring and all required 120 V control panels. Controls shall be responsible for providing its own transformers and 120 V power.
 - F. Two energy recovery units on roof shall be modified to vary supply fan speed based on duct static pressure.

- Furnish and install two duct static pressure sensors. One in each main duct at basement level. Wire directly back to energy recovery unit controller.
- 2) Modify packaged controls to vary fan speed to meet duct static pressure set point as determined by balancer.
 - (i) The package controller appears to have BACnet capability. Integrate existing controller into the BAS to provide the fan speed control. Integrate all other available points from the factory controller into the BAS
 - (ii) Update all graphics associated with this unit to monitor all available points including but not limited to
 - ERV enable/disable
 - Supply fan start/stop
 - Supply fan speed
 - return fan start/ stop
 - return fan speed
 - chilled water valve position
 - hot water valve position
 - heat recovery wheel enable/disable
 - discharge air temperature and humidity
 - return air temperature and humidity
 - Exhaust air temperature and humidity after the wheel
 - Supply air temperature and humidity before and after the wheel
- 3. Electrical
 - A. Reconnect ERV enthalpy wheels to the existing enthalpy wheel VFD in each ERV.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls Contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems.
 - C. Perform TAB procedures for the following systems/equipment, as specified in spc230593 and as noted below:
 - Provide full pre and post construction TAB at each ventilation air duct termination and on the energy recovery units at three different damper conditions. 100% of dampers open, 70% of dampers open, and 40% of dampers open.
- 5. Allotments

- A. Not applicable
- 6. Training
 - B. Provide training as required for this FIM.

08.05 – PD1 Replace Chilled Water Pumps and Add VFDs

- 1. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Existing Chilled Water Pumps Removal
 - Isolate, drain, disconnect, remove and properly dispose of existing (2) chilled water pumps located in the main mechanical room. Cut back chilled water supply and return lines to extent necessary to facilitate the scope of work.
 - 2) Existing pump house keep pads shall remain.
 - C. New Chilled Water Pumps Replacement
 - Provide (2) chilled water pumps (Basis of Design: Bell & Gossett). Refer to GMAX drawing M001 for schedule. Chilled water pumps shall meet the following:
 - (i) Flow rate: 167gpm, Head: 100ft, PLEV 60.6%, 460V/3PH/10HP
 - (ii) Pump motor shall be NEMA premium-efficiency inverter-ready
 - 2) Furnish (2) variable frequency drives with integral disconnect (Basis of Design: ABB ACH-580 with integral disconnect (on board BACnet card shall be default option))
 - Field coordinate and refer to Pump detail on GMAX drawing M001 and provide fitting and piping as necessary. Properly align pump suction and discharge piping and field adjust as necessary. Properly align the pump motor and shaft.
 - Provide propylene glycol to fill the system to the existing glycol solution concentration level. Notify McKinstry if the existing glycol solution level is not meeting 35%.
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other associated requirements called for in the following scope.
 - B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment, I/O modules, software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.

- 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
- 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 50% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
- 4) Reference the Control Contractor Performance Specifications for additional requirements.

C. <u>CWP-1&2 VFD Controls:</u>

- Integrate new pump VFD into existing Siemens BAS with the following points labeled as hardwired. Provide MS/TP wire from BAS field controller(s) to the VFD on-board BACNET card for information access. For each VFD furnished by Mechanical Contractors on CWP-1&2, the following points are required:
 - (i) Pump start/stop (hardwired)
 - (ii) Pump status (hardwired)
 - (iii) Pump VFD speed (AO) (hardwired)
 - (iv) Pump VFD alarm (hardwired)
 - (v) pump VFD kW (network card)
 - (vi) Fan or pump VFD speed (AI) (network card)
- 2) CWP-1&2 VFD control sequence:
 - (i) The two chilled water pumps shall work in parallel as the existing condition. Pump VFDs shall modulate to maintain a design loop delta T of 14°F. If there is any AHU cooling valve is commanded 90% (adj.) open and is still calling for cooling, pump VFD shall ramp up speed in 10 mins (adj) to until the critical AHU cooling valve closes down to 80% (adj.). Once the all AHU cooling valves are less than 90% open, pump VFD shall be reset back to control to maintain the design loop delta T temperature. <u>Minimum chilled water pump VFD shall not go down below 77% (corresponding to chiller min flow rate) at rate of ramp down at 10% per minute.</u>
- D. Reference controls P&ID diagram for proposed control points to be provided in GMAX drawing set.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.
 - B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability, and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.

- 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
- 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories all in compliance with NEC.
- 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
- 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
- 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
- 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
- 8) Contractor shall be responsible to provide 20A/120V convenience outlet within 20' 0" of the mechanical equipment per code if an existing outlet serving this purpose does not exist.
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. General Scope: Electrical work to support the replacement of combination magnetic motor starters serving pumps 'CWP-1' and 'CWP-2' with VFD's.
 - 1) Metering: Project will result in no change in electrical load. 30-day metering or 12-month utility demand data will not be required.
 - 2) Reference GMAX drawings for existing equipment locations.
- E. Demolition:
 - 1) Existing pumps 'CWP-1' and 'CWP-2' shall remain (480V/3PH, 10 HP).
 - (i) Disconnect and safe off power to pumps from serving panelboard 'H1M' (1st Floor, Mech 146).
 - (ii) Disconnect and remove existing combination magnetic motor starters for each pump.
 - (iii) Existing conduit and conductors shall remain for re-use.
- F. New Work:
 - 1) Existing pumps 'CWP-1' and 'CWP-2' (480V/3PH, 10 HP).
 - (i) Install new VFD's provided by others.
 - (ii) Extend existing conduit and conductors to VFD's and connect power.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities. Report to McKinstry's Construction Manager for field conditions that might impede the performance of this work.

- B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls contractors, for the appropriate timing and extent of this work, and for required interface with Mechanical and Control systems
- C. Perform specified pre and post TAB activities for the following systems/equipment and demonstrate to McKinstry Cx engineer.
 - Provide measurements of the existing chiller flow and pressure drop prior to construction. Provide measurements of the existing CWP-1&2 flow and pressure differential, as well as zero flow (dead head) pressure reading prior to construction.
 - Provide full pre and post construction TAB on chiller CH-1 and chilled water pumps CWP-1&2 including flow and pressure drop and 2 different operating conditions: Max (100%) and Min (77%) flows.

08.05 – PD3 Replace Chilled Water Pumps and Add VFDs

- 1. Mechanical
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation and other associated requirements called for in the following scope, and as indicated in the above supported documents.
 - B. Existing Chilled Water Pumps Removal
 - Isolate, drain, disconnect, remove and properly dispose of existing (2) chilled water pumps located in the main mechanical room. Cut back chilled water supply and return lines to extent necessary to facilitate the scope of work.
 - 2) Existing pump house keep pads shall remain.
 - C. New Chilled Water Pumps Replacement
 - 1) Provide (2) chilled water pumps (Basis of Design: Bell & Gossett). Refer to GMAX drawing M001 for schedule. Chilled water pumps shall meet the following:
 - (i) Flow rate: 211.2gpm, Head: 68ft, PLEV 68.9%, 460V/3PH/7.5HP
 - (ii) Pump motor shall be NEMA premium-efficiency inverter-ready
 - 2) Furnish (2) variable frequency drives with integral disconnect (Basis of Design: ABB ACH-580 with integral disconnect (on board BACnet card shall be default option))
 - Field coordinate and refer to Pump detail on GMAX drawing M001 and provide fitting and piping as necessary. Properly align pump suction and discharge piping and field adjust as necessary. Properly align the pump motor and shaft.
 - 4)
- 2. Controls
 - A. Contractor shall be responsible for all equipment, materials, accessories, programming, and other

associated requirements called for in the following scope.

- B. General requirements
 - Contractor shall survey existing facility controls as-builts and installed system to determine available controller capacity to support this scope of work. Include all necessary equipment, software, graphics and programming upgrades. This includes low voltage wiring and controls associated line voltage wiring with associated transformers. Install transformers in separate enclosure from the controller enclosures.
 - 2) For proposed control points, Contractor shall furnish and install devices, conduit, conductors, and related accessories.
 - 3) Provide capability to store and archive a minimum of one-year trend data for a minimum of 40% of the points on a 15-minute interval. Provide equipment level graphics for all new equipment or equipment with refurbished controllers added to the new control system.
 - 4) Reference the Control Contractor Performance Specifications for additional requirements.
 - 5) Integrate new chilled water pumps controls into BAS with the following points labeled as hardwired. Provide new I/O expansion as needed. Provide communication cable from BAS to the pump VFD on-board BACNET card for information access. The following control points shall be provided for <u>CWP-1&2</u>:
 - (i) Pump enable/disable (hardwired)
 - (ii) Pump VFD speed (AO) (hardwired)
 - (iii) Pump alarm (hardwired)
 - (iv) Pump status (hardwired)
 - (v) pump VFD kW (network card)
 - (vi) pump VFD speed (AI) (network card)
 - (vii) The two chilled water pumps shall work in parallel as the existing condition. Pump VFDs shall modulate to maintain a design loop delta T of 14°F. If there is any AHU cooling valve is commanded 90% (adj.) open and is still calling for cooling, pump VFD shall ramp up speed in 10 mins (adj) to until the critical AHU cooling valve closes down to 80% (adj.). Once the all AHU cooling valves are less than 90% open, pump VFD shall be reset back to control to maintain the design loop delta T temperature. <u>Minimum chilled water pump VFD shall not go down below 72% (corresponding to chiller min flow rate) at rate of ramp down at 10% per minute.</u>
- C. Reference controls P&ID diagram for proposed control points to be provided in GMAX drawing set.
- 3. Electrical
 - A. Contractor shall be responsible for equipment, materials, accessories, and other associated requirements called for in the following scope, and as indicated in the above supporting documents.

- B. General circuiting requirements
 - Contractor shall survey existing facility drawings and facility power distribution system to determine available space, constructability and load capacity to support this scope of work. If existing space or load capacity is insufficient to meet the requirements of the scope, Contractor shall immediately notify McKinstry.
 - 2) For power circuits indicated as being removed, Contractor shall remove conductors back to the associated panel, and shall remove associated starters, disconnects, and other devices. Conduit shall be cut back to within 3" of room penetration.
 - 3) For new power circuits, Contractor shall furnish and install overcurrent protection, conduit conductors, starter, disconnect, and related accessories all in compliance with NEC.
 - 4) Where power circuits indicated as being removed meet the requirements for new power circuits, existing components may be reused where in compliance with current NEC.
 - 5) Unless otherwise specified, similar loads may be combined on a common circuit as permitted by current NEC.
 - 6) Contractor shall circuit all new devices under this scope of work to the nearest available panelboard with enough load capacity to accommodate new added loads.
 - 7) Contractor shall evaluate feeders for reuse (if the new equipment is in the same location).
 - 8) Contractor shall be responsible to provide 20A/120V convenience outlet within 20' 0" of the mechanical equipment per code if an existing outlet serving this purpose does not exist.
- C. Electrical panels, disconnects, control panels, VFDs, serving mechanical equipment shall be installed to comply with clearance requirements of the NEC. Provide remote mounted panels and disconnects where required by the NEC.
- D. Install VFDs for Pumps CWP-1&2
 - 1) Existing pumps 'CWP-1' and 'CWP-2' shall be removed (480V/3PH, 5 HP).
 - (i) Disconnect and safe off power to pumps from served from panelboard `H1M'.
 - (ii) Disconnect and remove existing magnetic motor starters and disconnect switches serving pumps.
 - (iii) Existing conduit and conductors shall remain for re-use.
 - 2) New pumps 'CWP-1' and 'CWP-2' (480V/3PH, 7.5 HP).
 - (i) Install new VFD's provided by others.
 - (ii) Extend existing conduit and conductors to new pumps and VFD's and connect power.
- 4. Testing, Adjusting and Balancing (TAB)
 - A. Contractor shall review this scope of work and inspect field conditions to develop a work plan prior to commencement of TAB activities.
 - B. Coordinate with McKinstry's Construction and Commissioning personnel, and Mechanical and Controls contractors, for the appropriate timing and extent of this work, and for required interface with

Mechanical and Control systems

- C. Perform specified pre and post TAB activities for the following systems/equipment:
 - Provide measurements of the existing chiller flow and pressure drop prior to construction. Provide measurements of the existing CWP-1&2 flow and pressure differential, as well as zero flow (dead head) pressure reading prior to construction.
 - Provide full pre and post construction TAB on chiller CH-1 and chilled water pumps CWP-1&2 including flow and pressure drop and 2 different operating conditions: Max (100%) and Min (72%) flows.

09.0 – Interior and Exterior LED Lighting Upgrades

SEE APPENDIX F for line by line scope.

10.0 – Solar PV Systems

OVERVIEW

Engineer, procure, construct, commission and monitor solar PV systems at the site listed below and convert building with new solar PV installation to Xcel SPVTOU Rate Schedule B.

- A. Construct an electrically complete solar photovoltaic system, interconnected to the Xcel Energy utility grid; basis of design:
 - 1) Module: Jinko JKM405M-72HL-TV 405W monofacial modules, or approved equal.
 - 2) String Inverter: CPS (Chint Power Systems), SCA, or approved equal.
 - 3) Rapid shut down (Rooftop Systems only): Tigo, TS4, or approved equal.
 - 4) Racking (Flat Roof Mount): Panel Claw, clawFR, or approved equal.
 - 5) Parking Canopy:
 - a. Titan double-cantilever solar canopy structures, or approved equivalent
 - b. Five seven (5-7) degree tilt
 - c. Minimum ten foot, six inch (10'-6") clear span
 - d. Snowguards at bottom edge of array are included
 - e. Excepting snowguards, no decking, gutters, or other water management features are included
 - f. Pricing assumes concrete pier foundations at 30" diameter and 10' depth.
- B. The system shall include:
 - 1) DC & AC cabling and conduit.
 - 2) DC & AC system disconnects.

- 3) DC & AC bonding and grounding.
- 4) Inverters, inverter fuses, transformer (as needed), grounding transformer, rapid shutdown equipment.
- 5) Installation of data acquisition system (DAS).
- 6) Integration of data connection to data acquisition system assumed to be via an A12 provided LAN (local access network) port.
- 7) System commissioning
- C. Roofing and connections include:
 - 1) Pre-installation and post-installation roof deck inspection.
 - 2) Structural analysis of roof system to ensure it can accommodate the proposed system.
 - 3) Protective membrane slip sheets and mechanical attachments (as needed).
 - 4) Flash and seal all mechanical roof attachments and roof penetrations.
 - 5) Spudding is excluded from built-up roofs.
- D. Mounting structure shall comply with UL2703.
- E. Please see Solar PV Exclusions in the exclusions & clarifications section earlier in this schedule.

Project Site List:

Site	Address	PV Array Size (kW dc)	System Application
CPC - Elect Maintenance - BLDG 5	1271 W Bayaud Ave. Denver	69.7	PV on Existing Parking
Ci ci meet maintenance biblio s	1271 W Dayadd Ave, Denver	09.7	Canopy
Fire Station #2	5300 Memphis St, Denver	104.6	Flush Roof
Police Traffic Operations	3375 Park Ave, Denver	97.6	Flat Roof
Police Academy	8895 Montview Blvd., Denver	110.0	New Parking Canopy
Police District #2	3921 Holly Street, Denver	123.1	New Parking Canopy
Police District #3	1625 S University Blvd, Denver	- 160.8	New Parking Canopy
	Total	665.8 kW	



New PV on existing canopy - CPC Fleet Maintenance Bldg 5



Rooftop PV - Fire Station #2



Additional PV - Police Traffic Ops Complex Bldgs



New Parking Canopy with PV - Police Academy



New Parking Canopies with PV - PD#2 HQ



New Parking Canopies with PV - PD#3 HQ

GENERAL REQUIREMENTS

- Install and wire electrical components and interconnect the system in accordance with NEC, Owner and XCEL requirements.
- Complete site restoration and restore areas of disturbance to their original condition.
- Coordinate with XCEL to ensure installation compliance.
- MCKINSTRY will use NEC and implement NETA ATS testing standards for all voltages above 120VAC.
- MCKINSTRY is responsible for properly documenting the results of each Pre-Functional test.
- MCKINSTRY will review the proposed test procedure and final format Failure to properly complete and thoroughly document commissioning tests will prevent both substantial and final completion payments.
- MCKINSTRY will provide on-site commissioning support to adjust or corrections identified by commissioning agent.

DC INSTALL

Wire all modules per Issued for Construction (IFC) drawing set and applicable module installation manuals provided by module manufacturer.

DC wire management to comply with the following requirements.

- DC conductors to be properly routed to avoid sharp edges, rough surfaces, overly tight bending radii, moving parts of racking systems, direct exposure to sunlight, sagging wires, or mis-sized cable clips.
- DC conductors to be supported by stainless steel wire clips, UV-stabilized composite wire clips, UVstabilized wire ties or a cable tray. Nylon zip ties are NOT acceptable.
- DC wire management to comply with NEC 2020 Article 690.31(C)(1) regardless of the applicable AHJ code cycle. NEC 2020 Article 690.31(C)(1): Exposed cables to be supported and secured at intervals not to exceed 600mm (24 in.) by cable ties, straps, hangers or similar fittings listed and identified for securement and support in outdoor locations. PV wire or cable to be permitted in all locations where RHW-2 is permitted. Exception: PV Systems meeting the requirements of 691.4 to be permitted to have support and securement intervals as defined in the engineered design.

DC module connectors to match the connector specification of the PV module specified for the project(s). McKinstry to confirm which module connectors to use prior to procurement. DC bonding and grounding required by the local utility, AHJ adopted codes, and racking.

MLPE/RSD INSTALL

MCKINSTRY to install any Module Level Power Electronics (MLPEs) or Rapid Shutdown Units (RSDs) per Issued for Construction (IFC) drawing set and applicable manufacturer installation manuals.

AC INSTALL

- MCKINSTRY to provide all conductors and conduit required to interconnect the system in accordance with XCEL and NEC standards. Any material changes or deviations from the Issued For Construction (IFC) drawings will be approved by McKinstry prior to installation.
- MCKINSTRY to install Inverters with correctly sized inverter fuses and AC combiners.
- Wire all inverters per Issued for Construction (IFC) drawing set and inverter manufacturer installation manuals.
- All MPPTs to be properly balanced according to inverter manufacturer installation manuals.
- MCKINSTRY to provide the required meter housing(s) for project metering in accordance with local utility standards.
- MCKINSTRY to provide AC system disconnects as required by the local utility and AHJ adopted codes.
- MCKINSTRY to provide Arc Flash labels, equipment labels, and safety labels per NEC requirements. Arc Flash study details will be provided by design engineers.

BORING/TRENCHING (IF NEEDED)

- MCKINSTRY to complete trenching, directional boring, and required backfill to provide an electrically complete solar photovoltaic system, interconnected to the utility grid.
- Install AC trenching. Depth, width, depth flagging, and utility inspections to be installed/completed in accordance with XCEL standards.
- Install DC trenching. Depth, width, depth flagging, and utility inspections to be installed/completed in accordance with XCEL standards.
- Communication trenching depth, size, depth flagging, and inspections to be installed/completed in accordance with McKinstry and XCEL standards.
- MCKINSTRY to complete trenching and/or boring plan for approval prior to excavating ground.
- MCKINSTRY to repair/restore trenched areas as needed. McKinstry to restore disturbed areas to their original condition.
- Spare trenches to be installed in accordance with XCEL standards.
TRANSFORMERS (IF APPLICABLE)

- MCKINSTRY to provide any transformers required by the Issued for Construction (IFC) drawing set.
- Transformers and/or grounding transformers to be installed in accordance with XCEL standards and AHJ codes.
- MCKINSTRY to be responsible for the housekeeping pad structural engineering design if equipment is greater than 400lbs per IBC 1708.5. Other exemptions may apply.

DAS (DATA ACQUISITION SYSTEM)

- Installation of data acquisition system (DAS) including conduit, metering, CT's, data logger, communications cabling, and weather station components (pyranometers, back of panel temperature sensor, and ambient temperature sensors to be installed per manufacturer manuals)
- MCKINSTRY to install seal tight data acquisition system (DAS) conduit.
- Any splices made between RS485 data connections to use gel crimp wire connectors. RS485 cable should be Belden 3106A or similar. McKinstry to read and understand the following documents prior to mobilization.

MODULE INSTALL

- MCKINSTRY to install all modules per Issued for Construction (IFC) drawing set and applicable manufacturer installation manuals.
- MCKINSTRY is responsible for installation of solar modules and associated module installation hardware, including module bonding inherent within all module mounting hardware, as specified in Issued for Construction documents.
- MCKINSTRY is responsible for replacing solar modules broken during installation at their expense.
- MCKINSTRY is required to handle solar modules with extreme care, including, but not limited to: not sitting, walking or stepping on modules, not resting modules on helmet while transporting, unpacking and transporting modules per manufacturer requirements, and all other reasonable precautions.
- MCKINSTRY is responsible for daily spot inspections to array during installation to ensure modules are attached to racking system appropriately and securely, including any associated temporary installation requirements.

RACKING INSTALL

- MCKINSTRY to provide all racking material identified in the Material Scope Responsibility Matrix.
- MCKINSTRY to provide all miscellaneous mounting structure material not specifically shown in the

Material Scope Responsibility Matrix required to construct a code compliant, structurally erected solar mounting system, as specified in Issued for Construction documents.

- MCKINSTRY to install racking, ballast blocks, anchor hardware (mechanical attachments / standing seam clips), protective membrane slip sheets, and per Issued for Construction drawings.
- MCKINSTRY to install mounting structure row spacing and module tilt installed per Issued for Construction drawings.
- MCKINSTRY to approve of a roof deck warranty maintenance plan that adheres to the roof deck warranty maintenance requirements. Warranty maintenance requirements to be received from McKinstry's Construction Manager prior to commencement of any rooftop solar construction.
- MCKINSTRY to provide pre-installation and post-installation roof deck inspection by a certified roofing installer of the specific roof manufacturer installed on each applicable roof deck.
- MCKINSTRY to also provide, as required, protective membrane slip sheets and installation of approved mechanical attachments.
- MCKINSTRY will hire a certified roofing installer of the specific roof manufacturer installed on each applicable roof deck for the scope of flashing/sealing all mechanical roof attachments and roof penetrations. Installation must follow current roof warranty holder requirements.
- MCKINSTRY is responsible for handling and loading material on rooftops, as per structural engineering loading plan. Structural engineering loading plan will be provided by McKinstry.

Mounting structure will comply with UL2703 and be approved by McKinstry prior to installation.

CANOPY INSTALL

- MCKINSTRY to furnish and install all carport foundations, steel structure, columns, beams, racking and hardware as well as new under canopy lighting fixtures.
- MCKINSTRY will restore site asphalt to original condition

CLOSE OUT

MCKINSTRY will provide a "Close Out Package" that includes the following documents: (All documents to be provided in digital format).

- Pre-Functional commissioning test results.
- Equipment list of AC/DC equipment with installation date, warranty period, serial number and any manufacturer IOM manuals, including product data sheets.
- Issued for Construction (IFC) drawing redlines.

- String Wiring Diagram with the string # and inverter # listed for each string.
- DAS Communication cable routing diagram.
- Copies of passed inspection documents from the AHJ or utility, as applicable.
- MCKINSTRY will be responsible for repairing any issues documented on the Punchlist. Failure to properly complete and thoroughly document corrected Punchlist items will prevent final completion payment.

TRAINING

MCKINSTRY will provide a maximum of 4 hours of on-site training to key facility personnel. McKinstry targets this would be a one-time training (per CCD Facility Team) held at a single location (per Team) and shared with any facility personnel who can attend from their facility.

OPERATIONS & MAINTENANCE (O&M) SERVICES

O&M services are included in the project price for 1 (one) year from final completion of the individual PV systems. At that point, O&M activities must be continued so as to ensure reliable operation of the PV systems, either by CCD staff or a 3rd party.

Definitions:

The following defined terms are used throughout section.

- Corrective Maintenance (CM) Actions and/or techniques taken to correct failures, breakdowns, malfunctions, anomalies, or damages detected during inspections, or through monitoring or alarming. Corrective maintenance addresses unplanned equipment breakdowns by troubleshooting, repairing, or replacing defective equipment. It covers all activities by the O&M team to restore a PV system to its expected performance.
- Extraordinary Maintenance (EM) Any activity(s) or action(s) required in the case of major unpredictable events, such as Force Majeure or serial defects, that are considered outside the normal course of business.
- Predictive Maintenance (PdM) A condition-based maintenance strategy that analyzes and evaluates system degradation and potential faults and failures. This allows the operations and maintenance team to prioritize scheduled maintenance activities, optimize resources and increase system performance.
- **Preventative Maintenance (PM)** Scheduled inspection(s) and servicing of equipment to prevent breakdowns and unnecessary production losses. These take place annually according to a specific maintenance plan and schedule dependent on the equipment installed onsite. Preventative

Maintenance is the foundation of a complete solar O&M program.

• Warranty Management (WM) – The activity that manages all equipment under warranty at the time of service with the objective of reducing costs, coordinating repairs, and facilitating any required paperwork such as Return Merchandise Authorization (RMA) receipts.

Scope of Work*:

O&M STRATEGY	SERVICES	FREQUENCY	SCOPE INCLUSION?
Accot Management	Performance Monitoring & Reporting	Annual	No – 3 years in M&V Contract
Asset Management	OEM Warranty Support Claim	As Needed	Yes – 1 year
	Data Monitoring Subscription Renewal	Every 5 yrs	No
Operations	Daily Alert & Alarm Monitoring	-	Yes – 1 year
operations	Remote Diagnostics	As Needed	No
	Site Inspection (Annual)	Annual	Yes – 1 year
Preventative Maintenance (PM)	Performance Verification	Annual	No – 3 years in M&V Contract
	MV Transformer Service	Annual	[N/A]
	Minor Corrective Maintenance Issues	Annual	Yes – 1 year
Corrective Maintenance	Corrective Maintenance Response*	As Needed	Yes – 1 year
(CM)	Warranty Equipment Repair/Replacement	As Needed	Yes – 1 year
	Roof Inspection (Full Roof)	Every 5 yrs	No
Additional Services	Panel Cleaning	As Needed	No
	Vegetation Management	As Needed	No
	Pest Control	As Needed	No

* see exclusions below

Preventative Maintenance Standard Deliverables:

• Annually

- Site Inspection Report
- Performance Verification Results

• As Needed

• Corrective Maintenance Service Order Report

Clarifications & Assumptions:

- 1. The scope of work is based on regular working days within standard hours. Any hours billed outside this timeframe will be charged overtime.
- 2. The O&M Plan does not include Extraordinary Maintenance activities
- 3. The Corrective Maintenance scope of work outlined may at times require a contractor to perform the work. If this is required, McKinstry will manage and provide supervision of the work being performed.
- 4. Customer must provide uninterrupted access the DAS connections to McKinstry to complete this scope of work. For any LAN based DAS connections, the scope of work excludes truck rolls to reestablish connectivity. Any additional remobilizations will be billed at Time & Material rates.

Asset Management:

Performance Monitoring & Reporting (Excluded – Year 1-3 Included In M&V)

- Overall monitoring of the energy generation and weather data to verify system
 performance meets production expectations based on actual weather conditions. Normally these
 production expectations are outlined in the contract as a production or energy guarantee. This
 includes periodic reports to the asset owner verifying the system is performing as expected.
- In Energy Savings Performance Contracts (ESPCs), this specific scope of work item is normally covered under the Measurement & Verification (M&V) agreement.

OEM Warranty claim support (1 year)

• If equipment warranties are still intact at the time of service, McKinstry will assess equipment warranties, interface with original equipment manufacturers (OEM) and facilitate any paperwork involving warranty claims to facilitate the necessary repair.

Operations:

Daily Alert & Alarm Monitoring (1 Year)

- Remote supervision of the PV system's Data Acquisition System daily to ensure there are no active alerts and/or alarms that require immediate attention. If an alarm and/or alert requires immediate attention the customer will be notified. With customer approval a technician will be dispatched as part of the Corrective Maintenance strategy.
- 24hr automatic alarms will be set during the Commissioning phase to alert any system underperformance, equipment or communication failures.

Remote Diagnostics (Included Via Warranty Support Services)

 Remote diagnostics of any alerts and/or alarms using advanced communications and controls that may be impacting system performance. For example, our technicians can remotely upgrade inverter firmware, change inverter parameter settings, or reset the inverters in case a of fault – all without having to move from their desk.

Preventative Maintenance (PM)

Site Inspection (1 year)

- Visual verification of all system components and ensure system is installed per drawings and specifications.
- The visual inspection includes a review of the roofing conditions within the bounds of the solar installation.
- A sample set of all solar racking system points of contact with the roof will be inspected including the mechanical attachment seams and racking feet (including slip sheets if applicable). Sample set shall be 2-5% of all mechanical attachments and racking feet.
- Inspection will be performed annually, with an Inspection or PM report provided upon completion.
- Inspection report shall include any issues or recommendations that should be performed as part of a Corrective Maintenance service.

Performance Verification:

See Measurement & Verification Plan (Appendix B)

Medium Voltage (Mv) Transformer Service (Not Applicable)

Corrective Maintenance (CM):

Minor Corrective Maintenance Issues

• Minor corrective maintenance issues will be immediately attended to if the work can be completed within the allotted time for the scheduled site inspection. For example, if there is a dirty inverter filter the technician onsite will resolve this issue while onsite during the annual Site Inspection.

Corrective Maintenance Response

- Corrective Maintenance is included with exclusions listed below.
- McKinstry will dispatch a technician with customer approval to attend to any major alarms and/or alerts on an as needed basis. Following any dispatch, a service report will be provided to the customer.

- McKinstry will troubleshoot equipment onsite as needed to determine the root cause of the fault or failure.
- Services could include:
 - o DC and AC Current and/or Voltage Measurements
 - Thermal Imaging
- Deliverables include:
 - Service report summarizing the visit's results, any actions taken onsite, and any follow up actions required to return the system to its expected operation.
 - Service report will include any troubleshooting or testing results performed on the service dispatch.

Warranty Equipment Repair/Replacement:

After dispatching a technician to investigate and/or troubleshoot a fault or failure, specific equipment may be determined to require replacement. This can be site specific depending on system components. McKinstry will not replace any equipment without the consent and/or approval of the customer. This scope can include but is not limited to:

- Inverter component repair (i.e. the inverter fan) or full replacement
- Module replacement

Additional Services: n/a

Exclusions:

- Damage caused by lightning
- Damage caused by hail
- Damage caused by vandalism
- Full Roof Inspections
- Panel Cleaning
- Vegetation Management
- Pest Control
- Cell service (if needed) renewal
- Data monitoring subscription renewal

• Any labor associated with warranty replacements after 1 year from final completion of the individual PV systems

13.01 – PTO Air Sealing and Weather Stripping

1. General

- A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope and as indicated in the above supporting documents.
- B. Roof wall joint should be sprayed with two-part foam to prevent air loss. Exterior doors should be sealed to prevent air loss.
 - 1) Ext. doors to be weather sealed (7)
 - 2) Roof/wall joint to be sealed with 2 part foam (475 ft)
- C. Contractor shall move or find a way to work around any existing equipment installed on the wall inscope before beginning this work. This includes but is not limited to lighting, thermostats, fire alarms, etc. Any items that are temporarily moved shall be reinstalled in their original location.

13.01 – RAC Air Sealing and Weather Stripping

- 1. General
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope and as indicated in the above supporting documents.
 - B. Roof wall joint and side wall joint should be sprayed with two-part foam to prevent air loss. Exterior and interior doors should be sealed to prevent air loss.
 - 1) Ext. doors to be weather sealed (9)
 - 2) Int. doors to be weather sealed (18)
 - 3) Roof/wall joint to be sealed with two-part foam (60 ft). Measure and record area pre and post construction.
 - 4) Side wall joint to be sealed with two-part foam (35 ft)
 - C. Subcontractor shall move or find a way to work around any existing equipment installed on the wall in-scope before beginning this work. This includes but is not limited to lighting, thermostats, fire alarms, etc. Any items that are temporarily moved shall be reinstalled in their original location.

13.02 - PTO Ceiling and Wall Insulation

- 1. General
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope and as indicated in the above supporting documents.
 - B. Fur exposed parts of existing N, E, and W exterior walls in-scope with 4" metal studs, with R15 batt insulation, and 5/8" gypsum board to match the existing wall's energy performance
 - 1) Approximately 4,000 square feet (480' x 8.5') of wall to be furnished with new studs, insulation, and gypsum board. Refer to the attached reference drawings for the location of the wall.
 - 2) Installed wall shall match existing wall assembly insulation value. Contractor to verify. See reference drawings for wall assembly notes.
 - C. Contractor shall move or find a way to work around any existing equipment installed on the wall inscope before beginning this work. This includes but is not limited to lighting, thermostats, fire alarms, etc. Any items that are temporarily moved shall be reinstalled in their original location.
 - D. Paint new gypsum board to match the color of other interior walls in the facility.

13.04 – CMP Window Replacements

- 1. General
 - A. Contractor shall be responsible for equipment, materials, accessories, insulation, and other associated requirements called for in the following scope and as indicated in the above supporting documents.
 - B. Furnish and install new windows on west wall area as indicated in attached drawings.
 - 1) BOD: Pella Impervia Fiberglass
 - a) Commercial, double pane, fiberglass framed, single hung, low e, U-value min=0.38, SHGC=0.38
 - 2) Install per manufacturers installation recommendations and ensure to paint and patch surrounding interior and exterior walls/masonry as well as trim.
 - 3) Deinstall and reinstall any existing blinds
 - 4) Tinting to be determined upon site inspection and verified by customer
 - 5) Window Type Count
 - a) Building's third floor
 - (i) (28) Type A, (13) Type B, (2) Type C, (2) Type D
 - 6) Window dimensions to be verified upon site inspection prior to install.

20.01 – Rate Analysis

The following rate changes will reduce chilled water (CHW) costs to the City and County of Denver by reducing the contracted peak chilled water capacity (measured and billed in tons) values at the following sites. **CCD will be responsible for submitting the formal request to Xcel to make these changes.**

- Lindsey Flanigan Courthouse / Van Cise Detention Center: Request to lower contracted CHW capacity 10%, so from 2100 tons to 1890 tons. Note that recent maximum demands are around 1,000 tons so appear to have room to move contracted amount down.
- **2. Permit Bldg:** Request to lower contracted CHW capacity 10%, so from 150 tons to 135 tons. Note that recent maximum demands are around 80 tons so appear to have room to move contracted amount down.
- **3. CCB & PAB/PADF:** Request to lower contracted CHW capacity 10%, so from 400 tons to 360 tons for the City and County Bldg, and 350 to 315 for the Police Administration Bldg. Note that recent max demands are around 360 and 135 tons respectively so appear to have room to move contracted amount down.
- **4. 1245 Champa:** Request to lower contracted CHW capacity 10%, so from 165 tons to 149 tons. Note that recent max demands are around 100 tons so appear to have room to move contracted amount down.

22.01 - PowerED

CCD PowerED/ Controls Optimization/RCx is a systematic building efficiency and energy awareness program that helps clients achieve their environmental and fiscal goals with guaranteed results. It goes beyond typical energy services to engage the staff and users within your facilities, prompting them to take action to conserve resources.

McKinstry will provide powerED services for a 3-year program term (including an initial 90-day launch term) at 22 client facilities. powerED will commence after substantial construction completion, although with client approval can begin before substantial completion. The occupant engagement program or "People" module was removed from scope. Sites included in this FIM are:

• The Commons on Champa* *General Services turnover of Facilities Management for Commons on Champa to Arts and Venue occurred in September* 2023

- City and County Building
- Fleet Maintenance Building #5
- Gary Price Operations Building
- Denver Crime Lab
- Denver Municipal Animal Shelter
- Fire Station 2
- Fire Station #21
- Fire Station #22
- Fire Station #24
- Fire Station #26
- Lindsay-Flanigan Courthouse
- Police Administration Building PAB
- Police Traffic Operations Bureau
- Permit Building
- Denver Police Academy
- Police District #2
- Police District #3
- Rose Andom Center
- South Cherry Creek Transfer Station
- South Osage Fleet Maintenance Garage
- Van Cise-Simonet Detention Center

McKinstry is dedicated to providing the most value-driven, flexible, and innovative solution through powerED. Using a highly collaborative approach, we provide three key elements of focus: People, Process, and Performance. The resources and activities associated with each of the three powerED modules are described here as the scope of work for this FIM. Each of these elements will be introduced over a 3-year period at 22 client facilities. McKinstry proposes to perform the following tasks:

PROCESS MODULE

McKinstry will provide an on-site engineer to work with your building operations staff to investigate and report results for low- and no-cost energy savings opportunities. Our powerED engineer will take a serious look at your facilities and the potential for efficiency improvements. By gathering basic information about your systems, resources and utility use, we will estimate the range of potential for energy efficiency opportunities, cost savings, and operational benefits. Along the way, we will solicit your ideas and input on occupancy, systems, and scheduling to better understand the dynamics of your energy and resource use.

Included in the Process module is the monitoring and analysis of building automation data, which is used to monitor the ongoing performance of any controls modifications implemented as part of the ESPC project. The building analytics scope tracks KPIs that can be monitored and read through the building automation system points and provides automated alerts to McKinstry engineers if any KPIs that are out of range. As part of powerED, the McKinstry engineer will interpret the alerts (fault detection) and provide root cause analysis (diagnostics) and recommendations on any issues.

POWERED engineer

McKinstry's powerED engineer for the Process module will provide on-site technical expertise with a primary focus on identifying low- and no-cost opportunities to save energy, reduce water consumption, drive operational or maintenance savings, or otherwise improve the operations of facilities. Throughout this process, the engineer will engage your building operators and offer advice and education on various energy savings strategies. Their primary objectives are to:

- Collaborate with building operators; identify operator team deficiencies and provide ongoing training and support as needed
- Identify low- and no-cost savings opportunities to better improve the overall function and performance of CCD facilities
- Investigate opportunities and providing best practice recommendations
- Continually monitor energy use and resource conservation practices and provide feedback in timely intervals to the key stakeholders at CCD
- Assist in development and implementation of an energy policy or building guidelines
- Provide ongoing commissioning, building monitoring, and analysis of building systems to identify behavioral, operational, and maintenance strategies critical to energy savings
- Review building trends and operational analytics to identify areas for improvement
- Assist CCD in understanding and communicating ongoing performance data, results, and progress
- Deliver building automation monitoring and analytics, including interpreting automated alerts and provide root cause analysis and recommendations on any issues

KEY PROCESS Module INITIATIVES

Building Interviews

The operational process begins with identification of low- and no-cost operations and maintenance opportunities to develop a baseline of where your organization is culturally and operationally today. McKinstry's powerED engineer will conduct interviews with maintenance and operations staff and building occupants to assess existing conditions for each facility.

Site Assessments

McKinstry's powerED engineer will conduct a systems, operational, and occupancy assessment on each

facility during both occupied and unoccupied times. McKinstry will apply a systematic process of assessing each of your facilities to identify behavioral, operations, and maintenance strategies critical to energy savings. We will focus on investigating energy intensive systems, controls, and operational characteristics — identifying and documenting energy saving opportunities specific to each facility.

Best Practice Recommendations

McKinstry will provide ongoing facility recommendations that include an outline of existing conditions and recommendations for improvement. The powerED engineer will provide documentation of best practice recommendations for each facility, including site-specific strategies and recommended actions for implementation. Key stakeholders can rely on these recommendations as a foundation for developing action plans for energy savings measures.

Implementation Process Development

McKinstry will work with you to develop processes for incorporating site-specific recommendations. In some cases, these solutions will be small control changes or settings changes that can be done immediately. In more complex measures, it may require additional services for cost evaluation or engineering assistance. In all cases, an implementation approach will be identified for incorporation into your facility action plans.

Building Automation Monitoring & Analytics

McKinstry will utilize your existing building automation systems and implement a data interchange tool which allows the secure automated export of building automation system and metering data to McKinstry on an ongoing basis. Priority will be given for data-streaming and analytics analysis will be deployed where savings opportunity is most likely to be found. McKinstry will deploy system models and predictive analytics routines to provide automated ongoing analysis of building systems operation. The data analytic system will be modeled and programmed to proactively notify both McKinstry and applicable designated client staff when system operation does not match the implementation plan goals and standards. Specific tasks will include:

- Data set up and transfer to McKinstry cloud-based servers
- Necessary point mapping and tagging to specific client mechanical and electrical systems
- Development of engineering analytics that will allow for continuous monitoring of incoming data and identification of potential areas of opportunity
- Interpreting automated alerts and providing root cause analysis with recommendations to client
- Reviewing trends and operational analytics to identify areas of improvement

In addition to the high-level overview of the analytics, McKinstry's Reveal[™] dashboard provides the ability to dive into individual analytics for a selected time frame and perform analysis of the points involved in that analytic. This provides an additional ability to understand what is causing the faults and begin to develop

solutions to address the root cause of the issue. See Performance section below for more details.

Training

McKinstry will collaborate with your building operators and identify team deficiencies or training opportunities. McKinstry will provide training as appropriate to support energy-efficiency efforts within facilities. Training is considered on a case-by-case basis and could include educational lectures, hands-on training, functional testing, BAS training, etc. CCD will ensure availability and support for McKinstry trainings to staff.

Policy and Guidelines

McKinstry can assist in development of an energy policy and operations guideline at the direction of CCD. This policy provides guidelines for facility operation and maintenance, and adherence to it will result in significant energy savings throughout your facilities. This policy is designed to clarify expectations and provide direction for building use and desired occupant behavior. The policy is a written record of your mission, goals, procedures, and standards.

Building Improvements & Implementation of Recommendations

Throughout the implementation of powerED, McKinstry will identify ongoing operational opportunities to decrease energy consumption. The proposed operating criteria, deficiency resolutions, or other operational or maintenance recommendations will be provided to the CCD on an ongoing basis or at the minimum, quarterly. Maintenance repairs, setpoint changes, and alterations to systems will be performed by CCD with coordination and assistance from McKinstry. CCD is responsible for covering all associated costs for materials, equipment, labor, or third-party contractors. **Note that this project has a \$50,000 cost allowance included for implementing identified scope or upgrades (by McKinstry or others) outside of what is already included in the EPC scope.** Opportunities identified by McKinstry will focus on deficiencies (in the realm of standard equipment repair), not capital improvement measures. Systems must be operated per the proposed criteria to ensure energy cost savings are realized. CCD acknowledges their responsibility to ensure that these criteria are maintained, and associated energy savings are realized.

Key CCD Process Module Responsibilities

McKinstry's powerED engineer will facilitate the Process Module tasks and delivery for CCD. To ensure successful program delivery, CCD will support the implementation of this module by:

- Identifying and maintaining a single point of contact on the CCD facilities team to interface with the Process Module
- Reviewing, managing, and discussing recommendations provided by McKinstry on a regular basis
- Operating systems per the proposed criteria provided by McKinstry
- Implementing recommendations made by McKinstry, as feasible, including funding any

equipment, materials, labor, or external contractors required to implement recommendations

- Facilitating communication, training, and collaborative work time for McKinstry with other building staff (custodians, maintenance team, HVAC technician, facilities team, etc.) as needed
- Providing the McKinstry engineer with appropriate building access for site assessments, including after-hours access and remote access to the Building Automation System
- Implementing comprehensive building shutdowns over facility breaks and holidays, utilizing McKinstry guidelines and trainings
- Providing energy savings suggestions and insight into facility energy use
- Providing overall support, enthusiasm, and leadership for the program
- Ensuring ongoing implementation and maintenance of changes implemented
- Providing remote access to the building automation systems while the powerED service is in place
- Sharing building automation and utility data information with McKinstry while the powerED service is in place

PERFORMANCE MODULE

As the adage goes, "You can't manage what you don't measure." Our performance elements are fundamentally based on the ability to analyze, report, and proactively manage utility use and operational performance through McKinstry's Reveal[™] dashboard.

Reveal[™] is a cloud-based facility management technology for building performance optimization. Through an online portal that is unique to every client, this technology aggregates data from various building operation sources and provides powerful visualizations for facility managers, operators, and executives to drive critical decisions for performance. Specifically, Reveal[™] integrates utility bill, building meter, building automation system, building asset inventory, renewables, and weather data. It tracks facility performance using client-specific fault detection and diagnostics (FDD), KPIs and normalized baseline comparison. The result is a complete view of client facility optimization by facility operators, managers and all levels of an organization to inform operation, management decisions and the ability to effectively communicate strategy and results.

The following section highlights the various Reveal pages that will be deployed as part of the powerED program and the process to acquire and maintain the data displayed. Quarterly or as-requested performance reports and meetings will review highlights and updates by activity and overall program performance as well as the plan for the upcoming quarter.

OVERVIEW

The Reveal[™] Overview section includes a map of facilities with key metrics and summary information that provides a snapshot of overall facility performance to quickly start prioritizing efforts. Overview section features include the following:

- Access is configurable on a per user basis allowing information, end user access, and other details to be same or different for all users
- Fully adjustable time range for analysis user can select days, weeks, months years or custom range for analysis
- Adjustable by facility type and individual facilities
- Side bar includes highlights by individual facility for easy navigation and display on facility digital boards
- Chart view displays metric selected for facilities selected over time period selected
- A drop-down menu that filters data metrics displayed including:
 - Energy use index (EUI)
 - Energy cost index (ECI)
 - Savings (cost avoidance)
 - ENERGY STAR score
 - Percent savings (electric, gas, water, energy)
 - \circ Carbon reduction
 - Aggregated fault hours by facility
 - Other custom metrics: savings/sq ft, electricity/sq ft, gas/sq ft, kBtu/occupant

UTILITIES

Your utility bill is the starting point for measuring utility use in your facilities and quantifying the effectiveness of your facility and energy management programs. In order to deploy the **Reveal™ Utilities**, McKinstry tracks your utilities through utility bill data collection and bill entry including consumption and associated charges. The following services will be provided by McKinstry:

- 1. Account Set-Up and Data Entry: McKinstry will create a customized utility tracking process to collect your facility, account, and meter information. McKinstry will also enter historical utility data as needed.
- 2. **Ongoing Data Collection:** McKinstry will setup a feed of current utility data to update the data as it becomes available. Your organization will provide the appropriate permissions to allow McKinstry to coordinate with your utilities directly thus ensuring minimal effort is required.
- 3. **Bill Data Error Checking:** McKinstry will review all collected bill data and will flag any unusual data points for review with you to ensure that billing errors are identified and notify the utility of any suspected errors.

- 4. **Interval Data Collection:** If made available through your utilities or separate meters, interval data will be imported and stored in our data base to enable the visualization of more granular time frames down to 15-minute intervals where available.
- 5. **Data Visualization:** The data will be displayed on **Reveal™ Utilities** and includes the following:
 - Fully adjustable time range for analysis user can select days, weeks, months years or custom range for analysis
 - Adjustable by facility type and individual facilities
 - Data for any chart can be downloaded directly from the section in .CSV format
 - Cost information by utility type
 - \circ Total monthly cost by utility type
 - Monthly sub-source costs by utility type (i.e. domestic water, irrigation water, sewer, stormwater)
 - \circ Site cost comparisons for given time range
 - \circ Summary of costs by utility type for given time range
 - Consumption by utility units
 - \circ Total monthly consumption by utility type
 - \circ Year-over-year consumption comparison by utility type
 - \circ Site consumption comparison by utility type
 - \circ Interval data for each utility (where data is available)
- 6. McKinstry will collect and visualize data for the following utilities:

RENEWABLES

The **Reveal™ Renewables** section includes solar PV data tracking for all sites. McKinstry will acquire solar data from your utility, through submeters, or directly exported through technology on your systems for direct upload to Reveal™.

Reveal™ Renewables displays the following:

- Average daily solar production of one site or aggregated across multiple sites
- Real-time and historical production based on sites selected over time period selected
- Actual versus predicted production calculated using system capacity, expected performance, and weather
- Breakdown of facility site energy source grid energy consumption versus renewable energy consumption
- Calculated equivalencies to measure impact of renewable energy production

INSIGHTS

Savings

Savings reporting is a great way to demonstrate and communicate progress on energy and facility management efforts. Utilities savings are tracked through comparison to an adjusted baseline on the **Reveal™ Savings** subsection. McKinstry will establish a base year including utility usage and costs for a 12-month period. We will review data and validate it for accuracy, and corresponding weather data will be applied. We will work with you to identify significant impacts in utility consumption during the base year for the purpose of calculating adjustments for load changes, including implementation of the other applicable scopes of work, addition of equipment, or changes in occupancy or operating practices.

Information displayed on **Reveal™ Savings** includes:

- Actual values compared to baseline (utilities usage and cost avoidance)
- Savings trend over time for sites and time period selected
- Savings by site comparison

Analytics

Fault Detection & Diagnostics

Often, fault detection through a building automation system can be overwhelming and provide little value if the data isn't prioritized based on current building optimization needs. McKinstry will utilize your existing building automation systems and implement a data interchange tool which allows the secure automated export of building automation system and metering data to McKinstry on an ongoing basis. Priority will be given for

data-streaming and analytics analysis to be deployed where savings opportunity is most likely to be found. McKinstry will deploy system models and predictive analytics routines to provide automated ongoing analysis of building systems operation. The data analytic system will be modeled and programmed to proactively notify both McKinstry and applicable designated client staff when system operation does not match the implementation plan goals and standards. Specific tasks will include:

- 1. Data set up and transfer to McKinstry cloud-based servers.
- 2. Necessary data mapping to specific client mechanical and electrical systems.
- 3. Development of engineering analytics that will allow for continuous monitoring of incoming data and identification of potential areas of opportunity.

In addition to the high-level overview of the analytics, the dashboard provides the ability to dive into individual analytics for a selected time frame and perform analysis of the points involved in that analytic. This gives the user an additional ability to understand what is causing the faults and begin to develop solutions to address the root cause of the issue.

Analytics results displayed on **Reveal™ Analytics** includes the following:

- Total fault hours (defined as the number of hours a system is in fault) based on the current building, equipment, fault category, and time period selected
- Summary results including sum of fault hours out of total possible
- Fault hours by frequency and type
- Easy to understand on-screen graphic of all faults for tracked systems.

Opportunities

The **Reveal™ Opportunities** section provides the ability to easily view the current status of issues/opportunities for improvement, details associated with each issue, estimated savings, and the root cause. The opportunities section is a great way to review and collaborate on current facility, operations, and energy management opportunities.

Reveal[™] Opportunities displays the following information:

• Root cause summary of all opportunities

- Estimated net savings associated with implementing all identified opportunities
- Percent of opportunities implemented
- Issue score calculated from savings impact and feasibility
- Opportunities list that can be filtered and sorted by facility, opportunity type, date created, issue score and priority

KEY PERFORMANCE INDICATORS (KPIs)

The **Reveal™ KPIs** section tracks performance in key areas by comparing actual values to an ideal range or target. KPIs can be developed on any data point and target ranges can be static or based on variables such as outdoor air temperature. **Reveal™ KPIs** allows users to quickly identify which KPIs are performing well and which may need attention across multiple systems and facilities.

Key CCD Performance Module Responsibilities

McKinstry's powerED performance support team will provide measurement and verification of energy savings and cost avoidance. To ensure successful program delivery, CCD will support the implementation of this module by:

- Identifying and maintaining a single point of contact to review performance data and communicate important information to other stakeholders, including the facilities team
- Facilitating the initial utility bill and BAS data-flow set-up and ongoing access
- Setting up additional trends and archiving on points in the BAS necessary for the analytics
- Allowing McKinstry to modify BAS server to export BAS trend data to a secure external FTP site
- Maintaining data feeds and assist with data collection issues where applicable
- Assisting with Reveal[™] access to relevant stakeholders/users (up to 15 users)
- Reviewing Performance data and results via Reveal[™] on a monthly basis
- Assisting McKinstry in investigating any data anomalies or alerts
- Providing overall support, enthusiasm, and leadership for the program

powerED Guarantee Overview and Accounting

McKinstry is guaranteeing savings associated with reduced energy and operational savings opportunities identified through the powerED program.

Measure: "Measure" refers to any savings opportunity identified through the powerED program by McKinstry. A measure could consist of improved operational practices, system alterations, deficiency resolutions, maintenance savings, etc.

Baseline: "Baseline" refers to the existing operating characteristics that were used to calculate cost savings. In general, all parties acknowledge the baseline associated with any specific measure has been derived from the following sources:

- 1. Actual operating information gathered through field observation, measurement, data loggers, automation system trends, and interviews with CCD personnel.
- 2. CCD provided information concerning stipulated factors such as operational expenditures.
- 3. In some instances, a modified baseline may have been developed to address areas whereby preretrofit conditions do not reflect a system that is operating per current code or what CCD may deem as normal operation.

Proposed: Throughout the implementation of powerED, McKinstry will identify measures to decrease energy consumption or otherwise reduce operating costs. The proposed operational standards, deficiency resolutions, or other operational or maintenance recommendations will be provided to CCD on an ongoing basis or at the minimum, quarterly. McKinstry will work with CCD to determine building operational changes that will improve the efficiency of the building. Maintenance repairs, setpoint changes, and alterations to systems will be performed by CCD with some coordination and assistance from McKinstry. Systems must be operated per the proposed criteria to ensure energy cost savings are realized. CCD acknowledges their responsibility to ensure that these criteria are maintained, and associated energy savings are realized. Energy Savings Guarantees are further predicated on CCD maintaining their responsibilities as provided in the powerED Scope of Work.

Accounting

All operational, maintenance, and energy costs avoided by CCD from any steps taken by McKinstry in the facilities will be included in the Verified Savings for each year. If, during the powerED implementation period, additional measures are identified and implemented that generate additional energy, maintenance, and operational savings, these savings may be included in the Verified Savings after the Performance Commencement Date.

If McKinstry identifies a measure that reduces operational cost with minimal initial implementation cost or minimal operational impact to CCD, and CCD declines to implement the measure without reasonable cause within (60) days of notification, then the operational cost reduction associated with the measure will be stipulated and added to the Verified Savings on an annual basis. McKinstry acknowledges there may be instances where CCD and McKinstry agree to evaluate a measure and find that it creates unforeseen issues or does not produce the intended results. In such cases and upon mutual agreement between CCD and McKinstry, the measure may be reversed and would not be counted towards Verified Savings.

As an example, McKinstry may identify an opportunity to shut off an RTU supply fan during a break when the space is unoccupied. An example of a "reasonable" cause to decline to implement this measure would

be that the classroom served by the RTU is actually utilized during the break for an educational program. An example of an "unreasonable" cause would be CCD declining to change the HVAC schedule to accommodate just the possibility of an occupant using the space at some point over the break.

McKinstry will calculate the savings impact of recommendations made to CCD. All operational, maintenance, water costs, and energy costs avoided by CCD from any steps taken by McKinstry in the facilities will be included in the Verified Savings for each year. For measures with savings estimated equal to or greater than (See Appendix B), actual kW and kWh rates will be used to calculate savings and a measure-specific Measurement and Verification (M&V) plan will be created and executed. For measures with savings estimated at less than (See Appendix B), a blended rate will be used to calculate savings from the baseline to the proposed state using a one-time basic savings calculation (refer to rates listed in Appendix B); no M&V will be performed. Measures that are based primarily on demand savings, regardless of their estimated dollar savings, will use actual kW and kWh rates to calculate savings. Rate escalation will be applied. The threshold has been established to provide the most valuable and cost-effective M&V, with the understanding that a lower threshold adds increased cost for additional M&V activities while not necessarily providing additional value.

CCD understands that the Performance module dashboard will not serve as an M&V tool for guarantee accounting. The Performance module dashboard typically has a different baseline and start date than the M&V analysis and does not account for other savings related to operations and maintenance or demand savings. The dashboard shall be used only to provide a high-level understanding of building performance over time.

Notifications

McKinstry shall notify CCD as soon as possible of any deficiencies found during the course of trend logging and/or site visits. McKinstry shall review new and ongoing recommendations with CCD quarterly.

CCD will notify McKinstry in writing within thirty (30) calendar days of:

- a. Any measures provided to CCD but not implemented, with the CCD justification of cause for declining to implement
- b. Any material changes to energy consuming or regulating equipment, operating schedules, business/services conducted, occupancy, or hours of operation
- c. Any malfunctions, failures and related changes in energy consuming or regulating equipment
- d. Any damage to, destruction of, or condemnation of the Work
- e. Executed preventive maintenance and repair records

ESCO guarantees that the Project shall result in Guaranteed Annual Cost Savings to the City, as indicated, for each year of the Guarantee Period, as presented in the following **Table C1**.

Year	Annual Utility Cost Savings*	Annual O&M Cost Savings***	Annual Solar PV Cost Savings	Annual Solar Performance Incentive Savings	Annual Total Cost Savings
1	\$618,577**	\$0	\$67,846 -	\$39,684 -	\$726,107
2	\$726,866 -	\$0	\$69,127	\$39,486	\$835,479
3	\$746,400 -	\$0	\$70,432	\$39,288	\$856,120
1	\$567,804	\$ <mark>0</mark>	\$65 <mark>,094</mark>	\$34 <mark>,275</mark>	\$667,173
2	\$674 <mark>,866</mark>	\$ <mark>0</mark>	\$66 <mark>,323</mark>	\$34,104	\$775,293
3	\$693,143	\$ <mark>0</mark>	\$67,575	\$33,933	\$794,651

Table C1-1: Guaranteed Annual Cost Savings based on 2023 Utility Rates

* Electric (non PV), natural gas, district chilled water, district steam

**note that yr 1 guarantee utility savings are reduced due to Active Energy Management savings coming online over the course of the first performance year (as shown in the cash flow)

*** declined per the request of CCD – savings will accrue to individual CCD Facility teams

Table C2-1: Baseline Rates and Annual Escalation Rates:

Provider	Rate	Service	Service Type	Unit	\$/unit
Xcel	Xcel Secondary General (SG)	Electricity Demand	Summer	kW	\$ 23.19
Xcel	Xcel Secondary General (SG)	Electricity Demand	Winter	kW	\$ 18.68
Xcel	Xcel Secondary General (SG)	Electricity	Summer	kWh	\$ 0.03586
Xcel	Xcel Secondary General (SG)	Electricity	Winter	kWh	\$ 0.03803
Xcel	Xcel SPV-TOU Section B	Electricity Demand	Summer	kW	\$ 12.75
Xcel	Xcel SPV-TOU Section B	Electricity Demand	Winter	kW	\$ 10.82
Xcel	Xcel SPV-TOU Section B	Electricity	On Peak kWh	kWh	\$ 0.15411
Xcel	Xcel SPV-TOU Section B	Electricity	Off Peak kWh	kWh	\$ 0.05057
Xcel	Xcel Small Commercial (CSG)	Gas	Summer	therm	\$ 0.40867
Xcel	Xcel Small Commercial (CSG)	Gas	Winter	therm	\$ 0.42006
Xcel	Xcel Large Commercial (CLG)	Gas Capacity	Summer	therm	\$ 0.88662
Xcel	Xcel Large Commercial (CLG)	Gas	Summer	therm	\$ 0.30509
Xcel	Xcel Large Commercial (CLG)	Gas Capacity	Winter	therm	\$ 0.88213
Xcel	Xcel Large Commercial (CLG)	Gas	Winter	therm	\$ 0.31254
Xcel	nTherm Transport Gas Large	Gas	Transport	therm	\$ 0.28797
Xcel	nTherm Transport Gas Small	Gas	Transport	therm	\$ 0.38825
Xcel	Xcel Schedule H Steam Demand	Steam Demand	Demand	Mlb	\$ 84.72
Xcel	Xcel Schedule H Steam Consumption	Steam Consumption	Steam	Mlb	\$ 17.29
Xcel	Xcel CHW Consumption (CMP)*	Chilled Water Consumption	Chilled Water	ton/hr	\$ 0.1421
Xcel	Xcel CHW Contracted Demand (CMP)*	Chilled Water Demand	Chilled Water	ton	\$ 7.0020
Xcel	Xcel CHW Consumption (CCB, LFC, PAB, VDC)*	Chilled Water Consumption	Chilled Water	ton/hr	\$ 0.1423
Xcel	Xcel CHW Contracted Demand (CCB, LFC, PAB, VDC)*	Chilled Water Demand	Chilled Water	ton	\$ 7.0030
Xcel	Xcel CHW Consumption (PMB)*	Chilled Water Consumption	Chilled Water	ton/hr	\$ 0.1440
Xcel	Xcel CHW Contracted Demand (DCL, PMB)*	Chilled Water Demand	Chilled Water	ton	\$ 7.6300
Xcel	Xcel CHW Consumption (DCL)*	Chilled Water Consumption	Chilled Water	ton/hr	\$ 0.12590

Escalation rates utilized for this project are as follows:

- **Electricity** an electricity annual escalation of 2.4% was used.
- Natural gas a natural gas annual escalation of 4.5% was used.
- Chilled Water a district chilled water annual escalation of 2.4% was used.
- Steam a district steam annual escalation of 4.5% was used.
- Water & Sewer a water and sewer annual escalation rate of n/a was used (no water conservation scope).
- Maintenance a maintenance cost savings escalation rate of n/a was used (no savings claimed).
- Solar PV annual O&M service cost an annual PV O&M escalation rate of 2.0 % was used.
- Solar PV annual power output degradation an annual PV system power output degradation rate of 0.5% was used.

Table C3-1: Utility Rates by Buildings:

Utility Rate Schedule Summary														
			Baseline Electric	Rate Schedules	Proposed Electric F Solar PV	Proposed Electric Rate Schedules (for Solar PV scope) * Gas Rate Schedules					Steam Rat	e Schedule	CHW Rate	Schedule
Facility		Team	Xcel Secondary General (SG) Demand Rate	Xcel Secondary General (SG) Electricity Rate	Xcel SPV-TOU Section B Demand Rate	Xcel SPV-TOU Section B Electricity Rate	Xcel Small Commercial (CSG) Gate Rate	Xcel Large Commercial (CLG) Gas Rate	nTherm Transport Gas Large Rate	nTherm Transport Gas Small Rate	Xcel Schedule H Steam Demand Rate	Xcel Schedule H Steam Consumption Rate	Xcel CHW Consumption Rate	Xcel CHW Contracted Demand Rate
The Commons on Champa	СМР	E	x	x	-	-	x	-	-	-	x	x	x	x
City and County Building	ССВ	А	x	x	-	-	-	-	-	-	x	x	x	x
CPC - Fleet Maint - Bldg 5	FM5	CPC	x	x	x	x	-	-	x	-	-	-	-	-
CPC - Gary Price Ops - Bldg 2	GPO	CPC	x	x	-	-	-	-	-	x	-	-	-	-
Denver Crime Lab	DCL	D	x	x	-	-	-	-	-	-	x	x	x	x
Denver Municipal Animal Shelter	DAS	А	x	x	-	-	-	x	-	-	-	-	-	-
Fire Station #2	FS2	FS	x	x	x	x	x	-	-	-	-	-	-	-
Fire Station #21	FS21	FS	x	x	-	-	x	-	-	-	-	-	-	-
Fire Station #22	FS22	FS	x	x	-	-	x	-	-	-	-	-	-	-
Fire Station #24	FS24	FS	x	x	-	-	x	-	-	-	-	-	-	-
Fire Station #26	FS26	FS	х	x	-	-	x	-	-	-	-	-	-	-
Lindsey-Flanigan Courthouse	LFC	D	х	x	-	-	-	-	-	-	x	x	х	х
Police Admin Building	PAB	А	х	x	-	-	-	-	-	-	x	x	х	х
Police Traffic Operations Bureau	РТО	С	х	x	x	х	-	-	-	x	-		-	-
Permit Building	PMB	E	х	x	-	-	-	-	-	-	x	x	х	х
Police Academy	POA	С	х	x	x	х	x	-	-	-	-	-	-	-
Police District #2	PD2	С	х	x	x	х	x	-	-	-	-	-	-	-
Police District #3	PD3	В	х	x	x	х	x	-	-	-	-	-	-	-
Rose Andom Center	RAC	D	x	x	-	-	х	-	-	-	-	-	-	-
S. Cherry Creek Transfer Station	CTS	С	x	x	-	-	х	-	-	-	-	-	-	-
S. Osage Fleet Maint - Garage	OFM	В	x	x	-	-	х	-	-	-	-	-	-	-
Van Cise-Simonet Detention Ctr	VDC	D	x	x	-	-	x	-	-	-	x	x	x	x

Table C4: Proposed Unit Savings and Guaranteed Annual Cost Savings for Project (Year 2021 Utility Rates) by ECM

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity [kW]	Gas [Therms]	Steam [Mlbs]	Purchased Chilled Water [MMBTU]	Electricity [\$]	Electric Demand [\$]	Xcel REC Payments [\$]	Gas [\$]	Steam [\$]	Purchased Chilled Water [\$]	Annual Savings [\$]
22.01 - CCD Controls Optimization/RCx (FIRST YR VALUES)	CCD All	Controls optimization, utility dashboard and tracking, on-going RCx	1,366,231	0	16,279	1,134	1,279	\$50,387	\$0	\$0	\$4,910	\$18,839	\$15,167	\$89,302
22.01 - CCD Controls Optimization/RCx (2 nd + YR VALUES)	CCD All	Controls optimization, utility dashboard and tracking, on-going RCx	2,732,462	0	32,557	2,267	2,558	\$100,773	\$0	\$0	\$9,819	\$37,678	\$30,334	\$178,604
CCD Controls Optimization/RCx	CCD All		2,732,462	0	32,557	2,267	2,558	\$100,773	\$0	\$0	\$9,819	\$37,678	\$30,334	\$89,302/\$178,604
01.06-CCB Steam Condensate Heat Recovery	City and County Building	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	-3,032	0	0	323.1	0	(\$115)	\$0	\$0	\$0	\$5,370	\$0	\$5,255
01.06-PAB Steam Condensate Heat Recovery	Police Administration Building PAB	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	-3,032	0	0	310.5	0	(\$115)	\$0	\$0	\$0	\$5,161	\$0	\$5,045
02.01-CCB Chilled Water Pump Replacement	City and County Building	Replace existing chilled water pumps and VFDs. This will save electrical energy and reduce maintenance requirements.	43,014	60	0	0	0	\$1,604	\$1,216	\$0	\$0	\$0	\$0	\$2,820
03.07-PAB MZU to VAV Unit	Police Administration Building PAB	Convert existing multizone unit (MZU) to a variable air volume (VAV) unit to allow for better temperature control and energy savings.	16,548	23	0	401	498	\$617	\$466	\$0	\$0	\$6,665	\$5,905	\$13,653
04.01-CCB BAS Controls Upgrade/ Replacement	City and County Building	Upgrade outdated Siemens APOGEE controls to a BACnet compatible system and install new BACnet compatible controls on remaining standalone air handling units. Integrate new controls with the existing Building Automation System.	290,003	0	0	156.6	1,739	\$10,982	\$0	\$0	\$0	\$2,603	\$20,619	\$34,204
04.01-PAB BAS Controls Upgrade/ Replacement	Police Administration Building PAB	Upgrade the existing standalone pneumatic controls and convert to electronic signals through the addition of E-P transducers. Integrate new E-P controls with the existing BAS.	267,399	223.2	0	192.6	956	\$10,005	\$4,169	\$0	\$0	\$3,201	\$11,334	\$28,710
04.02-PAB Occupancy Based HVAC Control	Police Administration- Building PAB	Install occupancy temperature sensors and interlock- with fan coil unit control to setback temperatures- during unoccupied periods.	3,332	θ	θ	470.7	66	\$ 125-	\$0 -	\$0 -	\$0 -	\$7,823-	\$779 -	\$8,727
04.02-PAB Occupancy Based HVAC Control	Police Administration Building PAB	Install occupancy temperature sensors and interlock with fan coil unit control to setback temperatures during unoccupied periods.	2,945	0	0	360	63.9	\$111	\$0	\$0	\$0	\$5,983	\$753	\$6,847
09.01-CCB Interior LED Lighting Upgrades	City and County Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	372,059	1,161	0	-57.12	123	\$13,880	\$23,439	\$0	\$0	(\$949)	\$1,464	\$37,834
09.01-PAB Interior LED Lighting Upgrades	Police Administration Building PAB	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	392,225	741.86	0	-60.18	130	\$14,633	\$14,972	\$0	\$0	(\$1,000)	\$1,546	\$30,150
09.02-CCB Exterior LED Lighting Upgrades*	City and County Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.02-PAB Exterior LED Lighting Upgrades	Police Administration Building PAB	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	80,068	105.84	0	0	0	\$3,045	\$1,977	\$0	\$0	\$0	\$0	\$5,022

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity	Gas	Steam	Purchased Chilled Water	Electricity [\$]	Electric Demand	Xcel REC Payments	Gas	Steam	Purchased Chilled Water	Annual Savings [\$]
				[kW]	[Therms]	[Mlbs]	[MMBTU]		[\$]	[\$]	[\$]	[\$]	[\$]	
20.01-CCB Rate Analysis	City and County Building	Investigate the district chilled water utility agreements and negotiate better rates.	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$3,360	\$3,362
20.01-PAB Rate Analysis	Police Administration Building PAB	Investigate the district chilled water utility agreements and negotiate better rates.	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$2,940	\$2,941
Team A Total	City and County Building, Police Administration Building PAB	-	1,458,584	2,315	θ	1,737	3,512	\$54,661	\$4 6,238 -	\$0 -	\$0 -	\$28,872 -	\$47,951	\$ 177,722 -
Team A Total	City and County Building, Police Administration Building PAB		1,458,197	2,315	о	1,627	3,510	\$54,647	\$46,239	\$0	<i>\$0</i>	\$27,034	\$47,921	\$175,841
03.13-PD3 Upgrade Air Cooled Chiller	Police District #3	Replace air cooled chiller with a high efficiency air cooled chiller, this will replace ASHRAE end of life equipment	25,568	141	0	0	0	\$2,296	\$1,711	\$0	\$0	\$0	\$0	\$4,007
08.05-PD3 Add VFDs to Building Pumps	Police District #3	Add variable frequency drives (VFDs) with motor replacements to pumps.	349	0	0	0	0	\$28	\$0	\$0	\$0	\$0	\$0	\$28
09.01-DAS Interior LED Lighting Upgrades	Denver Municipal Animal Shelter	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	37,427	139	-106	0	0	\$1,393	\$2,807	\$0	(\$32)	\$0	\$0	\$4,168
09.01-OFM Interior LED Lighting Upgrades	South Osage Fleet Maintenance Garage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	55,534	80	-179	0	0	\$2,072	\$1,620	\$0	(\$78)	\$0	\$0	\$3,615
09.01-PD3 Interior LED Lighting Upgrades	Police District #3	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	88,617	180	-271	0	0	\$5,804	\$2,066	\$0	(\$118)	\$0	\$0	\$7,753
09.02-DAS Exterior LED Lighting Upgrades	Denver Municipal Animal Shelter	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	2,292	0	0	0	0	\$87	\$0	\$0	\$0	\$0	\$0	\$87
09.02-OFM Exterior LED Lighting Upgrades	South Osage Fleet Maintenance Garage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	14,959	0	0	0	0	\$569	\$0	\$0	\$0	\$0	\$0	\$569
09.02-PD3 Exterior LED Lighting Upgrades*	Police District #3	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
10.01-PD3 Solar Photovoltaic- Roof	Police District #3	Surface parking lot canopy solar system	249,338	θ	θ	θ	θ	\$12,305 -	\$0 -	\$9,350 -	\$0 -	\$0-	\$0 -	\$21,655 -
10.01-PD3 Solar Photovoltaic- Roof	Police District #3	Surface parking lot canopy solar system	218,990	0	0	0	0	\$14,548	\$0	<i>\$8,212</i>	\$0	<i>\$0</i>	\$0	\$22,760
Team B Total	Denver Municipal Animal Shelter, South Osage Fleet Maintenance Garage, Police District #3	-	474 ,083	54 1	- 556	θ	θ	\$24,555-	\$ 8,205 -	\$9,350 -	(\$228)	\$0 -	\$0 -	\$4 1,882 -
Team B Total	Denver Municipal Animal Shelter, South Osage Fleet Maintenance Garage, Police District #3		443,736	541	-556	0	о	\$26,797	\$8,205	\$8,212	(\$228)	\$ 0	\$0	\$42,986
03.04-POA VVT to VAV Unit Replacement	Denver Police Academy	Current roof top unit is VVT, refurbish existing VVT damper controls to allow better occupant control and comfort. Add zone-based occupancy sensor control.	4,683	45	332	0	0	\$479	\$539	\$0	\$144	\$0	\$0	\$1,163
03.13-PD1 Upgrade Air Cooled Chiller	Police District 1	Replace roof top air cooled chiller with a new chiller that has a better turndown. Existing chiller on roof is reaching end of life and should be replaced soon	37,205	189	0	0	0	\$1,345	\$4,027	\$0	\$0	\$0	\$0	\$5,372
04.01-POA BAS Controls Upgrade/ Replacement	Denver Police Academy	Upgrade/ replace existing BAS controls on HVAC systems. Upgrade to modern controls and best-in-class control sequence	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
04.02-PTO Occupancy Based HVAC Control	Police Traffic Operations Bureau	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	7,967	0	549.9	0	0	\$489	\$0	\$0	\$213	\$0	\$0	\$702

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity	Gas	Steam	Purchased Chilled Water	Electricity [\$]	Electric Demand	Xcel REC Payments	Gas	Steam	Purchased Chilled Water	Annual Savings [\$]
		Add upriable frequency drives (VEDs) with motor		[kW]	[Therms]	[Mlbs]	[MMBTU]		[\$]	[\$]	[\$]	[\$]	[\$]	
08.05-PD1 Add VFDs to Building Pumps	Police District 1	replacements to pumps.	923	0	0	0	0	\$33	\$0	\$0	\$0	\$0	\$0	\$33
09.01-CTS Interior LED Lighting Upgrades	South Cherry Creek Transfer Station	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	47,813	100.94	-154.02	0	0	\$1,784	\$2,036	\$0	(\$67)	\$0	\$0	\$3,753
09.01-PD2 Interior LED Lighting Upgrades	Police District 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	81,013	162.68	-257.04	0	0	\$5,306	\$1,864	\$0	(\$112)	\$0	\$0	\$7,059
09.01-POA Interior LED Lighting Upgrades	Denver Police Academy	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	69,422	117.6	-218.28	0	0	\$4,904	\$1,348	\$0	(\$95)	\$0	\$0	\$6,157
09.01-PPS Interior LED Lighting Upgrades**	Police Property Storage	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.01-PRC Interior LED Lighting Upgrades**	Parks and Rec Center	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.01-PTF Interior LED Lighting Upgrades**	Police Training Facility/ Shooting Range	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.01-PTO Interior LED Lighting Upgrades**	Police Traffic Operations Bureau	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	137,149	258.72	-526.32	0	0	\$9,145	\$2,966	\$0	(\$204)	\$0	\$0	\$11,906
09.02-CTS Exterior LED Lighting Upgrades	South Cherry Creek Transfer Station	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	8,402	0	0	0	0	\$320	\$0	\$0	\$0	\$0	\$0	\$320
09.02-PD2 Exterior LED Lighting Upgrades	Police District 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	25,415	0	0	0	0	\$1,285	\$0	\$0	\$0	\$0	\$0	\$1,285
09.02-POA Exterior LED Lighting Upgrades	Denver Police Academy	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	9,508	0	0	0	0	\$481	\$0	\$0	\$0	\$0	\$0	\$481
09.02-PPS Exterior LED Lighting Upgrades**	Police Property Storage	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.02-PRC Exterior LED Lighting Upgrades**	Parks and Rec Center	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.02-PTF Exterior LED Lighting Upgrades**	Police Training Facility/ Shooting Range	Replace existing non-LED lamps/fixtures with new LED Lamps/fixtures	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
09.02-PTO Exterior LED Lighting Upgrades**	Police Traffic Operations Bureau	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	37,322	0	0	0	0	\$1,887	\$0	\$0	\$0	\$0	\$0	\$1,887
10.02 - POA Solar Photovoltaic - Canopy	Denver Police Academy	Surface parking lot canopy solar system	161,131	0	0	0	0	\$13,191	\$0	\$6,042	\$0	\$0	\$0	\$19,233
10.01-PTO Solar Photovoltaic- Roof	Police Traffic Operations Bureau	Roof mounted solar PV system	136,799	0	0	0	0	\$8,892	\$0	\$5,130	\$0	\$0	\$0	\$14,022
10.02-PD2 Solar Photovoltaic - Canopy	Police District 2	Surface parking lot canopy solar PV system	282,910	θ	θ	θ	θ	\$15,378-	\$0-	\$10,609 -	\$0-	\$0-	\$0-	\$25,987-
10.02-PD2 Solar Photovoltaic - Canopy	Police District 2	Surface parking lot canopy solar PV system	169,016	0	0	0	0	\$10,383	\$0	\$6,338	<i>\$0</i>	<i>\$0</i>	\$0	\$16,721
13.01-PTO Air Sealing and Weather Stripping	Police Traffic Operations Bureau	Add weather stripping and spray foam to better seal building envelope, reduce infiltration and improve occupant comfort	2,606	0	1,329	0	0	\$153	\$0	\$0	\$516	\$0	\$0	\$669
13.02-PTO Ceiling and Wall Insulation	Police Traffic Operations Bureau	Add insulation to ceiling and walls, reduce leakage and improve on temperature control	2,163	0	5,120	0	0	\$127	\$0	\$0	\$1,988	\$0	\$0	\$2,115
Team C Total	Police District 1, South Cherry Creek Transfer- Station, Police Property- Storage, Parks and Rec- Center, Police Training Facility/ Shooting Range, Denver Police Academy, Police District 2, Police Traffic Operations- Bureau	-	1,052,431	874	6,175	0	Đ	\$ 65,199 -	\$ 12,780 -	\$ 21,782 -	\$2,384 -	\$0 -	\$0 -	\$ 102,145 -

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity	Gas	Steam	Purchased Chilled Water	Electricity [\$]	Electric Demand	Xcel REC Payments	Gas	Steam	Purchased Chilled Water	Annual Savings [\$]
				[kW]	[Therms]	[Mlbs]	[MMBTU]		[\$]	[\$]	[\$]	[\$]	[\$]	
Team C Total	Police District 1, South Cherry Creek Transfer Station, Police Property Storage, Parks and Rec Center, Police Training Facility/ Shooting Range, Denver Police Academy , Police District 2, Police Traffic Operations Bureau		938,537	874	6,175	0	0	\$60,204	\$12,780	\$17,510	\$2,383	\$0	\$0	\$92,877
09.01-FM5 Interior LED Lighting Upgrades	Fleet Maintenance Building #5	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	47,456	71	-136	0	0	\$2,952	\$809	\$0	(\$39)	\$0	\$0	\$3,722
09.01-GPO Interior LED Lighting Upgrades	Gary Price Operations Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	54,346	121	-155	0	0	\$2,027	\$2,433	\$0	(\$60)	\$0	\$0	\$4,400
09.02-FM5 Exterior LED Lighting Upgrades	Fleet Maintenance Building #5	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	45,491	0	0	0	0	\$2,300	\$0	\$0	\$0	\$0	\$0	\$2,300
09.02-GPO Exterior LED Lighting Upgrades	Gary Price Operations Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	31,506	0	0	0	0	\$1,198	\$0	\$0	\$0	\$0	\$0	\$1,198
10.02-FM5 Solar Photovoltaic - Canopy	Fleet Maintenance Building #5	Flush mount system on existing structural canopy	94,701	0	0	0	0	\$9,044	\$0	\$3,551	\$0	\$0	\$0	\$12,595
Team CPC Total	Gary Price Operations Building, Fleet Maintenance Building #5		273,499	191	-291	0	o	\$17,522	\$3,242	\$3,551	(\$99)	\$0	\$0	\$24,216
01.06-DCL Steam Condensate Heat Recovery	Denver Crime Lab	Recover heat from steam condensate and repurpose in heat exchanger to preheat domestic hot water tank. This will help offset steam consumption and reduce the amount of domestic water being used to temper the condensate before it is discharged.	-2,021	0	0	298	0	(\$77)	\$0	\$0	\$0	\$4,951	\$0	\$4,874
02.12-RAC Chiller Replacement	Rose Andom Center	Replace roof top air cooled chiller with a new chiller that has a better turndown.	37,709	254	0	0	0	\$1,375	\$5,281	\$0	\$0	\$0	\$0	\$6,657
04.07-RAC Ventilation Control	Rose Andom Center	Reconnect the energy recovery ventilator (ERV) enthalpy wheels to their associated VFDs and re-enable heat recovery.	-5,651	33.3	5,809	0	0	(\$227)	\$910	\$0	\$2,527	\$0	\$0	\$3,210
09.01-DCL Interior LED Lighting Upgrades	Denver Crime Lab	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	184,488	387.1	0	-29	62	\$6,883	\$7,814	\$0	\$0	(\$475)	\$648	\$14,870
09.01-LFC Interior LED Lighting Upgrades	Lindsay-Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED- lamps/ fixtures	575,531	1,914	θ	- 89	191	\$21,471 -	\$38,630 -	\$0 -	\$0-	(\$1,475)	\$2,266 -	\$60,892 -
09.01-LFC Interior LED Lighting Upgrades	Lindsay-Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	524,210	1,717	0	-85	191	\$19,557	\$34,654	<i>\$0</i>	\$0	(\$1,476)	\$2,266	\$55,001
09.01-RAC Interior LED Lighting Upgrades	Rose Andom Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	31,575	145.04	-84.66	0	0	\$1,175	\$2,926	\$0	(\$37)	\$0	\$0	\$4,064
09-01-VDC Interior LED Lighting- Upgrades	Van Cise-Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED- lamps/ fixtures	958,277	1,674	θ	-148	319	\$ 35,750 -	\$33,782 -	\$0 -	\$0-	(\$2,458)	\$3,777 -	\$70,851 -
09.01-VDC Interior LED Lighting Upgrades	Van Cise-Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	389,824	704	0	-60	129	\$14,543	\$14,193	\$0	\$0	(\$1,000)	\$1,537	\$29,273
09.02-DCL Exterior LED Lighting Upgrades	Denver Crime Lab	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	8,525	0	0	0	0	\$324	\$0	\$0	\$0	\$0	\$0	\$324
09.02-LFC Exterior LED Lighting Upgrades	Lindsay-Flanigan- Courthouse	Replace existing non-LED lamps/ fixtures with new LED- lamps/ fixtures	50,49 4	10.78	θ	θ	θ	\$1,920	\$201 -	\$0 -	\$0 -	\$0-	\$0 -	\$2,122
09.02-LFC Exterior LED Lighting Upgrades	Lindsay-Flanigan Courthouse	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	51,083	11	0	0	0	\$1,906	\$201	\$0	\$0	\$0	\$0	\$2,107
09.02-RAC Exterior LED Lighting Upgrades	Rose Andom Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	13,876	5.88	0	0	0	\$528	\$110	\$0	\$0	\$0	\$0	\$638

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity [kW]	Gas [Therms]	Steam [Mlbs]	Purchased Chilled Water [MMBTU]	Electricity [\$]	Electric Demand [\$]	Xcel REC Payments [\$]	Gas [\$]	Steam [\$]	Purchased Chilled Water [\$]	Annual Savings [\$]
09.02-VDC Exterior LED Lighting- Upgrades	Van Cise-Simonet- Detention Center	Replace existing non-LED lamps/ fixtures with new LED- lamps/ fixtures	9,988	θ	θ	θ	θ	\$380 -	\$0 -	\$0 -	\$0 -	\$0-	\$0 -	\$380 -
09.02-VDC Exterior LED Lighting Upgrades	Van Cise-Simonet Detention Center	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	36,094	0	0	0	0	\$1,347	\$0	<i>\$0</i>	<i>\$0</i>	<i>\$0</i>	<i>\$0</i>	\$1,347
13.01-RAC Air Sealing and Weather Stripping	Rose Andom Center	Seal crack and gaps in wall and exterior doors	-990	3	1,584	0	0	(\$38)	\$79	\$0	\$689	\$0	\$0	\$730
20.01-LFC Rate Analysis	Lindsay-Flanigan Courthouse	Investigate the district chilled water utility agreements and negotiate better rates.	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$17,640	\$17,640
Team D Total	Rose Andom Center, Denver Crime Lab, Lindsay-Flanigan Courthouse, Van Cise- Simonet Detention Center	-	1,861,801	4 ,427	7,308	33	571	\$ 69,465 -	\$ 89,734 -	\$0 -	\$ 3,179	\$ 543 -	\$24 ,336 -	\$ 187,259 -
Team D Total	Rose Andom Center, Denver Crime Lab, Lindsay-Flanigan Courthouse, Van Cise- Simonet Detention Center		1,268,722	3,260	7,308	124	382.36	\$47,296	\$66,168	\$0	\$3,179	\$2,000	\$22,091	\$140,734
04.02-CMP Occupancy Based HVAC Controls	The Commons on Champa	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	18,473	0	0	126	82.8	\$667	\$0	\$0	\$0	\$2,094	\$980	\$3,742
04.02-PMB Occupancy Based HVAC Controls	Permit Building	Where new lighting occupancy sensors are installed, interlock with HVAC system serving that area to setback during unoccupied periods	5,377	0	0	128.7	61.2	\$204	\$0	\$0	\$0	\$2,139	\$734	\$3,078
09.01-CMP Interior LED Lighting Upgrades	The Commons on Champa	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	137,731	270	0	-35.7	164.64	\$5,138	\$5,441	\$0	\$0	(\$593)	\$1,950	\$11,935
09.01-PMB Interior LED Lighting Upgrades	Permit Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	113,001	475	0	-29.58	254.8	\$4,216	\$9,595	\$0	\$0	(\$492)	\$3,058	\$16,376
09.02-CMP Exterior LED Lighting Upgrades	The Commons on Champa	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	7,889	0	0	0	0	\$300	\$0	\$0	\$0	\$0	\$0	\$300
09.02-PMB Exterior LED Lighting Upgrades	Permit Building	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	9,387	0	0	0	0	\$357	\$0	\$0	\$0	\$0	\$0	\$357
13.04-CMP Replace Single Pane Windows	The Commons on Champa	Replace single pane windows with high performance double pane windows with vinyl/ fiberglass frames	17,986	-6	0	100	25	\$680	(\$130)	\$0	\$0	\$1,662	\$296	\$2,508
20.01-CMP Rate Analysis	The Commons on Champa	Investigate the district chilled water utility agreements and negotiate better rates.	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$1,385	\$1,385
20.01-PMB Rate Analysis	Permit Building	Investigate the district chilled water utility agreements and negotiate better rates.	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$1,374	\$1,374
Team E Total	The Commons on Champa, Permit Building		309,844	739	0	289	588	\$11,562	\$14,905	\$0	\$0	\$4,810	\$9,778	\$41,055
01.01-FS21 Boiler Replacement	Fire Station #21	Replace end of life boiler with high efficiency boiler capable of staging/modulating to efficiently heat the building during the winter months.	0	0	461	0	0	\$0	\$0	\$0	\$201	\$0	\$0	\$201
01.02-FS24 Boiler Replacement	Fire Station #24	Replace end of life boiler with high efficiency boiler capable of staging/modulating to efficiently heat the building during the winter months.	0	0	415	0	0	\$0	\$0	\$0	\$181	\$0	\$0	\$181
09.01-FS2 Interior LED Lighting Upgrades	Fire Station 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	37,720	83	-115	0	0	\$2,471	\$954	\$0	(\$50)	\$0	\$0	\$3,375
09.01-FS21 Interior LED Lighting Upgrades	Fire Station #21	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	13,415	18	-41	0	0	\$500	\$356	\$0	(\$18)	\$0	\$0	\$838

ECM Name and Reference Number	Facility	ECM Description	Electricity [kWh]	Electricity	Gas	Steam	Purchased Chilled Water	Electricity [\$]	Electric Demand	Xcel REC Payments	Gas	Steam	Purchased Chilled Water	Annual Savings [\$]
				[kW]	[Therms]	[Mlbs]	[MMBTU]		[\$]	[\$]	[\$]	[\$]	[\$]	
09.01-FS22 Interior LED Lighting Upgrades	Fire Station #22	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	30,416	53	-94	0	0	\$1,133	\$1,068	\$0	(\$41)	\$0	\$0	\$2,160
09.01-FS24 Interior LED Lighting Upgrades	Fire Station #24	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	16,661	33	-51	0	0	\$620	\$671	\$0	(\$22)	\$0	\$0	\$1,269
09.01-FS26 Interior LED Lighting Upgrades	Fire Station #26	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	31,235	73	-95	0	0	\$1,163	\$1,465	\$0	(\$41)	\$0	\$0	\$2,587
09.02-FS2 Exterior LED Lighting Upgrades	Fire Station 2	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	6,310	0	0	0	0	\$319	\$0	\$0	\$0	\$0	\$0	\$319
09.02-FS21 Exterior LED Lighting Upgrades	Fire Station #21	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	411.6	0	0	0	0	\$16	\$0	\$0	\$0	\$0	\$0	\$16
09.02-FS22 Exterior LED Lighting Upgrades	Fire Station #22	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	510.58	0	0	0	0	\$19	\$0	\$0	\$0	\$0	\$0	\$19
09.02-FS24 Exterior LED Lighting Upgrades	Fire Station #24	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	10,130	0	0	0	0	\$385	\$0	\$0	\$0	\$0	\$0	\$385
09.02-FS26 Exterior LED Lighting Upgrades	Fire Station #26	Replace existing non-LED lamps/ fixtures with new LED lamps/ fixtures	19,393	0	0	0	0	\$738	\$0	\$0	\$0	\$0	\$0	\$738
10.01-FS2 Solar Photovoltaic - Roof	Fire Station 2	Roof mounted solar PV systems	133,360	0	0	0	0	\$9,036	\$0	\$5,001	\$0	\$0	\$0	\$14,037
Team Fire Total	Fire Station #21, Fire Station #22, Fire Station #24, Fire Station #26, Fire Station 2		299,563	260	480	0	0	\$16,399	\$4,515	\$5,001	\$209	\$0	\$0	\$26,124
Total - For All Measures - 1 st yr. (2021 <u>-</u> <u>Utility Rate</u> basis)**	-	-	7,096,037	9,3 46	29,395	3,192	5,951	\$309,749 -	\$179,618 -	\$39,68 4	\$ 10,354	\$ 53,06 4-	\$97,231	\$689,700 -
Total - For All Measures 1 st yr. (2021_ <u>Utility Rate</u> basis)**			6,358,329	8,180	29,395	3,173	5,759	\$284,814	\$156,054	\$34,274	\$10,354	\$52,683	\$94,957	\$633,135
1 st Yr 2023 <u>Utility Rate</u> Basis (Matches- yr1 of proforma)***			7,096,037	9,3 46	29,395	3,192	5,951	\$324,259	\$188,031	\$39,68 4-	\$ 11,759	\$59,682 -	\$ 102,691	\$726,107
			6,358,329	8,180	29,395	3,173	5,759	\$297,933	\$163,635	\$34,275	\$11,759	\$59,265	\$100,306	\$667,173

* The City & County Building and Police District #3 exterior lights are all LED already, so they were excluded from the lighting upgrade.

** No utility escalators applied.

*** With 2 years of escalators applied.

Measurement and Verification Plan

"M&V Services" means Services or activities relating to the measurement and verification by the ESCO of the efficiency and effectiveness of the Project, pursuant to this EPC Contract and the CEO Measurement and Verification Policy as applied.

This schedule shall use the following documents as a standard for presentation and reporting purposes.

EPC M&V Policy: Should the City wish to extend M&V services beyond the Guarantee Period per the M&V Term definition, the future additional annual costs to the City are presented in the table below. If the extended M&V costs beyond the Guarantee Period are not included in the Maximum Contract Price, they will be funded separately by the City.

Year	Guaranteed Annual Cost Savings (2023 Utility Rates)	Annual Cost for M&V Services (Total)	M&V Cost Percent of Guaranteed Annual Savings
1	\$726,107 \$567,804	\$72,600	10.0% 12.8%
2	\$835,479 \$674,804	\$41,837	5.0% -6.2%
3	\$856,120 \$693,143	\$42,835	5.0% -6.2%

1. INTRODUCTION TO M&V CONCEPTS

M&V is the process of quantifying the energy and cost savings resulting from improvements in energyconsuming systems. The effort required and rigor achieved should be commensurate with the project capital investment and savings risk. Energy and cost reductions are compared to a historical baseline. Savings are determined by comparing the energy use before and after the installation of ECMs.

The "before" case is called the baseline. The "after" case is referred to as the post-installation or performance period.

Energy Savings = Baseline Model Energy Use - Performance Period Energy Use

2. IPMVP M&V OPTIONS

The International Performance Measurement and Verification Protocol (IPMVP) is a guidance document that provides a conceptual framework for measuring, computing, and reporting savings achieved by energy or water efficiency projects at facilities. It defines key terms and outlines issues that must be considered in developing an M&V plan. Developed through a collaborative effort involving industry, government, financial, and other organizations, the IPMVP serves as the framework for M&V procedures. It provides four M&V options: Options A, B, C, and D. These categories are divided into two general types: retrofit isolation and whole facility. Retrofit isolation methods consider only the affected equipment or system independent of the rest of the facility. Whole facility methods consider the total energy use and de-emphasize specific equipment performance.

M&V Option	Description	Considerations
Option A	Retrofit Isolation with KEY Parameter Measurement	 Focus on performance of individual energy saving measure Short term measurements on one or two KEY parameters Intent is validation of savings calculations
Option B	Retrofit Isolation with ALL Parameter Measurement OR Sub-metering of energy use	 Focus on performance of individual energy saving measure Measure ALL key parameters to calculate annual energy use OR Directly sub-meter and measure energy use of an individual system
Option C	Whole Facility / Utility Meter Comparison	 Focus on metered utility use associated with the whole facility Extensive tracking of ALL factors pre & post impacting facility energy use Calculations to adjust baseline for owner directed load, operational or equipment changes Not appropriate for small utility savings (<20%)
Option D	Whole Facility Calibrated Simulation	 Focus on metered utility uses of the whole facility Savings based on a detailed, calibrated, whole building energy model Proposed savings highly dependent on energy model, inputs, calibration Mostly appropriate for new buildings or major retrofits
Stipulated	Calculated Savings	 Measures having high certainty of savings M&V cost would be a high percentage of savings Savings is mostly contingent on owner's use or operation

Reference:

M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 4.0 Prepared for the U.S. Department of Energy Federal Energy Management Program

OPTION A

Option A is a retrofit isolation approach designed for projects in which the potential to generate savings must be verified, but the actual savings can be determined from short-term data collection & measurement, engineering calculations, and stipulated factors. The approach is intended for retrofits where key performance factors (e.g. end-use capacity, demand, power) or operational factors (lighting operational hours, cooling tonhours) can be spot or short term measured during the baseline and post installation periods. Any factor not measured is estimated based on assumptions, analysis of historical data, or manufacturer data. Post installation energy use, equipment performance and usage are generally not measured throughout the term of the contract.

The intent of Option A is to verify performance through pre- and post-retrofit measurements. Usage factors can be measured or stipulated based upon engineering estimates, operating schedules, operator logs, typical weather data, or other documented information sources. More extensive measurements are generally only made once post-retrofit. Thereafter, inspections and short term measurements are conducted to verify that the 'potential to perform' exists. As long as the 'potential to perform' is verified, the savings are as originally claimed and should not vary over the contract term.

Option A methods are appropriate for less complex measures for which performance and operational characteristics are well understood and are unlikely to change. An Option A approach can also be suitable when the value of the measure's cost savings is low. Examples of projects where Option A may be appropriate include one-for-one lighting replacement measures, high efficiency motors with constant loads, or measures with a small percentage of overall cost savings.

OPTION B

Option B is a retrofit isolation or system-level approach similar to Option A but involves the measurement of all relevant parameters. Measurements of performance and operational factors provide long-term persistence data on the energy use of the equipment or system. Measurements may be short-term, periodic, or continuous.

This method is intended for retrofits with performance factors and operational factors that can be measured at the component or system level. Short-term periodic measurements can be used when variations in the measured factor are small, and may be sufficient to characterize the baseline. Continuous monitoring information can be used to improve or optimize the operation of the equipment over time, thereby improving the performance of the retrofit. This approach provides the greatest accuracy in the calculation of savings.

The intent of Option B is to verify performance periodically or continuously with long-term measurements.

3. GENERAL APPROACH TO M&V

All guaranteed savings calculations and assumptions for this project were reviewed and agreed to by City staff and/ or a third party expert reviewer during the Investment Grade Audit. At that time, McKinstry had provided all calculations and supporting information including all trend data used to develop the basis of these calculations. The general approach to verifying savings is to ensure that the proposed changes to Key Performance Indicators (KPIs), the levers which drive savings, have been implemented or to update these calculations based on as-measured data during the annual M&V process. McKinstry will take a tiered approach to M&V execution. **Tier I** will be used for those measures for which a utility bill calibrated full building energy simulation was developed. **Tier II** will be used for savings derived by modelling individual systems.

The level of effort for each tier is informed by balancing the confidence in the persistence of savings and the cost effectiveness of activities.

Tier I		Tier II
Definition	Annual Verification	One-time Measurement and Annual Verification
Intent	Verify that changes to KPIs persist to demonstrate that proposed savings are achieved. In the event that KPIs deviate from those prescribed, the energy model can be updated with performance period operation to reflect actual performance period savings.	Evaluate performance by measuring KPIs pre and post retrofit. Update models with measured values to reflect actual performance period savings.
Post-Install Activities	Record the final constructed and commissioned conditions of KPIs, as observed via the BAS and Functional Performance Testing (FPT); update models as necessary.	Measure KPIs pre and post retrofit. Review as- built documentation for KPIs of all installed systems and update savings according to as- built/commissioned conditions.
Post- Acceptance Activities	Review trends of KPIs to ensure that savings persist; update models as necessary.	City staff will be interviewed to verify operation, such that savings persist.
Frequency and Duration	While data will be collected continuously from the BAS, actual review of trends for M&V purposes will take place once during the performance period. KPIs will be trended for a minimum of four weeks to sufficiently demonstrate consistent operation.	One time pre/post measurements during the Post-Install Process. One time, on-site inspection during Performance Year One, only. For subsequent years, City staff will be interviewed to confirm functionality.
Sampling Plan	KPIs will be observed at a directed sample of units, in a directed sample of facilities, selected to represent a substantive proportion of the total ECM savings. A sample to include the largest units at the facilities with the greater apportionment of ECM savings will be selected to demonstrate that ECM savings are achieved. Additional samples will be collected should an unsatisfactory variation be found in the original sample	KPIs will be measured on a sample of the most common population types. For less common population types, KPIs measurements will be based on a table of manufacturers' data. The measured population types will represent more than 75% of ECM savings. For each population, the number of samples measured will be sufficient to achieve 20% precision at an 80% confidence; the assumed coefficient of variation (C_v) is 0.5. Additional samples will be collected if the C_v of the original sample exceeds 0.5.
4. KPI MATRIX

ECM Name	Facilities	M&V Option	Key Performance Indicators	Baseline Values	Proposed Values	M&V Approach
01.02-FS21 Boiler Replacement	Fire Station #21	N/A	Boiler efficiency	0.77	0.85	stipulated
01.01-FS24 Boiler Replacement	Fire Station #24	N/A	Boiler efficiency	0.77	0.91	stipulated
01.06-CCB Steam Condensate Heat Recovery	City and County Building	Stipulated	Condensate heat recovery addition	Condensate drains to sewage	Condensate is recovered through heat exchanger	Stipulated
01.06-DCL Steam Condensate Heat Recovery	Denver Crime Lab	Stipulated	Condensate heat recovery addition	Condensate drains to sewage	Condensate is recovered through heat exchanger	Stipulated
01.06-PAB Steam Condensate Heat Recovery	Police Administration Building PAB	Stipulated	Condensate heat recovery addition	Condensate drains to sewage	Condensate is recovered through heat exchanger	Stipulated
02.01-CCB Chilled Water Pump	City and County	N/A	Pump efficiency	0.83	0.84	stipulated
Replacement	Building	N/A	Motor efficiency	0.85	0.95	stipulated
02.12-RAC Chiller Replacement	Rose Andom Center	N/A	chiller efficiency	9.0 EER	15.6 EER	stipulated
03.04-POA VVT to VAV Unit Denv	Denver Police	N/A	Damper Control	fixed position	based on occ sensor	Stipulated
Replacement	Academy	N/A	RTU 1 only: SAT reset	No Reset	SAT resets at 75F	Stipulated
03.07-PAB MZU to VAV Unit Building PAB		Stipulated	Hot deck/Cold deck control	Hot deck and cold deck linked, constant volume of supply air	Hot deck and cold deck operate independently, variable volume of supply air	Stipulated
	-	Stipulated	VFD	Constant speed	Fan speed modulates	
03.13 All Upgrade Air Cooled	Polico District 1 #2	Stipulated	Tons of Cooling	140	130	Stipulated
Chiller	Folice District 1, #5	Stipulated	EER	10.2 BTU/Watt	16.3 BTU/Watt	Stipulateu
04.01-CCB BAS Controls	City and County	А	Economizing	Economize when OAT is between 68F-60F	Economize when OAT is between 70F-50F	Tior I
Upgrade/ Replacement	Building	А	unoccupied setback hours	6 hours/night on weekdays	9 hours/night on weekdays	
04.01-PAB BAS Controls	Police Administration	А	Economizing	AHU economizing not operating	Economize when OAT is between 70F-50F	Tior I
Upgrade/ Replacement	Building PAB	A	AHU fan speed control	AHU minimum fan speed = 80%	AHU minimum fan speed = 60%	
04.01-POA BAS Controls Upgrade/ Replacement	Denver Police Academy	stipulated	Air supply	Constant volume	Variable volume	Stipulated

ECM Name	Facilities	M&V Option	Key Performance Indicators	Baseline Values	Proposed Values	M&V Approach
04.02-PTO Occupancy Based HVAC Control	Police Traffic Operations Bureau	A	Unoccupied Temperature Setpoint	Occ Cool: 75F, Occ Heat: 72F Unocc Cool: 80F Unocc Heat: 70	Occ Cool: 75F Unocc Cool 80F Occ Heat 72F Unocc Heat 70 F Unocc Cool setback: 77F Unocc Heat setback: 68F	Tier I
04.02-PAB Occupancy Based HVAC Control	Police Administration Building PAB	A	Unoccupied Temperature Setpoint	Occ/Unocc Cool: 74F Occ/Unocc Heat: 72F	Occ Cool: 74F Occ Heat: 72F Unocc Cool: 78F Unocc Cool Setback: 76F Unocc Heat: 68F Unocc Heat Setback: 70F	Tier I
04.02-PMB Occupancy Based HVAC Controls	Permit Building	A	Unoccupied Temperature Setpoint	Occ Heat: 72F Occ Cool:74F Unocc Cool: 80F Unocc Heat: 65F	Occ Cool: 74F Unocc Cool: 80F Occ Heat: 72F Unocc Heat: 65F Unocc Cool setback: 76F Unocc Heat setback: 70F	Tier I
04.02-CMP Occupancy Based HVAC Controls	The Commons on Champa	A	Unoccupied Temperature Setpoint	Occ Cool: 73F, Occ Heat: 69F Unocc Cool: 80F Unocc Heat: 60F	Occ Cool: 73F, Occ Heat: 69F Unocc Cool 80F Unocc Heat 60F Unocc Cool setback: 75F Unocc Heat setback: 67F	Tier I
04.07-RAC Ventilation Control	Rose Andom Center	A	RAC: ERV energy recovery wheel heat recovery	disabled	enabled	Tier II
		А	RAC: ERV fan speed control	Constant speed	Fan speed modulates	
08.05 All Add VFDS to Building Pumps	Police District 1, 3	Stipulate	VFD installation	Constant speed	Variable speed	Stipulated
08.05-PD1 Add VFDs to Building Pumps	Police District 1	Stipulated	VFD installation	Constant speed	Variable speed	Stipulated
08.05-PD3 Add VFDs to Building Pumps	Police District #3	Stipulated	VFD installation	Constant speed	Variable speed	Stipulated

ECM Name	Facilities	M&V Option	Key Performance Indicators	Baseline Values	Proposed Values	M&V Approach
		A	Wattage	Refer to Audit	Refer to Audit	Tier II
09.01-All Interior LED Lighting	All in scope	N/A	Burn hours	Refer to Audit	Refer to Audit	Stipulated
opgrades		N/A	Quantity	Refer to Audit	Refer to Audit	Stipulated
		A	Wattage	Refer to Audit	Refer to Audit	Tier II
09.02-All Exterior LED Lighting	All in scope	N/A	Burn hours	Refer to Audit	Refer to Audit	Stipulated
opgrades		N/A	Quantity	Refer to Audit	Refer to Audit	Stipulated
10.01-FS2 Solar Photovoltaic - Roof	Fire Station 2	В	Weather adjusted kWh production	0 kWh	133,360 kWh	N/A
10.01-POA Solar Photovoltaic- Canopy	Denver Police Academy	В	Weather adjusted kWh production	0 kWh	161,131 kWh	N/A
10.01-PD3 Solar Photovoltaic- Roof	Police District #3	В	Weather adjusted kWh production	0 kWh	249,338 kWh Size to be determined 218,900 kWh	N/A
10.01-PTO Solar Photovoltaic- Roof	Police Traffic Operations Bureau	В	Weather adjusted kWh production	0 kWh	136,799 kWh	N/A
10.02-FM5 Solar Photovoltaic - Canopy	Fleet Maintenance Building #5	В	Weather adjusted kWh production	0 kWh	94,701 kWh	N/A
10.02-PD2 Solar Photovoltaic - Canopy	Police District 2	В	Weather adjusted kWh production	0 kWh	282,910 kWh 169,016 kWh	N/A
13.01-PTO Air Sealing and	Police Traffic	Stipulated	Door parameter leakage sealed	0 ft	140 ft around doors sealed	Chinulated
Weather Stripping	Operations Bureau	Stipulated	Roof/wall connection leakage sealed	0 ft	475 ft around roof/wall connection sealed	Stipulated
13.01-RAC Air Sealing and	Dana Andara Cantan	Stipulated	Doors' leakage sealed	0	27 exterior & interior doors	Chinadatad
Weather Stripping	Kose Andom Center	Stipulated	Wall leakage sealed	0	Side wall of 2nd floor storage room sealed	Stipulated
13.02-PTO Ceiling and Wall Insulation	Police Traffic Operations Bureau	Stipulated	Wall insulation R- Value	1.96 exposed concrete block	12.11 insulated wall	Stipulated
13.04-CMP Replace Single Pane	The Commons on	Stipulated	Window U-value	Single pane, 0.535	Double pane, 0.38	Stipulatod
Windows	Champa	Stipulated	SHGC	Single pane, 0.59	Double pane, 0.45	Supulated

ECM Name	Facilities	M&V Option	Key Performance Indicators	Baseline Values	Proposed Values	M&V Approach
20.01-CCB Rate Analysis	City and County Building	A	CHW monthly demand reservation fee	400 tons/month contracted	360 tons/month contracted	Tier II
20.01-CMP Rate Analysis	The Commons on Champa	А	CHW monthly demand reservation fee	165 tons/month contracted	149 tons/month contracted	Tier II
20.01-LFC & VDC Rate Analysis	Lindsay-Flanigan Courthouse & Van Cise-Simonet Detention Center	A	CHW monthly demand reservation fee	2100 tons/month contracted (shared between Courthouse and Detention Center)	1890 tons/month contracted	Tier II
20.01-PAB Rate Analysis	Police Administration Building PAB	А	CHW monthly demand reservation fee	350 tons/month contracted	315 tons/month contracted	Tier II
20.01-PMB Rate Analysis	Permit Building	А	CHW monthly demand reservation fee	150 tons/month contracted	135 tons/month contracted	Tier II
22.01 Controls Optimization/RCx	CCD all	TBD	Operational changes	To be determined as measures are identified	To be determined as measures are identified	TBD

5. powerED SUPPLEMENT

During construction and throughout the performance periods, the energy, water, and cost savings impact of each specific measure identified as an element of the powerED program will be documented. Savings potential will be quantified via industry accepted calculation methodology.

SAVINGS THRESHOLD

Measures that are implemented with an annual savings potential less than **\$17,000** will be verified via one-time pre- and post-measurements of the identified KPIs. In coordination with the City, an M&V plan with a fully documented baseline, sufficient modelling, and periodic measurement of KPIs will be created and executed for implemented measures with a savings potential greater than **\$17,000**.

The **\$17,000** threshold has been established to provide the most valuable and cost effective M&V, with the understanding that a lower threshold adds increased cost for additional M&V activities while not necessarily providing additional value. Generally, measures with well understood savings and lower savings potential should require a one-time measurement of KPIs, while those with greater savings merit more detailed M&V efforts.

UTILITY RATES FOR POWERED SAVINGS

Natural gas, propane, water, and sewer savings will be calculated using the contractual utility rates for each facility. For measures with savings estimated below the threshold, a blended rate of **\$0.11/kWh** will be used to quantify electricity and demand savings. For measures with savings equal to or above the threshold, the contractual electricity and demand rates will be applied.

Measure Savings	Electricity (kWh)	Natural Gas (Therms)	Steam (Mb)	Chilled Water (Ton/hr)
Below threshold	\$0.11	\$0.35	\$17.29	0.14
Equal to or above threshold	See	section 2.1 Baseline	Energy Use in IGA	A

All applicable utility rates will be escalated by the agreed upon escalation rates starting in Year 2.

6. SAMPLING PLAN

LIGHTING

Lighting follows 80/20 sampling plan where measurements are taken at a 20% precision level with 80% confidence level. The baseline and proposed wattage readings are based on total project savings percentage, combining for the top 75% of the savings contribution load. The following table shows the pre-construction and post-construction fixtures and their respective kW readings. The sample size is based on the fixture's population size.

Pre Construction Fixture Type	Existing kW	Sample Size	Post Construction Fixture Type	Proposed kW	Sample Size
F T8 F32-32W-48" NLO- 2L	446.34	11	RET-2xLEDT4FT-DW	145.84	11
F T8 F32-28W-48" NLO- 2L	127.78	11	RET/1x100LEDSI/Mogul Base Bypass (PAR)_DET_CTR	13.80	11
F T8 F32-32W-48" NLO- 3L	134.39	11	RET-1X20_LEDT4FT_T5	15.72	10
F T8 F32-32W-48" NLO- 4L	88.82	11	IN/1x150LEDF_SB	7.50	10
F T8 F32-32W-48" NLO- 1L	121.38	11	Lamp/1x25LEDSI/A21	2.25	11
F T5 45.8" 54W- 1L	57.54	11	RET-2xLEDT4FT_T5-DRIVER	7.62	11
MH Mogul 150W-1L	36.86	11	LAMP-1x9LEDSI-A19	4.17	11
MH Mogul 250W-1L	32.75	11	RET-2XLEDT8FT-DW	6.50	11
MH Mogul 175W-1L	25.80	11	LAMP/1x15LEDPLV_Omni	4.48	11
MH Mogul 400W- 1L	26.56	10			
F T5 45.8" 54W- 2L	42.01	11			
CFL SI MED 32W- 1L	21.92	11			
F T8 F32-32W-48" RLO- 4L	23.36	11			

7. CITY O&M REPORTING RESPONSIBILITIES

Refer to Section 21 of the Agreement - Material Changes -

8. SCHEDULE OF VERIFICATION REPORTING ACTIVITIES

Item	Submission Timeline	Customer Review and Acceptance Period
Post-Installation Report	60 to 90 days after Completion	30 days
Annual Report	60 to 90 days after conclusion of performance period	30 days

9. CALIBRATION SUPPLEMENT

The analysis of some KPIs will require data collected using the existing BAS systems. The calibration maintenance of measuring and metering devices that are elements of these systems are the responsibility of the City. McKinstry will provide details of equipment make, model, and calibration for all other devices used as an element of the M&V process.

10. REFERENCES

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ECM Scope and Description	IGA Appendix D/ EPC Schedule B
ECM Proposed Annual Savings	IGA Report Section 3/ EPC Schedule G
Schedule of Values	EPC Schedule F
Customer Maintenance Responsibilities	EPC Schedule S

11. M&V REPORT CONTENT & FORMAT

(I) EXECUTIVE SUMMARY

- 1) Project Summary
- 2) Summary Of Guaranteed And Verified Utility Cost Savings
- 3) Comparison Of Guaranteed And Verified Savings By ECM By Utility Type
- 4) Summary Of Observations, Issues, And Recommendations
- 5) Brief ECM Descriptions
- 6) M&V Approach

(II) DETAILED M&V SECTIONS – BY INDIVIDUAL ECM

- 1) Brief ECM Descriptions
- 2) M&V Activities Overview
 - A) M&V Plan Overview
 - B) Summary Of Sampling Plan
 - C) Table Of KPI Measurements
- 2) Observations, Issues, and Recommendations
- 3) Verified Savings Calculation And Methodology
 - A) Calculation And Methodology Summary
 - B) Guarantee Factor Details
 - C) Summary Of Guaranteed And Verified Savings For Performance Year

(II) APPENDICES

- 1) Supporting Documentation
 - A) Testing Data, Trend Charts, And Analysis
 - B) Bas Screen Captures
 - C) Site Visit Photos
- 2) Utility Rates

12. RISK, RESPONSIBILITY AND PERFORMANCE MATRIX

RESPONSIBILITY/DESCRIPTION	CONTRACTOR PROPOSED APPROACH
1. Financial	
M&V confidence: The City assumes the responsibility to determine the confidence that it desires to have in the M&V program and energy savings determinations. The desired confidence will be reflected in the resources required for the M&V program, and the ESCO must consider the requirement prior to submittal of the final proposal. Clarify how project savings are being verified (e.g., equipment performance, operational factors, energy use) and the impact on M&V costs.	McKinstry's approach to the application of M&V will be to verify the perform the steps taken in the verification process. The approach to M&V on each implementation complexity of the ECM. As applicable, equipment performa- through the BAS data for buildings that are applicable.
Energy Related Cost Savings: The City and the contractor may agree that the project will include savings from <i>recurring</i> and/or <i>one-time</i> costs. This may include one-time savings from avoided expenditures for projects that were appropriated but will no longer be necessary. Including one-time cost savings before the money has been appropriated may involve some risk to the Institution. Recurring savings generally result from reduced O&M expenses or reduced water consumption. These O&M and water savings must be based on actual spending reductions. Clarify sources of non-energy cost savings and how they will be verified.	No one-time cost avoidances are included in the project financials. Non-er monthly contracted chilled water capacity at facilities subscribed to distric included in the project per the request of the City.
Delays: Both the contractor and the City can cause delays. Failure to implement a viable project in a timely manner costs the Institution in the form of lost savings, and can add cost to the project (e.g., construction interest, re-mobilization). Clarify schedule and how delays will be handled.	McKinstry has mitigated this risk by providing ample schedule contingency mitigated by not taking construction-period savings into account in the pro- and will provide a buffer for any potential schedule extensions.
Major changes in facility: The City controls major changes in facility use, including closure. Clarify responsibilities in the event of a premature facility closure, loss of funding, or other major change.	In the case of facility closure, loss of funding, or other major changes, Mc ECM reduction, modification, or removal. In the event of major changes in facility use, the energy savings will be ca conditions as contained in M&V Plan.



mance of the installed ECMs. The M&V Plan details ECM is matched with the level of savings and the nance is measured and operational factors are tracked

nergy cost savings include a 10% reduction in the ct chilled water. O&M expense savings have not been

y within the construction schedule. This risk is further ro forma. Construction-period savings will be a reality

Kinstry and the City will have open discussions of

alculated based on the baseline and proposed

RESPONSIBILITY/DESCRIPTION	CONTRACTOR PROPOSED APPRO	DACH		
2. Operational				
Operating hours: The City generally has control over operating hours. Increases and decreases in operating hours can show up as increases or decreases in "savings" depending on the M&V method (e.g., operating hours multiplied by improved efficiency of equipment vs. whole-building/utility bill analysis). Clarify whether operating hours are to be measured or stipulated and what the impact will be if they change. If the operating hours are stipulated, the baseline should be carefully documented and agreed to by both parties.	Detailed operating hour baselines have been developed; the values were presented to the City in the IGA acceptable values to be used in the savings calculations. Savings will be verified at the originally proposed hours regardless of future changes. If operating hours may recalculate savings at its discretion to demonstrate the impact of the change. The application of the operating hours varies by type of measures proposed, magnitude of savings, and the overall savings. Operating hours are applied as follows:			
	Measure Category	Baseline	Post-Install	
	Lighting	Measured kW, stipulated hours	Measured	
	Schedule Changes	On-site observations, staff interviews	Measured	
	Equipment Replacement	On-site observations, Utility Data	Agreed Upon	
	General Facility Operating Hours	Staff Interviews, Published Schedules	Agreed Upon	
	If equipment loads do change, McK	instry may recalculate savings at its discretion to de	monstrate the imp	
Load: Equipment loads can change over time. The City generally has control over hours of operation, conditioned floor area, intensity of use (e.g., changes in occupancy or level of automation). Changes in load can show up as increases or decreases in "savings" depending on the M&V method. Clarify whether equipment loads are to be measured or stipulated and what the impact will be if they change. If the equipment loads are stipulated, the baseline should be carefully documented and agreed to by both parties. Weather: A number of energy efficiency measures are affected by weather. Neither the contractor nor the Institution has control over the weather. Should the Institution agree to accept risk for weather	City assumes all risk and responsibility individual savings calculations. If accepted at the baseline baseline load conditions, as the facility actual savings. As such, demand savings calculations for ECM 04.0X station closest to the site or the locometer.	ility to manage the equipment loads at or below the ctual equipment loads, as defined in the M&V plan, a ne load conditions. If equipment load is lower than t lity now has the potential to increase the loads to the vings associated with FIM 10.XX Solar Photovoltaic HVAC Controls are based on Typical Meteorological al airport. All post-install calculations will continue to	baseline conditions re higher than bas baseline, all saving re baseline values will be stipulated. Year (TMY) weather o use the TMY weather	
fluctuations, it shall be contingent upon aggregate payments not exceeding aggregate savings. Clearly specify how weather corrections will be performed.	applicable. Interactive heating and ASHRAE "Fraction of Annual Lightin regression of the utility bills.	cooling effects for ECM 09.01-Lighting Upgrades and g Heat to Cooling and Heating" values. McKinstry wi	I ECM 09.02 are ba Il not perform a fac	
	Solar M&V and Weather Normal The production of solar arrays is hig neither McKinstry nor the City has of weather files that are the best stati- associated dollar savings represent factor applied. Utilizing project site monitor the relevant weather paran for other non-routine procedures as verified savings for a performance p conditions for the year. Neither Mck the estimated TMY conditions that r non-weather-related issues.	ization ghly dependent upon the available solar irradiance a control. Savings calculations for ECM 10.XX are base stical fit for a specific project site. The guaranteed so the estimated performance from a TMY based energy integrated data acquisition systems that include weat neters in order to normalize the verified solar product a necessary; i.e. system down time events caused by period will be reported as the actual solar production (instry nor the City shall be penalized or credited for result in excess or insufficient availability of solar irradi	nd other weather failed on Typical Meteo olar production in k y production mode ather station comp ction for <u>estimated</u> y non-weather-rela adjusted to reflec weather condition adiance, weather p	



to identify the

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bact of the change.

rformance period. The s documented in seline values, all s will be capped at without impact on the

er files for the weather ther files as ased on published cility level weather

factors of which orological Year (TMY) kWh/kW and the el with a guarantee onents, McKinstry will generation, adjusting ated issues. The t the typical weather ns that deviate from parameters, or other

User participation: Many facility improvement measures requ	uire user participation to generate savings	City maintenance of proper time schedules, set-points, and programming of
(e.g., control settings). The savings can be variable and the cor	ntractor may be unwilling to invest in	maintenance requirements for any new systems will be identified and docu
these measures. Clarify what degree of user participation i	is needed and utilize monitoring and	McKinstry will provide training, videotaping, and operating guides. McKinst
training to mitigate risk. If performance is stipulated, docum	ent and review assumptions carefully and	during the performance period. City maintenance of trends, trend export,
consider M&V to confirm the capacity to save (e.g., confirm tha	t the controls are functioning properly).	execution of the M&V Plan.

3. Performance	
Equipment performance: The contractor has control over the selection of equipment and is responsible for its proper installation, commissioning, and performance. The contractor has responsibility to demonstrate that the new improvements meet expected performance levels including specified equipment capacity, standards of service, and efficiency. Clarify who is responsible for initial and long-term performance, how it will be verified, and what will be done if performance does not meet expectations.	McKinstry will select major equipment that will have life expectancy that m requirements of the City, facility needs, and provides enhancement of the or perform periodic checks to ensure that performance does not degrade impa- maintenance (PM) is performed by the City in accordance with industry and in a case of equipment non-performance, McKinstry may contact the OEM f performance standards or replace to remedy performance deficiencies. Mck equipment manufacturers if warranted, and will also ensure these warrantic acceptance.
Operations: Performance of the day-to-day operations activities is negotiable and can impact performance. However, the contractor bears the ultimate risk regardless of which party performs the activity. Clarify which party will perform equipment operations, the implications of equipment control, how changes in operating procedures will be handled, and how proper operations will be assured.	McKinstry has assumed the City will maintain operation of all ECMs. McKins regardless of who performs the O&M tasks. McKinstry will provide operating that the systems are operated and maintained per OEM required guidelines
Preventive Maintenance: Performance of day-to-day maintenance activities is negotiable and can impact performance. However, the contractor bears the ultimate risk regardless of which party performs the activity. Clarify how long-term preventive maintenance will be assured, especially if the party responsible for long-term performance is not responsible for maintenance (e.g., contractor provides maintenance checklist and reporting frequency). Clarify who is responsible for performing long-term preventive maintenance to maintain operational performance throughout the contract term. Clarify what will be done if inadequate preventive maintenance impacts performance.	McKinstry will provide all necessary training on the maintenance requireme Should the maintenance requirements be inadequate, McKinstry will notify determine the best approach to ensure proper maintenance practices are a McKinstry and/or OEM specifications.
Equipment Repair and Replacement: Performance of day-to-day repair and replacement of contractor-installed equipment is negotiable; however, it is often tied to project performance. The contractor bears the ultimate risk regardless of which party performs the activity. Clarify who is responsible for performing replacement of failed components or equipment replacement throughout the term of the contract. Specifically address potential impacts on performance due to equipment failure. Specify expected equipment life and warranties for all installed equipment. Discuss replacement responsibility when equipment life is shorter than the term of the contract.	Refer to Maintenance & Warranty Coordination Matrix in Schedule W.



of controls is required. For ECMs proposed, routine umented. To ensure the City understands the risk, try may review operating logs on a periodic basis and access to automation systems is required for

neets or exceeds the contract term, is based on the operation and savings of the ECMs. McKinstry will bacting savings, and verify routine preventive ad OEM specifications and per subsection C below. If for required repairs to return equipment to OEM cKinstry will secure long-term warranties from cies are transferrable to the City at project

stry will be responsible for equipment performance ng and PM guidelines and initial training to ensure s that will ensure savings are retained.

ents of the equipment for operation by the City. the City immediately and will work with the City to adhered to in accordance with prescribed practices by



City and County of Denver/McKinstry Energy Performance Agreement



City Contract/Control # 202161179-00 Invoice # 0 Invoice Date: 1/0/1900 Invoice Type: CIP Terms: NET 30 Transmittals: None

Funding Sourc	e Break Do	own
CASR Building	\$	-
CASR Renewables	\$	-
GS CIP		\$0.00
Gross Total	\$	-
Retainage	\$	-
Net Total	\$	-

APPLICATION AND CERTIFICATI	ON FOR PAYMENT	AIA DOCUMENT G702	
TO OWNER: CITY AND COUNTY OF DENVER 201 W Colfax Ave Dept 111 Dept of General Service Denver, CO 80202 FROM CONTRACTOR: MCKINSTRY ESSENTION, LLC	APPLICATION NO: PERIOD FROM: PERIOD TO: CCD PROJECT #: McKINSTRY PROJECT #:	202161179-00 Cost of Services (MCP) 203895-	Distribution to: X OWNER ARCHITECT CONTRACTOR
5005 3RD AVE S SEATTLE, WA 98134	CONTRACT DATE:	12/9/21	INVOICE NO: DATE:
CONTRACTOR'S APPLICATION F Application is made for payment, as shown below, in connect Continuation Sheet, AIA Document G703, is attached.	FOR PAYMENT ion with the Contract.	The undersigned Contractor certifies that to the best information and belief the Work covered by this Ap completed in accordance with the Contract Docume the Contractor for Work for which previous Certific payments received from the Owner, and that curren	t of the Contractor's knowledge, plication for Payment has beer nts, that all amounts have been paid by ates for Payment were issued and t payment shown herein is now due.
1. ORIGINAL CONTRACT SUM 2. Net change by Change Orders 3. CONTRACT SUM TO DATE (Line 1 ± 2) 4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) 5. RETAINAGE: a. 5 of Completed Work (Column D + E on G703) b. 5 % of Stored Material (Column F on G703)	\$ 2,346,783.00 \$ 175,040.00 \$ 2,521,823.00 \$ 0.00 0.00	CONTRACTOR: By: State of: Washington Subscribed and sworn to before me this Notary Public: My Commission expires:	Date: County of: King day of
Total Retainage (Lines 5a + 5b or Total in Column I of G703) 6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total) 7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate) 8. CURRENT PAYMENT DUE 9. BALANCE TO FINISH, INCLUDING RETAINA (Line 3 less Line 6)	\$ <u>0.00</u> <u>\$0.00</u> <u>\$0.00</u> <u>\$0.00</u> <u>\$2,521,823.00</u>	OWNERS'S CERTIFICATE F In accordance with the Contract Documents, based comprising the application, the Owner certifies to th Owners's knowledge, information and belief the W the quality of the Work is in accordance with the Co is entitled to payment of the AMOUNT CERTIFIED AMOUNT CERTIFIED\$	OR PAYMENT on on-site observations and the data he best of the ork has progressed as indicated, ontract Documents, and the Contractor D. 0.00
CHANGE ORDER SUMMARY ADD Total changes approved in previous months by Owner	ITIONS DEDUCTIONS \$0.00 \$0.00	(Attach explanation if amount certified differs from Application and onthe Continuation Sheet that are o OWNER:	the amount applied. Initial all figures on this changed to conform with the amount certified.)
Total approved this Month \$18	<mark>0,150.00</mark> \$0.00	Ву:	Date:
TOTALS \$18 NET CHANGES by Change Order	0,150.00 \$0.00 \$180,150.00	This Certificate is not negotiable. The AMOUNT C Contractor named herein. Issuance, payment and ac prejudice to any rights of the Owner or Contractor u	CERTIFIED is payable only to the ceptance of payment are without under this Contract.

Users may obtain validation of this document by requesting a completed AIA Document D401 - Certification of Document's Authenticity from the Licensee.

CONTINUATION SHEET 1

AIA DOCUMENT G703

AIA E	Occument G702, APPLICATION AND CERTIF	ICATION FOR PA	AYMENT, contain	0	0 1/0/00							
Le tob	actors signed certification is attached.	dallar					וס		AFFLN 1/0/00	DEPIOD TO:	1/0/00)
III tabl	alumn Lon Contracts where variable retainage f	uonar. ar lina itama may a	nnla				FI	LICE FROM	. 1/0/00 MCKIN	ISTRY IOB NO:	203805)
Use C	orunnin i on Contracts where variable retainage it	or the ttems may a	ррту.				CITY	AND COUN	TY OF DENVER	PROJECT NO	: 202161179-00 Cost of Services (MCP)	
Α	В		С		D	Е		G	Н	I	J	К
ITEM	DESCRIPTION OF WORK	SCHEDULED	CHANGE	REVISED	WORK CO	MPLETED	TOTAL	%	BALANCE	RETAINAGE	COMPLETED	CASR or
NO.		VALUE	ORDERS	SCHEDULE OF VALUES	FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD	COMPLETED AND STORED TO DATE (D+E+F)	$(G \div C)$	TO FINISH (C - G)	(IF VARIABLE RATE)	SCOPES OF WORK	GF/CIP FUNDING
	City and County Building											
1	01.06-CCB Steam Condensate Heat Recovery	\$12,897		\$12,897					\$12,897			CASR BLDG.
2	02.01-CCB Chilled Water Pump Replacement	\$18,560		\$18,560					\$18,560			GF/CIP BLDG.
3	04.01-CCB BAS Controls Upgrade/ Replacement	\$84,486		\$84,486					\$84,486			CASR BLDG.
4	09.01-CCB Interior LED Lighting Upgrades	\$31,522		\$31,522					\$31,522			CASR BLDG.
	Police Administration Building											
5	01.06-PAB Steam Condensate Heat Recovery	\$9,623		\$9,623					\$9,623			CASR BLDG.
6	03.07-PAB MZU to VAV Unit	\$10,261		\$10,261					\$10,261			GF/CIP BLDG.
7	04.01-PAB BAS Controls Upgrade/ Replacement	\$72,739	(\$24,493.00)	\$48,246					\$48,246			CASR BLDG.
8	04.02-PAB Occupancy Based HVAC Control	\$11,532	(, , ,	\$11,532					\$11,532			CASR BLDG.
9	09.01-PAB Interior LED Lighting Upgrades	\$19,313		\$19,313					\$19,313			CASR BLDG.
10	09.02-PAB Exterior LED Lighting Upgrades	\$4,149		\$4,149					\$4,149			CASR BLDG.
	Denver Municipal Animal Shelter											
11	09.01-DAS Interior LED Lighting Ungrades	\$8.462		\$8.462					\$8.462			CASE BLDG
12	09.02-DAS Exterior LED Lighting Upgrades	\$244		\$244					\$244			CASR BLDG.
12		φ211		0211					0211			CABIC BEDG.
	Police District #3											
13	03.13-PD3 Upgrade Air Cooled Chiller	\$46,205		\$46,205					\$46,205			GF/CIP BLDG.
14	08.05-PD3 Add VFDs to Building Pumps	\$9,209		\$9,209					\$9,209			CASR BLDG.
15	09.01-PD3 Interior LED Lighting Upgrades	\$5,658		\$5,658					\$5,658			CASR BLDG.
16	10.01-PD3 Solar Photovoltaic - Canopy	\$77,221		\$77,221					\$77,221			CASR RENEW
	South Osage Fleet Maintenance Garage											
17	09.01-FS26 Interior LED Lighting Upgrades	\$2,528		\$2,528					\$2,528			CASR BLDG.
18	09.02-FS26 Exterior LED Lighting Upgrades	\$489		\$489					\$489			CASR BLDG.
	Continuation Sheet 2 Totals	\$485,855		\$485,855					\$485,855			
	Continuation Sheet 3 Totals	\$324,065		\$324,065					\$324,065			
	Continuation Sheet 4 totals	\$1,111,764	\$199,533	\$1,311,297					\$1,311,297			
GRAN	D TOTALS ALL CONTINUATION SHEETS	\$2,346,783	\$175,040	\$2,521,823					\$2,521,823			+
1		. , ,			1	1	1	1		1	1	1

CONTINUATION SHEET 2

AIA DOCUMENT G703

		_												
AIA D	ocument G702, APPLICATION AND CERTIFICA	TION FOR PAYME	ENT, containing							APF	LICATION NO:		0	
Contra	ctor's signed certification is attached									APPLI	CATION DATE:		1/0/1900	
In tabu	lations below, amounts are stated to the nearest doll	lar.						PEI	RIOD FROM:	1/0/00	PERIOD TO:		1/0/1900	
Use Co	olumn I on Contracts where variable retainage for lin	ne items may apply.								MCKIN	STRY JOB NO:	203895-		
								CITY AI	ND COUNTY	OF DENVE	R PROJECT NO:	2021611/9-00 Cost of Services (MCP)		
A	В		С	DELUCED	D	E	F	G		Н	I	J		K
TTEM	DESCRIPTION OF WORK	SCHEDULED	CHANGE	SCHEDULE OF	WORK CON	IPLETED	MATERIALS	TOTAL	%	BALANCE	RETAINAGE	COMPLETED		CASR or
NO.		VALUE	ORDERS	VALUES	APPLICATION	THIS PERIOD	PRESENTLY	AND STORED	(G ÷ C)	TO FINISH (C - G)	(IF VARIABLE RATE)	SCOPES OF WORK		GF/CIP FUNDING
					(D+E)		(NOT IN	TO DATE		(0-0)	((TL)	WORK		
							D OR E)	(D+E+F)						
	Park Avenue Police Traffic Operations													
19	04.02-PTO Occupancy Based HVAC Control	\$3,081		\$3,081						\$3,081		McKinstry Services Complete		CASR BLDG.
20	09.01-PTO Interior LED Lighting Upgrades	\$13,894		\$13,894						\$13,894		McKinstry Services Complete		CASR BLDG.
21	09.02-PTO Exterior LED Lighting Upgrades	\$2,699		\$2,699						\$2,699		McKinstry Services Complete		CASR BLDG.
22	10.01-PTO Solar Photovoltaic- Roof	\$41,662		\$41,662						\$41,662		Commissioning Complete		CASR RENEW
23	13.01-PTO Air Sealing and Weather Stripping	\$14,415		\$14,415						\$14,415		McKinstry Services Complete		GF/CIP BLDG.
24	13.02-PTO Ceiling and Wall Insulation	\$61,686		\$61,686						\$61,686		McKinstry Services Complete		GF/CIP BLDG.
	Denver Police Academy													
25	03.04-POA VVT to VAV Unit Replacement	\$28,630		\$28,630						\$28,630		McKinstry Services Complete		GF/CIP BLDG.
26	04.01-POA BAS Controls Upgrade/ Replacement	\$22,768		\$22,768						\$22,768		McKinstry Services Complete		CASR BLDG.
27	09.01-POA Interior LED Lighting Upgrades	\$4,155		\$4,155						\$4,155		McKinstry Services Complete		CASR BLDG.
28	09.02-POA Exterior LED Lighting Upgrades	\$719		\$719						\$719		McKinstry Services Complete		CASR BLDG.
29	10.02 - POA Solar Photovoltaic - Canopy	\$67,947		\$67,947						\$67,947		Commissioning Complete		CASR RENEW
	Police District #1													
30	03.13-PD1 Upgrade Air Cooled Chiller	\$52,104		\$52,104						\$52,104		McKinstry Services Complete		GF/CIP BLDG.
31	08.05-PD1 Add VFDs to Building Pumps	\$10,689		\$10,689						\$10,689		McKinstry Services Complete		CASR BLDG.
	Police District #2													
32	09.01-PD2 Interior LED Lighting Upgrades	\$4,485		\$4,485						\$4,485		McKinstry Services Complete		CASR BLDG.
33	09.02-PD2 Exterior LED Lighting Upgrades	\$2.005		\$2.005						\$2.005		McKinstry Services Complete		CASR BLDG.
34	10.02-PD2 Solar Photovoltaic - Canopy	\$103,925		\$103,925						\$103,925		Construction Administration		CASR RENEW
	South Cherry Creek Transfer Station													
35	09.01-CTS Interior LED Lighting Upgrades	\$3.275		\$3,275						\$3.275		McKinstry Services Complete		CASR BLDG.
36	09.02-CTS Exterior LED Lighting Upgrades	\$957		\$957						\$957		McKinstry Services Complete		CASR BLDG.
	0 0 10											·····		
	Fleet Maintenance Building 5													
37	09.01-FM5 Interior LED Lighting Upgrades	\$3,225		\$3,225						\$3,225		McKinstry Services Complete		CASR BLDG.
38	09.02-FM5 Exterior LED Lighting Upgrades	\$2,766		\$2,766						\$2,766		McKinstry Services Complete		CASR BLDG.
39	10.02-FM5 Solar Photovoltaic - Canopy	\$40,772		\$40,772						\$40,772		Commissioning in progress		CASR RENEW
	PAGE TOTALS	\$485,855		\$485,855						\$485,855				
				•										

CONTINUATION SHEET 3

AIA DOCUMENT G703

AIA D	A Document G702 APPLICATION AND CERTIFICATION FOR PAYMENT containing													
Contra	actor's signed certification is attached		,	8						APPLICA	TION DATE:		1/0/1900	
In tabi	ilations below, amounts are stated to the nearest dol	lar.						PF	RIOD FROM:	1/0/00	PERIOD TO:		1/0/1900	
Use C	olumn I on Contracts where variable retainage for li	ne items may appl	v.							MCKINS	FRY JOB NO:	203895-		
								CITY A	AND COUNTY	OF DENVER F	ROJECT NO:	202161179-00 Cost of Services (MCP)		
Α	В		С		D	Е	F	0	3	Н	Ι	1		К
ITEM	DESCRIPTION OF WORK	SCHEDULED	CHANGE	REVISED	WORK COM	IPLETED	MATERIALS	TOTAL	%	BALANCE	RETAINAGE	COMPLETED		CASR or
NO.		VALUE	ORDERS	SCHEDULE OF VALUES	FROM PREVIOUS	THIS PERIOD	PRESENTLY	COMPLETED	(G ÷ C)	TO FINISH	(IF VARIABLE	SCOPES OF		GF/CIP FUNDING
				EOED	APPLICATION		STORED	AND STORED		(C - G)	RATE)	WORK		
					(D + E)		(NOT IN D OR F)	TO DATE (D+F+F)						
	Gary Price Operations Building 2						D OK D)	(2.2.1)						
39	09.01-GPO Interior LED Lighting Upgrades	\$ 8,343		\$8,343						\$8,343		McKinstry Services Complete		CASR BLDG.
40	09.02-GPO Exterior LED Lighting Upgrades	\$ 1,875		\$1,875						\$1,875		McKinstry Services Complete		CASR BLDG.
	Danvar Crima Lah													
41	01.06 DCL Steam Condensate Heat Recovery	\$ 12.703		\$12 703						\$12 703		Commissioning in Progress		CASP BLDG
42	09.01-DCL Interior LED Lighting Upgrades	\$ 14 145		\$14,145						\$14,145		McKinstry Services Complete		CASR BLDG.
43	09.02-DCL Exterior LED Lighting Upgrades	\$ 1.081		\$1.081						\$1.081		McKinstry Services Complete		CASR BLDG.
		. ,		. ,						. ,		5 1		
	Lindsey-Flanigan Courthouse													
45	09.01-LFC Interior LED Lighting Upgrades	\$71,689		\$71,689						\$71,689		Construction Administration		CASR BLDG.
46	09.02-LFC Exterior LED Lighting Upgrades	\$1,942		\$1,942						\$1,942		Construction Administration		CASR BLDG.
	Rose Andom Center													
47	02.12-RAC Chiller Replacement	\$49,228		\$49,228						\$49,228		Commissioning in Progress		GF/CIP BLDG.
48	04.07-RAC Ventilation Control	\$6,376		\$6,376						\$6,376		McKinstry Services Complete		CASR BLDG.
49	09.01-RAC Interior LED Lighting Upgrades	\$5,353		\$5,353						\$5,353		McKinstry Services Complete		CASR BLDG.
50	09.02-RAC Exterior LED Lighting Upgrades	\$626		\$626						\$626		McKinstry Services Complete		CASR BLDG.
51	13.01-RAC Air Sealing and Weather Stripping	10,914		\$10,914						\$10,914		McKinstry Services Complete		GF/CIP BLDG.
	Van Cise-Simonet Detention Center													
52	09.01-VDC Interior LED Lighting Upgrades	\$52,277		\$52,277						\$52,277		Construction Administration Complete		CASR BLDG.
53	09.02-VDC Exterior LED Lighting Upgrades	\$2,248		\$2,248						\$2,248		Construction Administration Complete		CASR BLDG.
	The Commons on Chemps													
54	04.02-CMP Occupancy Based HVAC Controls	\$6.055		\$6.055						\$6.055		McKinstry Services Complete		CASE BLDG
55	09.01-CMP Interior LED Lighting Upgrades	\$19.662		\$19,653						\$19,653		McKinstry Services Complete		CASR BLDG.
56	09.02-CMP Exterior LED Lighting Upgrades	\$284		\$284						\$284		McKinstry Services Complete		CASR BLDG.
57	13.04-CMP Replace Single Pane Windows	\$28,617		\$28,617						\$28.617		McKinstry Services Complete		GF/CIP BLDG
										,017		, <u>-</u>		
50	Permit Building	05.005		65.075						65.075				CACE DI DO
58	04.02-PMB Occupancy Based HVAC Controls	\$5,275		\$5,275						\$5,275		McKinstry Services Complete		CASE BLDG.
59	09.02 DMD Enterior LED Lighting Upgrades	\$25,054		\$23,054						\$25,054		McKinstry Services Complete		CASE BLDG.
00	09.02-PMB EXterior LED Lighting Upgrades PAGE TOTALS	\$324.065		\$324.065						\$324.065		weekinsu y Services Complex		CASK DLDU.
1	PAGE TOTALS	\$324,065		\$524,065	1			1	1	\$324,065	1			1

PAGE TOTALS

\$1,111,764

\$199,533

\$1,311,297

EPC Schedule F-2: Schedule of Values

CC	ONTINUATION SHEET 4					AIA DOCUN	MENT G703									
AIA I Contra In tab Use C	Document G702, APPLICATION AND CERTIFICATION actor's signed certification is attached. ulations below, amounts are stated to the nearest dollar. 'olumn I on Contracts where variable retainage for line iten	N FOR PAYMENT, o ns may apply.	containing	aining APPLICATION NO: 0 APPLICATION DATE: 1/0/1900 PERIOD FROM: 1/0/00 PERIOD TO: 1/0/1900 MCKINSTRY JOB NO: 203895- CITY AND COUNTY OF DENVER PROJECT NO: 202161179-00 Cost of Services (MCP)												
А	В		С		D	Е	F	G		Н	I	1	К			
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	CHANGE ORDERS	REVISED SCHEDULE OF VALUES	WORK CON FROM PREVIOUS APPLICATION (D + E)	IPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G÷C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)	COMPLETED SCOPES OF WORK	CASR or GF/CIP FUNDING			
61 62 63	Fire Station #2 09.01-FS2 Interior LED Lighting Upgrades 09.02-FS2 Exterior LED Lighting Upgrades 10.01-FS2 Solar Photovoltaic - Roof	\$2,614 \$543 \$33,359		\$2,614 \$543 \$33,359						\$2,613.85 \$542.68 \$33,359.44		McKinstry Services Complete McKinstry Services Complete Commissioning Complete	CASR BLDG. CASR BLDG. CASR RENEW			
64 65 66	Fire Station #21 01.01-FS21 Boiler Replacement 09.01-FS21 Interior LED Lighting Upgrades 09.02-FS21 Exterior LED Lighting Upgrades	\$27,708 \$1,476 \$73		\$27,708 \$1,476 \$73						\$27,707.76 \$1,475.79 \$73.41		McKinstry Services Complete McKinstry Services Complete McKinstry Services Complete	GF/CIP BLDG. CASR BLDG. CASR BLDG.			
67 68	Fire Station #22 09.01-FS22 Interior LED Lighting Upgrades 09.02-FS22 Exterior LED Lighting Upgrades	\$1,117 \$12		\$1,117 \$12						\$1,116.96 \$11.52		McKinstry Services Complete McKinstry Services Complete	CASR BLDG. CASR BLDG.			
69 70 71	Fire Station #24 01.02-FS24 Boiler Replacement 09.01-FS24 Interior LED Lighting Upgrades 09.02-FS24 Exterior LED Lighting Upgrades	\$19,043 \$843 \$310		\$19,043 \$843 \$310						\$19,042.50 \$842.81 \$309.65		McKinstry Services Complete McKinstry Services Complete McKinstry Services Complete	GF/CIP BLDG. CASR BLDG. CASR BLDG.			
72 73	Fire Station #26 09.01-FS26 Interior LED Lighting Upgrades 09.02-FS26 Exterior LED Lighting Upgrades	\$2,679 \$755		\$2,679 \$755						\$2,678.95 \$755.09		McKinstry Services Complete McKinstry Services Complete	CASR BLDG. CASR BLDG.			
74	Solar O&M	\$11,000		\$11,000						\$11,000.00			CASR RENEW			
75	CCD Controls Optimization/RCx	\$610,331	(\$54,000.00)	\$556,331						\$556,331.00		All Teams integration for identified energy opportunities. Reveal dashboard launched.	GF/CIP BLDG.			
76	Contingency	\$399,903	\$38,207.00	\$438,110						\$438,110.00		CSP 074 PD2 Array 1/A Removal	CASR RENEW			
77	Steam Migration Study		\$40,286.00	\$40,286						\$40,286.00		Report provided, services complete	CASR BLDG.			
78	Owner-Driven/Unforeseen-condition Cost Increase 1/8/24		<mark>\$180,150.00</mark>	<mark>\$180,150</mark>						<mark>\$180,150.00</mark>			GF/CIP BLDG.			

\$1,311,297

EPC Schedule G-2: Proposed Financial Cost and Cash Flow Analysis

Table 1 – Project General Inputs and Representative Cash Flow

Chy and County of Denver Project Pro Forma (Representative I	r EPC Financial Perform	mance of EF	PC Project)																		MCKEASURY the Life Of Your Building
			<u> </u>																		~
Genc. I Inputs						Annual Savi	ngs				Solar Mair	ntenance							Cash Flow Analys	5	
PC Program Total	\$ 16,916,474	Year 2023 Start	Electric	PECo	Electric (PV	Nat Cac	Stoom	Chillod Wator	Total Utility	PV Service	PV Inverter	PV DAS	PV DE/RE-	Total Savings	M&V Cost	Savings Less M&V	Interact	Drincipal	Total Propert	Loan Balanco	Appual Cach Flow
rd Party Fee (%)	0.0%		(non-PV)	NLCS	Production)	Nat Gas	Jtean		Savings	Contract***	(by	by	Install****			& Maintenance	Intelest	гппстрат	Total	Loan balance	Annual Cash Flow
rd Party Fee (\$)	- ¢ 3.091.977	0	\$322,229	\$0	\$53,765	¢11 750	(\$7,442)	\$41,415	\$409,967	\$0	\$0 ¢0	\$0	\$0 ¢0	\$409,967	\$0 (#72,600)	\$409,967	\$0 (¢221,354)	\$0 (#923 21)	\$0 (\$1.044.730)	\$13,834,597	\$0 (#147.101)
ncentives (Applied to Yr 1 savings -> payment)**	\$ 21,032	2	\$506,708	\$39,486	\$69,127	\$17,418	\$82,054	\$120,686	\$835,479	(\$11,181)	\$0 \$0	\$0	\$0 \$0	\$824,298	(\$41,837)	\$782,460	(\$208,180)	(\$02,577)	(\$1,044,730)	\$11,764,703	(\$262,270)
Constr. Period Int. (Capitalized)	\$	3	\$518,869	\$39,288	\$70,432	\$18,202	\$85,746	\$123,583	\$856,120	(\$11,405)	\$0	\$0	\$0	\$844,715	(\$42,835)	\$801,880	(\$194,795)	(\$849,935)	(\$1,044,730)	\$10,914,767	(\$242,850)
ears of Analysis	\$ 13,834,597 30	4	\$531,322 \$544,073	\$39,092	\$73,117	\$19,021 \$19,877	\$93,605	\$126,549	\$877,350 \$899,187	(\$11,633)	\$0	(\$4,637)	\$0	\$865,717	\$0	\$865,717 \$882,684	(\$181,154)	(\$853,534)	(\$1,044,730)	\$9,173,882	(\$179,013)
inance Term (Yrs)	15	6	\$557,131	\$38,702	\$74,497	\$20,772	\$97,851	\$132,696	\$921,649	(\$12,103)	\$0	\$0	\$0	\$909,546	\$0	\$909,546	(\$153,342)	(\$891,388)	(\$1,044,730)	\$8,282,494	(\$135,185)
ayment Type ndicative Interest Rate	Fixed	7 8	\$570,502	\$38,508	\$75,904	\$21,707 \$22,683	\$102,254	\$135,881 \$139,142	\$944,755	(\$12,345)	\$0 \$0	\$0 \$0	\$0 \$0	\$932,410	\$0 \$0	\$932,410	(\$139,079) (\$124,589)	(\$905,651)	(\$1,044,730) (\$1,044,730)	\$7,376,843 \$6,456,702	(\$112,320)
	1.00 %	9	\$598,21	\$38,124	\$78,797	\$23,704	\$111,664	\$142,481	\$992,985	(\$12,844)	\$0	\$0	\$0 \$0	\$980,141	\$0 \$0	\$550,141	(\$109,867)	(\$934,863)	(\$1,044,730)	\$5,521,839	(\$64,589)
Annual Savings (2023 basis)	¢4,424,209	10	\$612,572	\$37,933	\$80,285	\$24,771	\$116,689	\$145,901	\$1,018,151	(\$13,101)	\$0 ¢0	(\$5,120)	\$0 ¢0	\$999,930	\$0 ¢0	\$999,930	(\$94,909)	(\$949,821)	(\$1,044,730)	\$4,572,018	(\$44,800)
lectric (non-PV)	\$494,832	11	\$642,329	\$37,555	\$83,345	\$27,050	\$121,940	\$149,402	\$1,070,694	(\$13,630)	\$0	\$0	\$0	\$1,050,083	\$0	\$1,057,064	(\$64,271)	(\$980,459)	(\$1,044,730)	\$2,626,541	\$12,334
lectric (PV Production & Rate Switch)	\$67,846	13	\$657,744	\$37,367	4 918	\$28,268	\$133,161	\$156,660	\$1,098,119	(\$13,903)	(\$43,231)	\$0	\$0	\$1,040,985	\$0	\$1,040,985	(\$48,584)	(\$996,146)	(\$1,044,730)	\$1,630,395	(\$3,745)
lectric (PV RECs) Tears of non-PV Energy Savings	\$39,684	<u>14</u>	\$673,530 \$689,695	\$37,180	\$86,52	\$29,540	\$139,153 \$145,415	\$160,419	\$1,126,345 \$1,155,399	(\$14,181)	\$0 \$0	\$0	\$0	\$1,112,164	\$0 \$0	\$1,112,164 \$1,058,627	(\$32,646) (\$16,452)	(\$1,012,084) (\$1,028,278)	(\$1,044,730) (\$1,044,730)	\$618,310 (\$409,967)	\$67,434
latural Gas	\$16,668	16	<i>\\</i>	\$36,810	\$89,819	0/005	<i>Q1107110</i>	\$10 I/L/ 0	\$126,629	(\$14,753)	\$0	\$0	\$0	\$111,876	\$0	\$111,876	\$0	\$0	\$0	\$0	\$111,876
iteam	\$78,520	17		\$36,626	\$91,515				\$128,141	(\$15,049)	\$0	\$0	±0	\$113,092	\$0	\$113,092	\$0	\$0	\$0	\$0	\$113,092
Nilled Water	\$0	10		\$36,260	\$95,003				\$129,085	(\$15,657)	\$0	\$0	\$0 \$0	\$114,336	\$0 \$0	\$114,336	\$0	\$0	\$0 \$0	\$0	\$114,336
		20		\$36,079	\$96,797				\$132,876	(\$15,970)	\$0	(10,241)	\$0	\$110,665	\$0	\$110,665	\$0	\$0	\$0	\$0	\$110,665
Service Costs V Annual O&M Cost (Yr 2) ***	(\$10,330)	21		+ +	\$98,625				\$98,625 \$100,487	(\$16,289)	\$0 \$0	\$0 \$0	\$0 \$0	\$82,336	\$0 \$0	\$82,336 \$83,872	\$0 \$0	\$0 \$0	\$0 \$0	\$0 \$0	\$82,336
V Data Acquisition System (\$/term)	(\$4,200)	23			\$102,384				\$102,384	(\$16,947)	\$0	\$0	\$0	\$85,437	\$0	\$85,437	\$0	\$0	\$0	\$0	\$85,437
V Data Acquisition System Term (years)	5	24		+ +	\$104,317				\$124,317	(\$17,286)	\$0 ¢0	\$0	\$0 ¢0	\$87,031	\$0 ¢0	\$87,031	\$0 ¢0	\$0	\$0 ¢0	\$0	\$87,031
Escalation Rates		26			\$100,280				\$108,293	(\$17,984)	(\$37,936)	\$0	\$0	\$52,372	\$0	\$52,372	\$0	\$0	\$0	\$0	\$52,372
lectric Utility Cost	2.4%	27			\$110,338				\$110,338	(418,344)	\$0	\$0	\$0 ¢0	\$91,993	\$0	\$91,993	\$0	\$0	\$0	\$0	\$91,993
iteam	4.5%	28			\$112,421				\$112,47	(\$18, 1)	\$0 \$0	\$0	\$0	\$95,710	\$0 \$0	\$93,710	\$0 \$0	\$0 \$0	\$0 \$0	\$0 \$0	\$95,458
hilled water	2.4%	30			\$116,706				\$116,706	(\$19,467)	\$0	(\$7,608)	\$0	\$89,631	\$0	\$89,631	\$0	\$0	\$0	\$0	\$89,631
nnual PV Savings Degradation	0.5%	Totals Notes:	\$8,758,605	\$757,087	\$2,704,619	\$341,527	\$1,613,132	\$2,082,02	\$16,257,904	(\$433,748)	(\$81,_58)	(\$36,149)	(\$76,655)	\$15,874,217	(\$157,273)	\$15,716,944	(\$1,836,354)	(\$13,834,597)	(\$15,670,951)	\$94,788,012	\$45,993
V Annual O&M Cost	2.0%	* Include	es investment gra	ade audit fee																	
V Inverter Replacement Cost (Equipment)	-1.0%	** Xcelei	nergy incentives	are contingent	on final appr	oval. Amounts	shown ar for	reference only.													
W Data Acquisition System Cost 0&M Savings Last Year	18	**** By Oth	ers (CCD Respon	sibility)	2+ by others																
		Yr 0 (construc	ction period) ene	rgy savings are	estimated o	nly															
ear 1 M&V Cost	\$72,600	l otal paymen	t in year 1 includ	es construction	n period savir																
ear 2 M&V Cost	\$41,837																				
ear 3 M&V Cost rd Party Fee (%)	\$42,835																				
1&V End Year	3																				
laintenance Service Cost	\$0																				
PV Specific																					
EC Value (\$/kWh-year)	\$0.0375																				
EC End Year	20																				
C kW Roof Mounted	97.6																				
nverter Material Replacement Cost (2020)	(\$49,265)																				
stimated Inverter Replacement Interval rs of 3rd Party PV O&M *	13 30																				
powerED saving		Ì																			
	22.01 - CCD																				
owerED measure name	PowerED 50%																				
lectric	\$100,773																				
latural Gas	\$9,819																				
chiller water	\$30,334																				
utidential and Proprietary																					



EPC Schedule G-2: Proposed Financial Cost and Cash Flow Analysis

City and County of Denver EPC

City and County of Denver Project Pro Forma (Representative	r EPC Financial Perfe	ormance of	EPC Proje	ct)																M	ICK instry For The Life Of Your Building
Conoral Inputs						مع ادبيمم	lings				Solar Main	tenance				Total Annual		(ash Flow Analys	sis	
EPC Program Total 3rd Party Fee (%)	\$ 16,729,602 0.0%	Year 2023 Start	Electric (non-PV)	RECs	Electric (PV Production)	Nat Gas	Steam	Chilled Water	Total Utility Savings	PV Service Contract***	PV Inverter Replacement	PV DAS Subscription	PV DE/RE- Install****	Total Savings	M&V Cost	Savings Less M&V & Maintenance	Interest	Principal	Total Payment	Loan Balance	Annual Cash Flow
3rd Party Fee (\$)	\$ -	0	\$276,495	\$0	\$49,684		(\$5.984)	\$39,166	\$359,362	\$0	\$0	\$0	\$0	\$359.362	\$0	\$359.362	\$0	\$0	\$0	\$13,472,685	\$0
Initial Customer Capital* (PO & Cash Amounts)	\$ 3.256.917	1	\$396,474	\$34,275	\$65,094	\$11,759	\$59,265	\$100,306	\$667,173	\$0	\$0	\$0	\$0	\$911,205	(\$72,600)	\$838,605	(\$215,563)	(\$801,837)	(\$1,017,400)	\$ 12,311,486	(\$178,795)
Incentives (Applied to Yr 1 savings -> payment)*	\$ 244,032	2	\$457,585	\$34,104	\$66,323	\$17,418	\$81,618	\$118,244	\$775,293	(\$11,181)	\$0	\$0	\$0	\$764,112	(\$41,837)	\$722,274	(\$202,734)	(\$814,666)	(\$1,017,400)	\$11,496,820	(\$295,126)
Constr. Period Int. (Capitalized)	\$ -	3	\$468,567	\$33,933	\$67,575	\$18,202	\$85,291	\$121,082	\$794,651	(\$11,405)	\$0	\$0	\$0	\$783,246	(\$42,835)	\$740,411	(\$189,699)	(\$827,701)	(\$1,017,400)	\$10,669,119	(\$276,989)
Financed Cost	\$ 13,472,685	4	\$479,813	\$33,763	\$68,851	\$19,021	\$89,129	\$123,988	\$814,566	(\$11,633)	\$0	\$0	\$0	\$802,933	\$0	\$802,933	(\$176,456)	(\$840,944)	(\$1,017,400)	\$9,828,174	(\$214,467)
Years of Analysis	30	5	\$491,328	\$33,595	\$70,151	\$19,877	\$93,140	\$126,964	\$835,055	(\$11,866)	\$0	(\$4,637)	\$0	\$818,552	\$0	\$818,552	(\$163,001)	(\$854,399)	(\$1,017,400)	\$8,973,775	(\$198,848)
Finance Term (Yrs)	15	6	\$503,120	\$33,427	\$71,475	\$20,772	\$97,331	\$130,011	\$856,136	(\$12,103)	\$0	\$0	\$0	\$844,033	\$0	\$844,033	(\$149,330)	(\$868,070)	(\$1,017,400)	\$8,105,705	(\$173,367)
Payment Type	Fixed	7	\$515,195	\$33,259	\$72,825	\$21,707	\$101,711	\$133,131	\$877,829	(\$12,345)	\$0	\$0	\$0	\$865,483	\$0	\$865,483	(\$135,441)	(\$881,959)	(\$1,017,400)	\$7,223,746	(\$151,917)
Indicative Interest Rate	1.60%	8	\$527,560	\$33,093	\$74,200	\$22,683	\$106,288	\$136,326	\$900,151	(\$12,592)	\$0	\$0	\$0	\$887,559	\$0	\$887,559	(\$121,330)	(\$896,070)	(\$1,017,400)	\$6,327,676	(\$129,841)
	· · · · ·	9	\$540,221	\$32,928	\$75,601	\$23,704	\$111,071	\$139,598	\$923,123	(\$12,844)	\$0	\$0	\$0	\$910,279	\$0	\$910,279	(\$106,993)	(\$910,407)	(\$1,017,400)	\$5,417,269	(\$107,121)
Annual Savings (2023 basis)		10	\$553,187	\$32,763	\$77,028	\$24,771	\$116,069	\$142,949	\$946,766	(\$13,101)	\$0	(\$5,120)	\$0	\$928,546	\$0	\$928,546	(\$92,426)	(\$924,974)	(\$1,017,400)	\$4,492,295	(\$88,854)
Baseline Utility Spend	\$4,434,308	11	\$566,463	\$32,599	\$78,482	\$25,886	\$121,292	\$146,379	\$971,102	(\$13,363)	\$0	\$0	\$0	\$957,739	\$0	\$957,739	(\$77,627)	(\$939,773)	(\$1,017,400)	\$3,552,521	(\$59,661)
Electric (non-PV)	\$446,861	12	\$580,058	\$32,436	\$79,964	\$27,050	\$126,751	\$149,892	\$996,152	(\$13,630)	\$0	\$0	\$0	\$982,522	\$0	\$982,522	(\$62,590)	(\$954,810)	(\$1,017,400)	\$2,597,711	(\$34,878)
Electric (PV Production & Rate Switch)	\$65,094	13	\$593,980	\$32,274	\$81,474	\$28,268	\$132,454	\$153,490	\$1,021,939	(\$13,903)	(\$43,231)	\$0	\$0	\$964,806	\$0	\$964,806	(\$47,313)	(\$970,087)	(\$1,017,400)	\$1,627,624	(\$52,594)
Electric (PV RECs)	\$34,275	14	\$608,235	\$32,113	\$83,012	\$29,540	\$138,415	\$157,174	\$1,048,488	(\$14,181)	\$0	\$0	\$0	\$1,034,307	\$0	\$1,034,307	(\$31,792)	(\$985,608)	(\$1,017,400)	\$642,016	\$16,907
Years of non-PV Energy Savings	15	15	\$622,833	\$31,952	\$84,579	\$30,869	\$144,643	\$160,946	\$1,075,822	(\$14,464)	\$0	(\$5,653)	(\$76,655)	\$979,051	\$0	\$979,051	(\$16,022)	(\$1,001,378)	(\$1,017,400)	(\$359,362)	(\$38,349)
Natural Gas	\$16,668	16		\$31,792	\$86,176				\$117,968	(\$14,753)	\$0	\$0	\$0	\$103,215	\$0	\$103,215	\$0	\$0	\$0	\$0	\$103,215
Steam	\$78,104	17		\$31,633	\$87,803				\$119,436	(\$15,049)	\$0	\$0	\$0	\$104,388	\$0	\$104,388	\$0	\$0	\$0	\$0	\$104,388
Chilled Water	\$115,473	18		\$31,475	\$89,461				\$120,936	(\$15,350)	\$0	\$0	\$0	\$105,587	\$0	\$105,587	\$0	\$0	\$0	\$0	\$105,587
D&M	\$0	19		\$31,318	\$91,150				\$122,468	(\$15,657)	\$0	\$0	\$0	\$106,811	\$0	\$106,811	\$0	\$0	\$0	\$0	\$106,811
		20		\$31,161	\$92,871				\$124,032	(\$15,970)	\$0	(\$6,241)	\$0	\$101,821	\$0	\$101,821	\$0	\$0	\$0	\$0	\$101,821
Service Costs		21			\$94,624				\$94,624	(\$16,289)	\$0	\$0	\$0	\$78,335	\$0	\$78,335	\$0	\$0	\$0	\$0	\$78,335
PV Annual O&M Cost (Yr 2) ***	(\$10,330)	22			\$96,411				\$96,411	(\$16,615)	\$0	\$0	\$0	\$79,796	\$0	\$79,796	\$0	\$0	\$0	\$0	\$79,796
PV Data Acquisition System (\$/term)	(\$4,200)	23			\$98,231				\$98,231	(\$16,947)	\$0	\$0	\$0	\$81,284	\$0	\$81,284	\$0	\$0	\$0	\$0	\$81,284
PV Data Acquisition System Term (years)	5	24			\$100,085				\$100,085	(\$17,286)	\$0	\$0	\$0	\$82,799	\$0	\$82,799	\$0	\$0	\$0	\$0	\$82,799
		25			\$101,975				\$101,975	(\$17,632)	\$0	(\$6,891)	\$0	\$77,453	\$0	\$77,453	\$0	\$0	\$0	\$0	\$77,453
Escalation Rates		26			\$103,900				\$103,900	(\$17,984)	(\$37,936)	\$0	\$0	\$47,980	\$0	\$47,980	\$0	\$0	\$0	\$0	\$47,980
Electric Utility Cost	2.4%	27			\$105,862				\$105,862	(\$18,344)	\$0	\$0	\$0	\$87,518	\$0	\$87,518	\$0	\$0	\$0	\$0	\$87,518
Natural Gas	4.5%	28		++	\$107,861				\$107,861	(\$18,711)	\$0	\$0	\$0	\$89,150	\$0	\$89,150	\$0	\$0	\$0	\$0	\$89,150
Steam	4.5%	29		++	\$109,897				\$109,897	(\$19,085)	\$0	\$0	\$0	\$90,812	\$0	\$90,812	\$0	\$0	\$0	\$0	\$90,812
Chilled water	2.4%	30			\$111,972				\$111,972	(\$19,467)	\$0	(\$7,608)	\$0	\$84,897	\$0	\$84,897	\$0	\$0	\$0	\$0	\$84,897
Annual PV Savings Degradation	0.5%	Totals	\$7,904,621	\$653,894	\$2,594,913	\$341,527	\$1,604,470	\$2,040,481	\$15,139,906	(\$433,748)	(\$81,168)	(\$36,149)	(\$76,655)	\$14,756,219	######	\$14,598,946	(\$1,788,315)	(\$13,472,685)	(\$15,261,000)	\$92,906,575	(\$662,054)
O&M Cost Savings	2.0%	Notes:																			
PV Annual O&M Cost	2.0%	* Include	es investment	grade audit fe	36																
DV/Invertor Deplecement Cost (Equipment)	1 00/	** Voolor	oorau incontius	an are conting	ont on final	anneound A	mounte chouve	are for refer	anco anlu												

2.0%

18

** Xcel energy incentives are contingent on final approval. Amounts shown are for reference only.
 ** Yr 1 PV 0&M included in EPC Cost, yrs 2+ by others
 *** By Others (CCD Responsibility)
 Yr 0 (construction period) energy savings are estimated only
 Total payment in year 1 includes construction period savings

Measurement & Verification	
Year 1 M&V Cost	\$72,600
Year 2 M&V Cost	\$41,837
Year 3 M&V Cost	\$42,835
3rd Party Fee (%)	0.0%
M&V End Year	3
Maintenance Service Cost	\$0

PV Data Acquisition System Cost

O&M Savings Last Year

PV Specific	
REC Value (\$/kWh-year)	\$0.0375
REC End Year	20
DC kW Installed Total	794.6
DC kW Roof Mounted	97.6
Inverter Material Replacement Cost (2020)	(\$49,265)
Estimated Inverter Replacement Interval	13
Yrs of 3rd Party PV O&M *	30

powerED savings	
	22.01 - CCD
powerED measure name	PowerED
First Year powerED savings %	50%
Electric	\$100,773
Natural Gas	\$9,819
Steam	\$37,678
Chilled Water	\$30,334
Confidential and Proprietary	

EPC Schedule G-2: Proposed Financial Cost and Cash Flow Analysis

Table 2 – Overall Project Costing Detail (Combined)				
Cost of Services (MCP) via this Agreement:	\$2,346,783 \$2,526,933			
Cost of Equipment (MEP) via the Escrow Agreement:	\$13,834,597 \$13,472,685			
Cost of Direct Purchase Equipment (MDPEP) via the Purchase Order:	\$735,094			
Total Project Value to be Paid to Contractor:	\$16,916,474 \$16,734,712			

Table 3 – Project Costing Percentages (CEO Costing Template)

Α.	Technical Energy Audit			
В.	Total Facility Area	(Gross Square Footage)	1,942,863	Per TEA Contract
C.	\$ / SqFt		\$ 0.200	Per TEA Contract
D.				
E.	Implementation Costs		Actual % of Total Project Cost	% Maximum Per TEA Contract
F.	Pre-Construction	Costs		
G.		8.0%		
н.		3.0%		
Ι.	Other Pre-Construction Costs 2.9%		3.0%	
J.				
к.	Construction Cost	S		
L.				-
О.		7.0%		
Ρ.		Project Engineering	1.9%	2.0%
Q.		General Conditions	1.5%	1.5%
R.		Construction Completion 4.0%		4.0%
s.		Other Construction Costs	4.0%	4.0%
т.				
U.	Estimated Project A	mount		
v.	Profit		10.0%	10.0%
W	. Contingency		3.0%	4.0%

Certification that Cost-weighted Average Service Life of Equipment Exceeds Financing Term

ECM Name and Reference Number	Facility	Cost of Equipment	Service Life 🔟	Weighted Service Life Value
01.01-FS21 Boiler Replacement	Fire Station #21	\$320,994	25	0.580
01.02-FS24 Boiler Replacement	Fire Station #24	\$221,305	25	0.400
01.06-CCB Steam Condensate Heat Recovery	City and County Building	\$148,377	22	0.236
01.06-DCL Steam Condensate Heat Recovery	Denver Crime Lab	\$147,175	22	0.234
01.06-PAB Steam Condensate Heat Recovery	Police Administration Building PAB	\$114,551	22	0.182
02.01-CCB Chilled Water Pump Replacement	City and County Building	\$217,758	20	0.315
03.04-POA V/VT to VAV Unit Replacement	Denver Police Academy	\$392.086	15	0.425
03.07-PAB MZU to VAV Unit	Police Administration Building PAB	\$130,805	15	0.423
03.13-PD1 Upgrade Air Cooled Chiller	Police District 1	\$699.564	23	1.163
03.13-PD3 Upgrade Air Cooled Chiller	Police District #3	\$631,886	23	1.051
04.01-CCB BAS Controls Upgrade/ Replacement	City and County Building	\$754,093	15	0.818
04.01-PAB BAS Controls Upgrade/ Replacement	Police Administration Building PAB	\$793,231	15	0.860
04.01-POA BAS Controls Upgrade/ Replacement	Denver Police Academy	\$138,145	15	0.150
04.02-CMP Occupancy Based HVAC Controls	The Commons on Champa	\$69,661	15	0.076
04.02-PAB Occupancy Based HVAC Control	Police Administration Building PAB	\$132,676	15	0.144
04.02-PMB Occupancy Based HVAC Controls	Permit Building	\$60,684	15	0.066
04.07-RAC Ventilation Control	Rose Andom Center	\$73,976	17.5	0.094
08.05-PD1 Add VFDs to Building Pumps	Police District 1	\$125,456	12	0.109
08.05-PD3 Add VFDs to Building Pumps	Police District #3	\$109,173	12	0.095
09.01-CCB Interior LED Lighting Upgrades	The Commons on Champa	\$374,035	20	0.342
09.01-CMP Interior LED Lighting Upgrades	South Charpy Crook Transfer Station	\$242,408	20	0.350
09.01-DAS Interior LED Lighting Upgrades	Denver Municipal Animal Shelter	\$112 516	12	0.034
09 01-DCL Interior LED Lighting Upgrades	Denver Crime Lab	\$167 516	12	0.050
09.01-EM5 Interior LED Lighting Upgrades	Eleet Maintenance Building #5	\$39,223	12	0.034
09.01-FS2 Interior LED Lighting Upgrades	Fire Station #2	\$30,794	12	0.027
09.01-FS21 Interior LED Lighting Upgrades	Fire Station #21	\$17,027	12	0.015
09.01-FS22 Interior LED Lighting Upgrades	Fire Station #22	\$13,397	12	0.012
09.01-FS24 Interior LED Lighting Upgrades	Fire Station #24	\$10,005	12	0.009
09.01-FS26 Interior LED Lighting Upgrades	Fire Station #26	\$31,706	12	0.028
09.01-GPO Interior LED Lighting Upgrades	Gary Price Operations Building	\$102,945	12	0.089
09.01 LFC Interior LED Lighting Upgrades-	Lindsay Flanigan Courthouse	\$862,211	12	0.748
09.01-LFC Interior LED Lighting Upgrades	Lindsay-Flanigan Courthouse	\$779,868	12	0.676
09.01-OFM Interior LED Lighting Upgrades	South Osage Fleet Maintenance Garage	\$29,689	12	0.026
09.01-PAB Interior LED Lighting Upgrades	Police Administration Building PAB	\$225,736	12	0.196
09.01-PD2 Interior LED Lighting Upgrades	Police District 2	\$53,819	12	0.047
09.01-PD3 Interior LED Lighting Upgrades	Police District #3	\$07,802	12	0.059
09.01-POA Interior LED Lighting Ungrades	Denver Police Academy	\$50,938	12	0.207
09.01-RAC Interior LED Lighting Upgrades	Rose Andom Center	\$65,394	12	0.057
09.01-VDC Interior LED Lighting Upgrades	Van Cise-Simonet Detention Center	\$620,559	12	0.538
09.01-VDC Interior LED Lighting Upgrades	Van Cise-Simonet Detention Center	\$402,159	12	0.349
09.02-CMP Exterior LED Lighting Upgrades	The Commons on Champa	\$3,556	12	0.003
09.02-CTS Exterior LED Lighting Upgrades	South Cherry Creek Transfer Station	\$11,580	12	0.010
09.02-DAS Exterior LED Lighting Upgrades	Denver Municipal Animal Shelter	\$3,030	12	0.003
09.02-DCL Exterior LED Lighting Upgrades	Denver Crime Lab	\$13,155	12	0.011
09.02-FM5 Exterior LED Lighting Upgrades	Fleet Maintenance Building #5	\$35,529	12	0.031
09.02-FS2 Exterior LED Lighting Upgrades	Fire Station #2	\$6,911	12	0.006
09.02-FS21 Exterior LED Lighting Upgrades	Fire Station #21	\$869	12	0.001
09.02-FS22 Exterior LED Lighting Upgrades	Fire Station #22	\$145	12	0.000
09.02-F524 Exterior LED Lighting Upgrades	Fire Station #24	\$3,941 60.206	12	0.003
09.02-F326 Exterior LED Lighting Upgrades	Gan Price Operations Building	\$9,590	12	0.008
09.02-GFO Exterior LED Lighting Upgrades	Lindsay-Flanigan Courthouse	\$23,542	12	0.021
09.02-DEM Exterior LED Lighting Upgrades	South Osage Elect Maintenance Garage	\$6 199	12	0.020
09.02-PAB Exterior LED Lighting Upgrades	Police Administration Building PAB	\$48,813	12	0.042
09.02-PD2 Exterior LED Lighting Upgrades	Police District 2	\$25,750	12	0.022
09.02-PMB Exterior LED Lighting Upgrades	Permit Building	\$2,817	12	0.002
09.02-POA Exterior LED Lighting Upgrades	Denver Police Academy	\$9,040	12	0.008
09.02-RAC Exterior LED Lighting Upgrades	Rose Andom Center	\$7,692	12	0.007
09.02-VDC Exterior LED Lighting Upgrades	Van Cise-Simonet Detention Center	\$28,518	12	0.025
10.01-FS2 Solar Photovoltaic - Roof	Fire Station #2	\$398,261	30	0.864
10.01-PD3 Solar Photovoltaic- Roof	Police District #3	\$908,603	30	1.970
10.02 - POA Solar Photovoltaic - Canopy	Denver Police Academy	\$805,274	30	1.746
10.02-FM5 Solar Photovoltaic - Canopy	Fieet Maintenance Building #5	\$480,338	30	1.042
10.02 PD2 Solar Photovoltaic - Canopy	Police District 2	\$1,218,850 \$1.157.667	3U 20	2.643
13 04-CMP Replace Single Pape Windows	The Commons on Champa	\$1,137,007	30 40	2.510
Total - For All Measures by Category		\$13,834.507	V T	0.999 <u>21.1</u>
Total - For All Measures by Category		\$13,472,685		20.7

Certification that Cost-weighted Average Service Life of Equipment Exceeds Financing Term

Notes
(1) Using Schedule B Cost values for equipment to be financed
(2) Service Life (indicate source of service life by ECM on the following table). See IGA Section 3 of the main report body.
(3) Total of ECM/FIM Individual Average Service Life Values
Formula: Cost-Weighted Average Service Life = \sum ((each ECM cost × service life) ÷ total construction cost)
(4) Financing Agreement Term from final Principal Representative financing documents
(Section 24-30-2001(1)(d), C.R.S. states that the maximum term of the payments shall be less than the Cost-
Weighted Average Useful (service) Life of utility cost-savings equipment for which the contract is made, not
to exceed 25 years)

Schedule Y-2

FORM OF ACCEPTANCE CERTIFICATE NO. 59 of 141 FOR ENERGY SERVICES EQUIPMENT Appendix A Item 59, McKinstry December 13, 2021, as amended, Equipment Lease Purchase Agreement

Re: Equipment Lease Purchase Agreement (the "Lease") dated December 13, 2021, as amended, between JPMorgan Chase Bank, N.A., as Lessor, and the City and County of Denver, Colorado (the "City"), as Lessee.

To: JPMorgan Chase Bank, N.A. 1111 Polaris Parkway, Suite 4N Mail Suite OH1-1085 Columbus, Ohio 43240 Attn: Operations Managers Phone: 1-800-678-2601 E-mail: cefi.escrow.disbursement.request@jpmchase.com

and

U.S. Bank National Association Attn: Erica Fouks, Trust Finance Management, 60 Livingston Avenue, EP-MN-WS3T St. Paul, MN 55107-2292 E-mail: <u>Erica.Fouks@usabank.com</u>

In accordance with the Lease and a related Escrow Agreement, the undersigned City Representative hereby certifies and represents to, and agrees with the Lessor as follows:

(1) The Equipment described in the Lease at Exhibit A as Item 59 described for McKinstry have been delivered, installed, tested and accepted on the date hereof.

(2) The City has conducted such inspection and testing of this Equipment as it deems necessary and appropriate and hereby acknowledges that it accepts this Equipment for all purposes.

(3) No event or condition that constitutes, or with notice or lapse of time, or both, would constitute, an Event of Default (as defined in the Lease) exists at the date hereof.

(4) The Lessor is hereby requested to approve the payment of, and the Escrow Agent is hereby requested to pay, the Vendor designated below as Payee, the sum of One Million Two Hundred Eighteen Thousand Eight Hundred Thirty Six Dollars (\$1,218,836.00) One Million One Hundred Fifty Seven Thousand Six Hundred Sixty Seven (\$1,157,667) in payment of all of the cost of the acquisition, delivery, and testing of the Equipment listed at Item 59 described for McKinstry on Exhibit A to the Lease. Such amount is due and payable under the invoice of the Payee attached hereto with respect to the cost of the acquisition, delivery, installation and testing of the Equipment and has not formed the basis of any prior request for payment. The Equipment for which this payment is to be made is all of the "Equipment" listed at Item 59 described for McKinstry in Exhibit A to the Lease. Pursuant to paragraph 4 of the Escrow Agreement, the Escrow Agent is to notify the Manager of Finance that this payment has been made.

Payee: McKinstry, Inc. 16025 Table Mountain Parkway, Suite 100 Golden, CO 80403

Payee's Federal ID Number: _____

(5) If all Acceptance Certificates have been completed with the processing of this Acceptance Certificate, then coincident with the payment of the Vendor pursuant to (4) above, the Escrow Agent is hereby directed to pay all amounts remaining in the Acquisition Fund in accordance with paragraph 4 of the Escrow Agreement.

City and County of Denver, Colorado, as Lessee

By: _____ Manager of General Services (as City Representative under the Lease)

Acceptance Date: _____

APPROVED:

JPMorgan Chase Bank, N.A., as Lessor

By:_____

Title:

FORM OF ACCEPTANCE CERTIFICATE NO. 70 of 141 FOR ENERGY SERVICES EQUIPMENT Appendix A Item 70, McKinstry December 13, 2021, as amended, Equipment Lease Purchase Agreement

Re: Equipment Lease Purchase Agreement (the "Lease") dated December 13, 2021, as amended, between JPMorgan Chase Bank, N.A., as Lessor, and the City and County of Denver, Colorado (the "City"), as Lessee.

To: JPMorgan Chase Bank, N.A. 1111 Polaris Parkway, Suite 4N Mail Suite OH1-1085 Columbus, Ohio 43240 Attn: Operations Managers Phone: 1-800-678-2601 E-mail: cefi.escrow.disbursement.request@jpmchase.com

and

U.S. Bank National Association Attn: Erica Fouks, Trust Finance Management, 60 Livingston Avenue, EP-MN-WS3T St. Paul, MN 55107-2292 E-mail: <u>Erica.Fouks@usabank.com</u>

In accordance with the Lease and a related Escrow Agreement, the undersigned City Representative hereby certifies and represents to, and agrees with the Lessor as follows:

(1) The Equipment described in the Lease at Exhibit A as Item 70 described for McKinstry have been delivered, installed, tested and accepted on the date hereof.

(2) The City has conducted such inspection and testing of this Equipment as it deems necessary and appropriate and hereby acknowledges that it accepts this Equipment for all purposes.

(3) No event or condition that constitutes, or with notice or lapse of time, or both, would constitute, an Event of Default (as defined in the Lease) exists at the date hereof.

(4) The Lessor is hereby requested to approve the payment of, and the Escrow Agent is hereby requested to pay, the Vendor designated below as Payee, the sum of **Eight Hundred Sixty Two Thousand Two Hundred Eleven Dollars (\$862,211.00)** Seven Hundred Seventy Nine **Thousand Eight Hundred Sixty Eight (\$779,868.00)** in payment of all of the cost of the acquisition, delivery, and testing of the Equipment listed at Item 70 described for McKinstry on Exhibit A to the Lease. Such amount is due and payable under the invoice of the Payee attached hereto with respect to the cost of the acquisition, delivery, installation and testing of the Equipment and has not formed the basis of any prior request for payment. The Equipment for which this payment is to be made is all of the "Equipment" listed at Item 70 described for McKinstry in Exhibit A to the Lease. Pursuant to paragraph 4 of the Escrow Agreement, the Escrow Agent is to notify the Manager of Finance that this payment has been made.

Payee: McKinstry, Inc. 16025 Table Mountain Parkway, Suite 100 Golden, CO 80403

Payee's Federal ID Number: _____

(5) If all Acceptance Certificates have been completed with the processing of this Acceptance Certificate, then coincident with the payment of the Vendor pursuant to (4) above, the Escrow Agent is hereby directed to pay all amounts remaining in the Acquisition Fund in accordance with paragraph 4 of the Escrow Agreement.

City and County of Denver, Colorado, as Lessee

By: _____ Manager of General Services (as City Representative under the Lease)

Acceptance Date: _____

APPROVED:

JPMorgan Chase Bank, N.A., as Lessor

By:_____

Title:

Schedule Y-2

FORM OF ACCEPTANCE CERTIFICATE NO. 76 of 141 FOR ENERGY SERVICES EQUIPMENT Appendix A Item 76, McKinstry December 13, 2021, as amended, Equipment Lease Purchase Agreement

Re: Equipment Lease Purchase Agreement (the "Lease") dated December 13, 2021, as amended, between JPMorgan Chase Bank, N.A., as Lessor, and the City and County of Denver, Colorado (the "City"), as Lessee.

To: JPMorgan Chase Bank, N.A. 1111 Polaris Parkway, Suite 4N Mail Suite OH1-1085 Columbus, Ohio 43240 Attn: Operations Managers Phone: 1-800-678-2601 E-mail: cefi.escrow.disbursement.request@jpmchase.com

and

U.S. Bank National Association Attn: Erica Fouks, Trust Finance Management, 60 Livingston Avenue, EP-MN-WS3T St. Paul, MN 55107-2292 E-mail: <u>Erica.Fouks@usabank.com</u>

In accordance with the Lease and a related Escrow Agreement, the undersigned City Representative hereby certifies and represents to, and agrees with the Lessor as follows:

(1) The Equipment described in the Lease at Exhibit A as Item 76 described for McKinstry have been delivered, installed, tested and accepted on the date hereof.

(2) The City has conducted such inspection and testing of this Equipment as it deems necessary and appropriate and hereby acknowledges that it accepts this Equipment for all purposes.

(3) No event or condition that constitutes, or with notice or lapse of time, or both, would constitute, an Event of Default (as defined in the Lease) exists at the date hereof.

(4) The Lessor is hereby requested to approve the payment of, and the Escrow Agent is hereby requested to pay, the Vendor designated below as Payee, the sum of Six Hundred Twenty Thousand Five Hundred Fifty Nine Dollars (\$620,559.00) Four Hundred Two Thousand One Hundred Fifty Nine (\$402,159) in payment of all of the cost of the acquisition, delivery, and testing of the Equipment listed at Item 76 described for McKinstry on Exhibit A to the Lease. Such amount is due and payable under the invoice of the Payee attached hereto with respect to the cost of the acquisition, delivery, installation and testing of the Equipment and has not formed the basis of any prior request for payment. The Equipment for which this payment is to be made is all of the "Equipment" listed at Item 76 described for McKinstry in Exhibit A to the Lease. Pursuant to paragraph 4 of the Escrow Agreement, the Escrow Agent is to notify the Manager of Finance that this payment has been made.

Payee: McKinstry, Inc. 16025 Table Mountain Parkway, Suite 100 Golden, CO 80403

Payee's Federal ID Number: _____

(5) If all Acceptance Certificates have been completed with the processing of this Acceptance Certificate, then coincident with the payment of the Vendor pursuant to (4) above, the Escrow Agent is hereby directed to pay all amounts remaining in the Acquisition Fund in accordance with paragraph 4 of the Escrow Agreement.

City and County of Denver, Colorado, as Lessee

By: _____ Manager of General Services (as City Representative under the Lease)

Acceptance Date: _____

APPROVED:

JPMorgan Chase Bank, N.A., as Lessor

By:_____

Title: