



City of Louisville

Internal Decarbonization Plan

POLICE & MUNICIPAL COURT DECARBONIZATION AUDIT REPORT

992 WEST VIA APPIA
LOUISVILLE, COLORADO
AUGUST 18, 2023

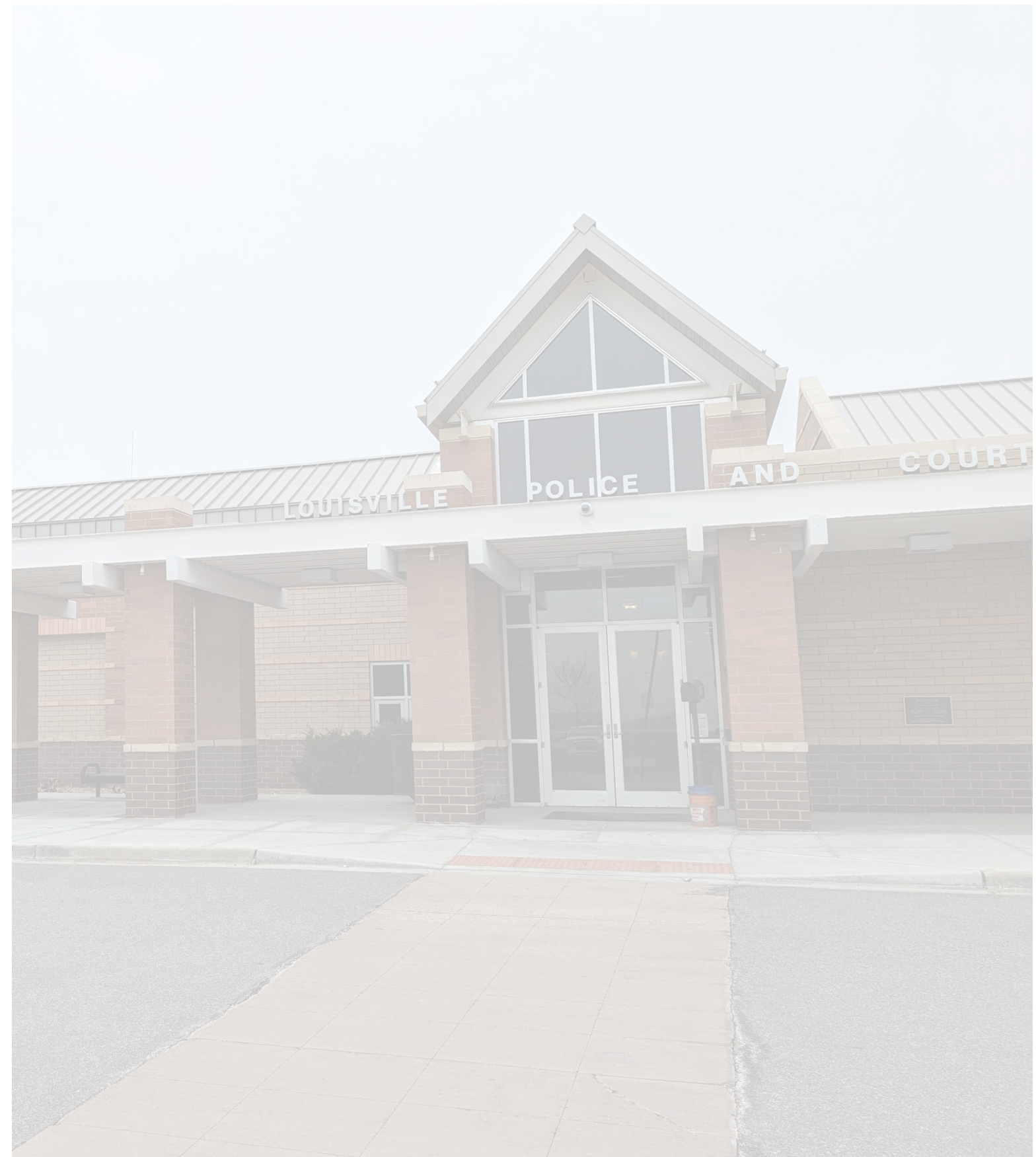
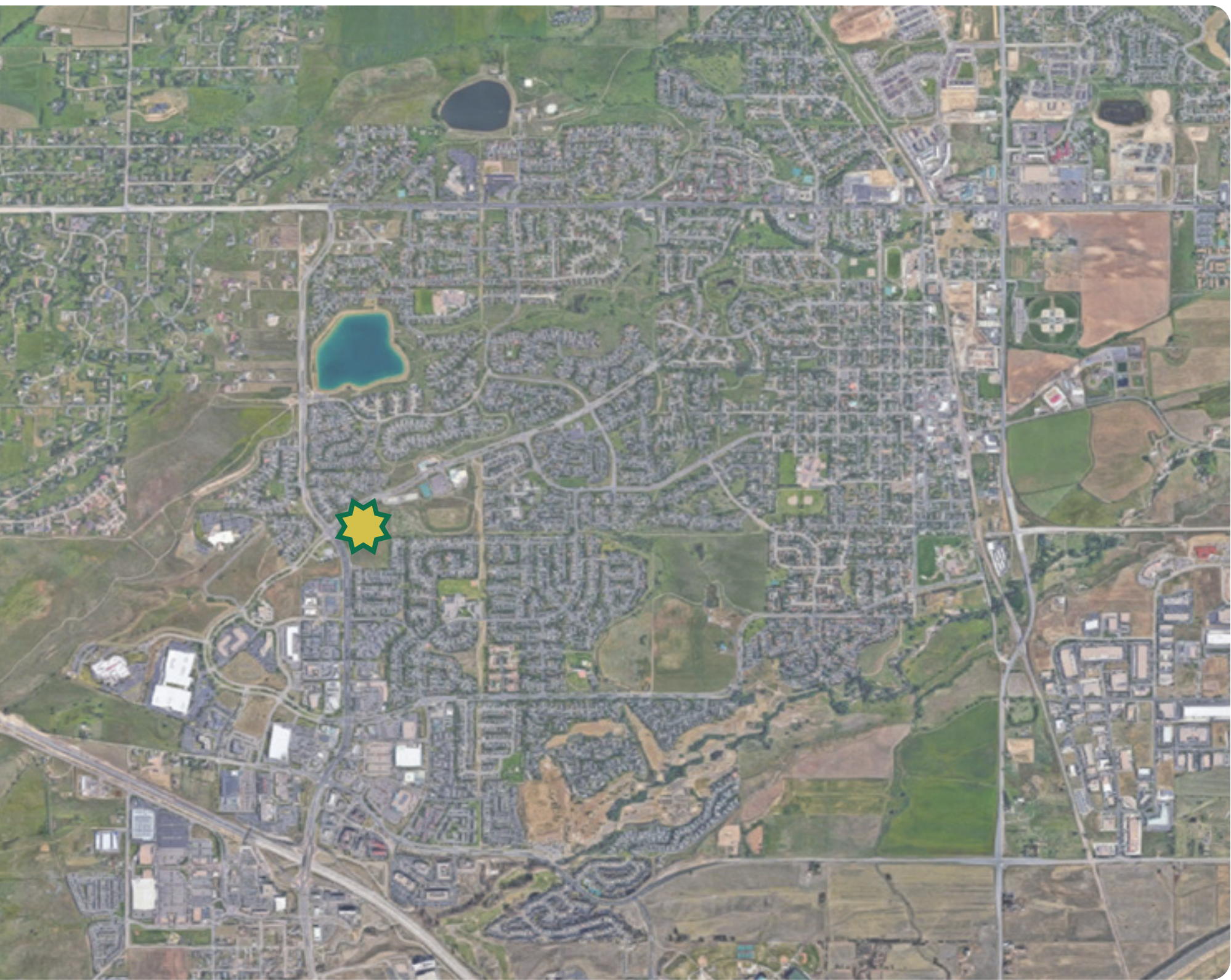


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Date	Version History
3/28/2023	Version 1 - Issued for City Review and Input
8/18/2023	Version 2 - Issued to City

Background

In August of 2019, City Council passed Resolution 25, Series 2019, which set clean energy and carbon emission reduction goals for the municipality and larger community. This resolution sets goals to meet all of Louisville’s municipal electric needs with 100% carbon-free sources by 2025, and to reduce core municipal greenhouse gas emissions annually below the 2016 baseline through 2025. The City of Louisville has demonstrated its commitment toward creating a healthy and sustainable environment for its residents, evident through Resolution 25-2019 (Setting Clean Energy and Carbon Emission Reduction Goals), as well as their Sustainability Action Plan (adopted in October 6, 2020). In support of these goals, McKinstry was contracted to identify a strategic roadmap for electrification and decarbonization of all City buildings, fleet, equipment and operations* by 2030, and recommend an alternative target if appropriate.

This is an interim report, providing initial directions, findings, as well as a draft set of detailed decarbonization approaches for the Police & Municipal Court.

*Does not include water, wastewater, street lighting/signals

There are many possible pathways for decarbonizing Louisville. With guidance from City staff, this report focuses on identification of strategies that provide the highest value, most fiscally responsible path forward to achieve Louisville’s decarbonization goals.



Decarbonization Recommendation

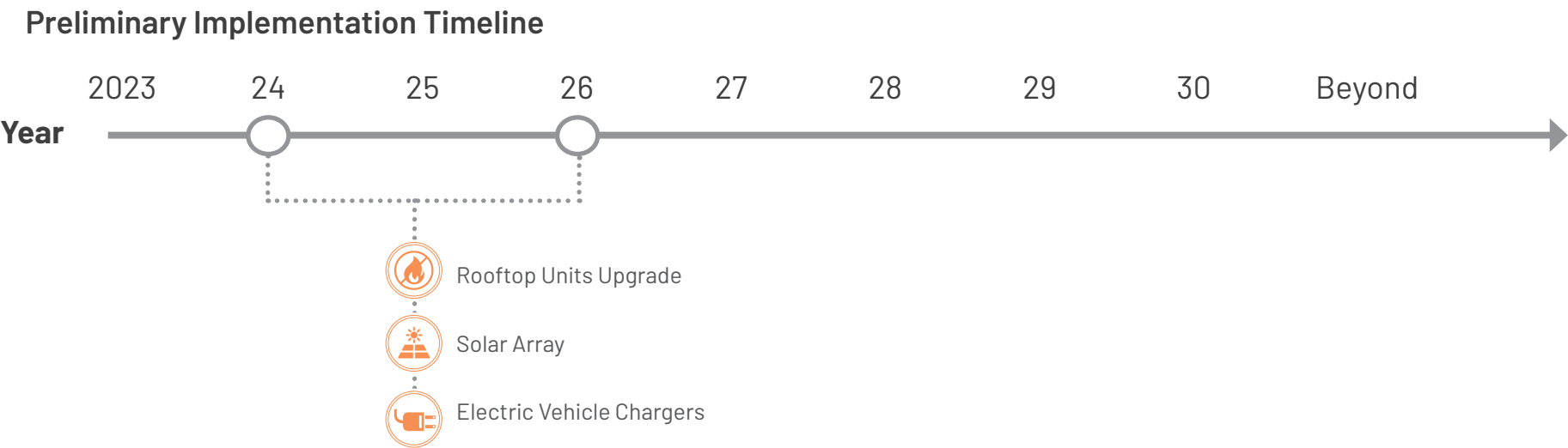
The table below outlines the findings of the study, and highlights the opportunity to use hybrid electrification as a viable and cost-effective path towards carbon neutrality. The total cost is the total amount of money that will need to be allocated for budgetary purposes. The net cost is the total construction costs minus the replacement costs that would’ve been spent to replace the existing units with like-for-like fossil fuel units. The net cost represents the true cost of this decarbonization effort. All information included in this table is explained in greater detail in this report. **These are “all-in costs” and represent the total cost of construction. They are also Rough Order of Magnitude (ROM) numbers, with a +/-20% range.** See “Construction Pricing Context” section for more detail.

	Scenario	Life Cycle Carbon Reduced	Life Cycle Carbon % Reduction	Total First Cost	Net First Cost Over Business as Usual Cost
	Full Electrification	1,000 tons	100%	\$4M	\$3M
	Hybrid Electrification	900 tons	90%	\$2M	\$1M
	Renewables	N/A	N/A	\$1M*	N/A
	EV Charging	N/A	N/A	\$250k	N/A

*Renewable costs do not account for funding from the Inflation Reduction Act (IRA).

Implementation

A preliminary implementation timeline is shown below, based on the 2023 Capital Improvement Plan (CIP).



Baseline | Building Use & Energy and Carbon Analysis

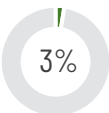
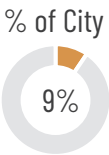
Baseline Building Use

Baseline Year
2019

Building Size
23,912 ft²

Building Energy
87 EUI

Building Carbon
68 Tons



Building Information

- Built in 2004.
- Primary use is police station & courthouse.
- The police side of the building is occupied 24x7.
- The courthouse is occupied 8:00AM-5:00PM Mondays - Fridays.

Recent Renovations and Energy Improvements

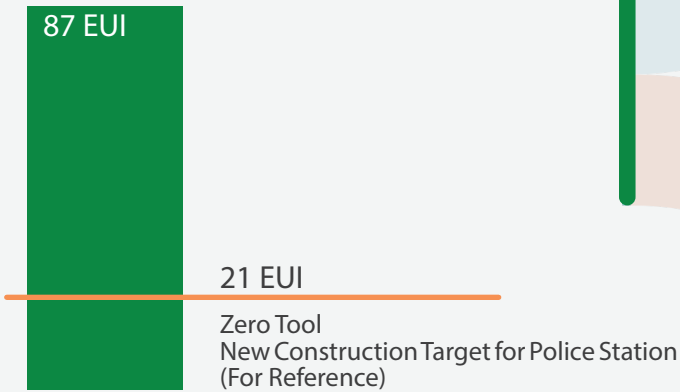
- Current - Basement Remodel
- 2022/2023: LED Lighting Upgrades



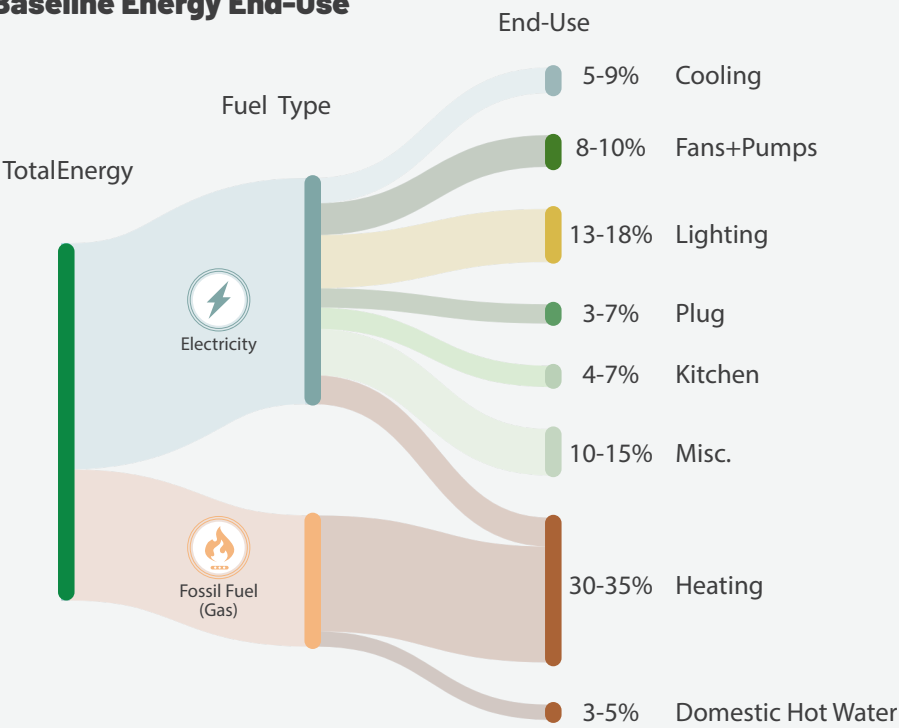
Baseline Energy Use

Baseline energy use at the Police & Municipal Court is shown below. The energy end-use diagram details how energy is consumed at the building. Baseline Annual Energy Use shows how the Police & Municipal Court performs relative to the new construction targets for

Baseline Annual Energy Use Intensity (EUI)



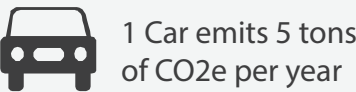
Baseline Energy End-Use



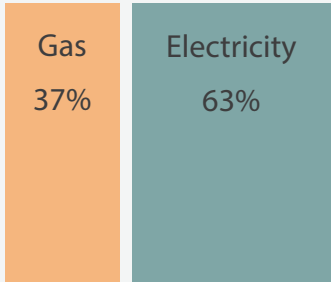
Baseline Carbon Use

The City of Louisville participates in programs to offset their existing electrical consumption with renewable sources. **Therefore, for the purposes of this study the total carbon emissions at Louisville will be solely driven by on-site fossil fuel combustion and emissions associated with electric consumption will be zero.**

The amount of electric consumption offset needed for zero carbon will be addressed in future phases of this study, and will be evaluated at the portfolio level. The offset will be a function of post-decarbonization electrical consumption considering carbon and load reduction measures, on-site renewable energy provided, and the grid emissions of the Xcel Energy.



Baseline Energy



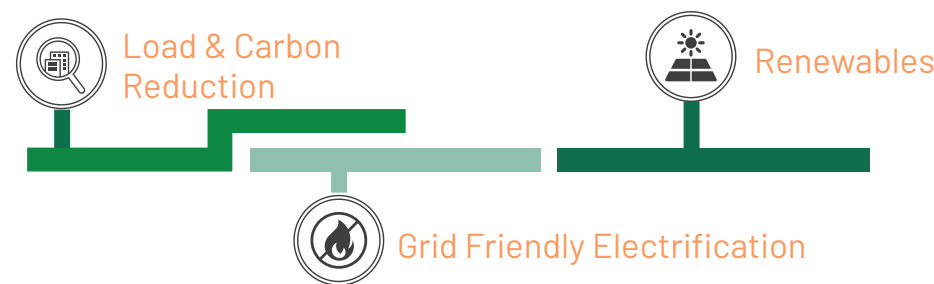
Baseline Carbon



Decarbonization Measures | Decarbonization Process, Load & Carbon Reductions

Decarbonization Process

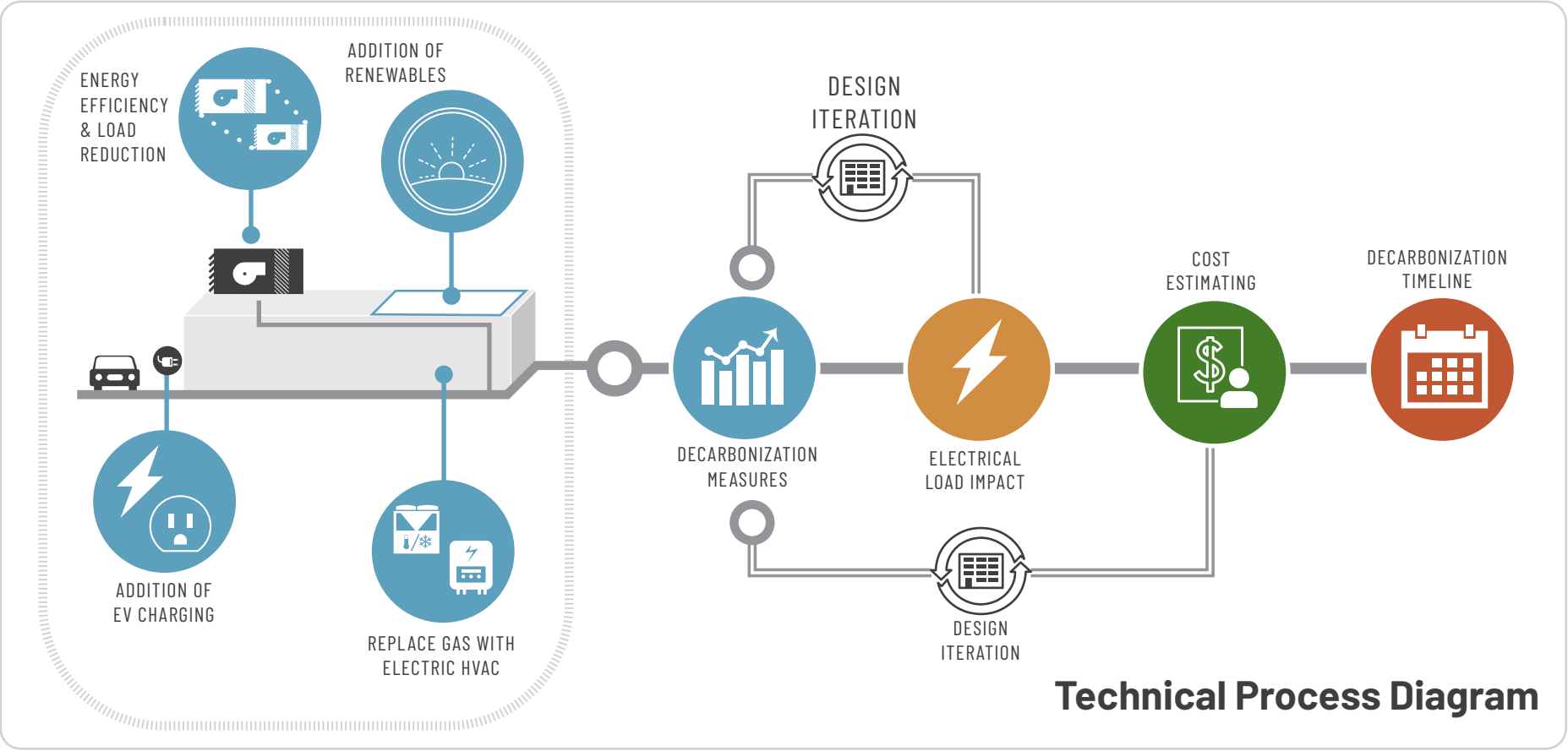
There are a host of measures to employ on the path of decarbonization, ranging from time-tested traditional energy efficiency measures to the more aggressive electrification measures. The key to decarbonization is finding the right balance between measures, as indicated by the graphic below. With this approach, Louisville will find the most cost-effective path to full decarbonization.



The decarbonization solution starts by identifying measures at the building, and continues with design iteration to arrive at the final timeline, as seen in the Technical Process Diagram.

Load & Carbon Reduction

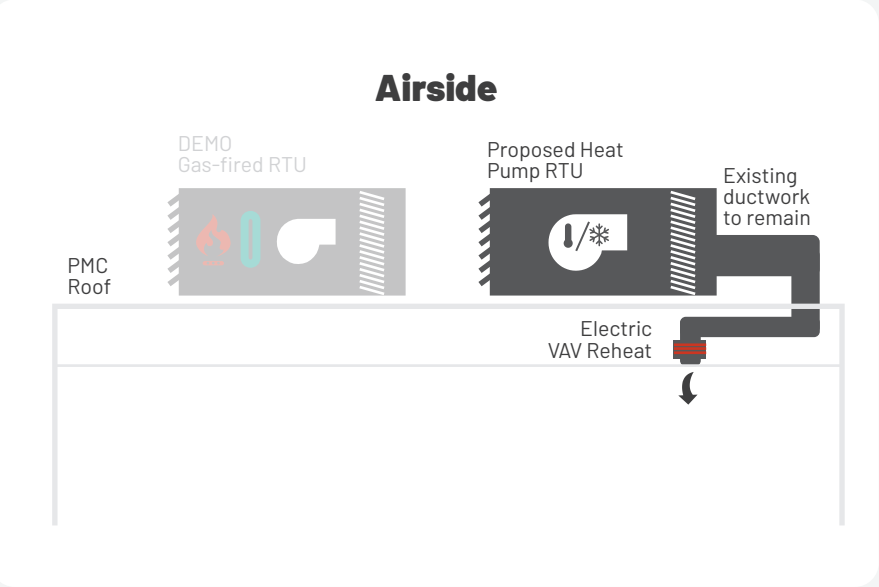
The recent shift towards decarbonization still operates on the core foundation of reducing building's overall energy use. Measures can have two functions: reducing annual energy/carbon consumption and reducing peak building demand load. Since this building is relatively new and has already had LED lighting installed, load reduction opportunities are minimal. These measures are often incentivized by Xcel and may have shorter paybacks.



Load	Carbon	Measure	Description
☐	☒	HVAC OCCUPANCY SENSORS	The building is used 24/7 but has long amounts of times when certain areas aren't occupied but could become occupied at any moment. HVAC occupancy sensors will allow the areas not being used to have an intermediate setback. This setback is not as big as an unoccupied setback so that the space can recover quickly when it is occupied.
☐	☒	SCHEDULING	The building currently has a building automation system. By reviewing the current schedule and checking that it meets the building usage and tightening up the occupied hours, savings can be realized by not conditioning the spaces when not occupied.
☐	☒	CONTROLS OPTIMIZATION / RETRO-COMMISSIONING (RCX)	This measure consists of reducing energy use through ongoing commissioning. This work focuses on identifying low- and no-cost opportunities to drive energy savings and optimize operational practices in the facilities. This is primarily accomplished through ongoing site audits, data analysis, training, and collaboration with the facility's operational team.
☒	☒	DUCT AIR SEALING/INSULATION	Sections of HVAC ducting which provide heating, cooling, and/or ventilation are a significant potential thermal and air leakage point – particularly because they are pressurized/under vacuum. Sealing joints with either mastic or volatilized sealant, and adding insulation saves energy and improves air quality.
☒	☒	ENVELOPE AIR SEALING	Buildings are often remarkably leaky – the wall/parapet junction being a frequent culprit. Ensuring a building is tight and ventilated right is an effective efficiency measure that also has durability benefits (condensation often occurs at air leakage points) and improves air quality (mold reduction and limiting outside air infiltration during wildfire events).
☐	☒	LIGHTING CONTROLS/VACANCY SENSORS	LED light replacements typically are the most cost effective way for saving electricity in the lighting arena, but adding lighting controls (which turn off lights with vacancy and vary based on available daylight) provide additional savings and better user experience (avoiding over-lighting).
☒	☒	ADVANCED PLUG LOAD REDUCTION	Items that are plugged into outlets – plug loads – often make up the single largest use of electricity in buildings, after heat pump heating and cooling. A dedicated, ongoing program for ensuring plug load items are actually needed, the most efficient available, and/or appropriately switched is a great way to save electricity.

Proposed HVAC Systems

The Police & Municipal Court’s primary HVAC system is a packaged Rooftop Unit (RTU). Simple diagrams of this systems and their proposed electrification measures are shown below.



AIRSIDE
Ventilation, heating, and cooling are supplied through (3) packaged rooftop units (RTUs), which provide cooling via packaged refrigerant and heating via gas-fired burner. Supply air is sent to VAV electric reheat boxes.

The decarbonized system will replace the gas fired RTUs with heat pump based RTUs that utilizes electric heat as backup. Backup heat is utilized to supplement the heat pump as temperatures drop and heat pump capacity is reduced or when temperatures drop below the heat pump operation limit. This is typically a small amount of time in the year and has minor energy impacts.

- The appendices to this Summary include:
- Appendix 1: Additional decarbonized mechanical systems that were considered
 - Appendix 2: Decarbonized mechanical system scoping documents and sketches

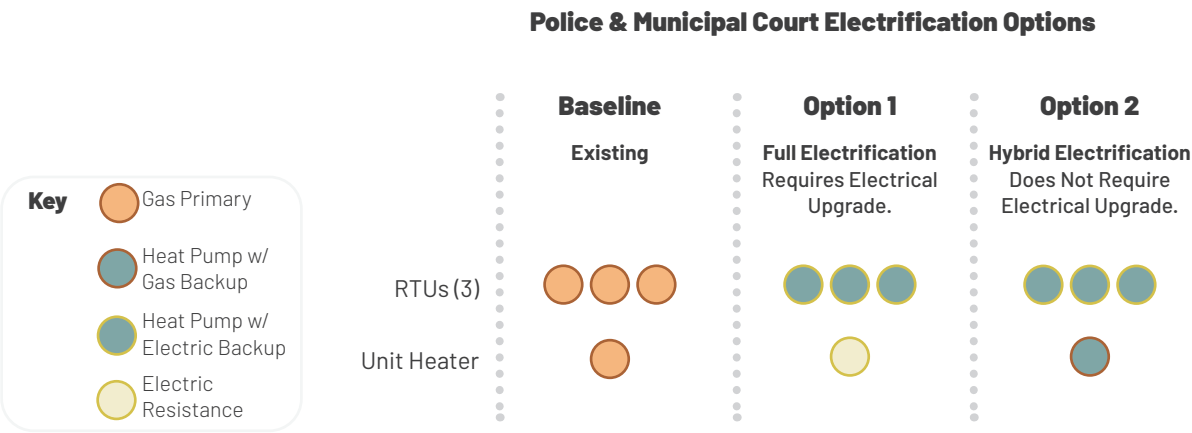
DOMESTIC HOT WATER

Domestic hot water (DHW) is currently served by an electric water heater, to remain as is.

All Electric vs Hybrid Systems

Hybrid systems are a useful tool for **sensible and cost-effective decarbonization**, as they strike a balance between carbon reduction, construction costs, and utility demand costs. In general, it can be expensive to electrify the “last 10%”, because the system is sized for the coldest day of the year, which rarely occurs. In many cases, using gas as the peaking fuel source on the coldest day will mitigate need for an electrical upgrade while still achieving significant carbon reductions.

Based on the sizes of the mechanical equipment and the load profile of the building, the Hybrid option for the Police & Municipal Court would use existing gas unit heaters for backup, while all other mechanical equipment would be all-electric. As described in the electrical impacts section, full electrification would require an electrical service upgrade.



Beneficial Electrification

- Electrification of mechanical systems provides value beyond energy and carbon savings. These include, but are not limited to:
- Enhanced ventilation control (outside-air supply, CO₂ Control, etc.) with new RTUs
 - Improved thermal comfort with right-sized RTUs and updated controls
 - Improved resiliency of newer units

Decarbonization Measures | Renewables & Electric Vehicle Chargers

Renewables

Renewable energy plays the important role of offsetting remaining carbon emissions after building load reductions and electrification has been made. This can be handled through a variety of avenues – behind-the-meter systems, Community Solar Gardens, and utility subscriptions. Since City of Louisville already offsets its current electricity with renewable utility subscriptions, we focused on customer-owned, behind-the-meter systems that would provide more value to the City of Louisville. At the Police and Courts Building, City of Louisville could install a 257kW-DC fixed-tilt ground mount solar PV system.



SIMPLE PAYBACK

Payback is an easy way to determine the value of a solar system. Solar PV systems last around 25-30 years. McKinstry typically only recommends systems that – including Inflation Reduction Act credits, utility incentives, and/or other funding sources – will pay back within the system lifetime. At this stage of evaluation, simple payback is used. However, if the project advances, more detailed cash flows and paybacks can be calculated.

INTERCONNECTION METHOD & INCENTIVES

Due to size and VOSE, the Police and Courts ground array would interconnect behind the utility meter and would qualify for Xcel's Solar*Rewards C&I Tier 2 incentive. This array was not considered for Community Solar since those gardens must typically be much larger (500kW-AC+) to make financial sense. Additionally, this solar project would be eligible for the Inflation Reduction Act (IRA) incentives, giving 25-30% of the solar cost back to City of Louisville depending on the chosen financing mechanism.

Note that first costs shown in this report do not yet account for the IRA savings.

ON-SITE VERSUS GRID PURCHASE

Some of the benefits of on-site solar vs renewables purchased from the grid are listed below.

- Avoid solar sprawl at scale - avoiding offsetting of impacts to rural areas.
- Avoid electrical energy loss due to transmitting power over long distances
- Dispersed approach is typically grid beneficial, especially when on-site renewables are a small percentage of the total usage of building - most solar on this bldg would be self used.
- Enable future resiliency through addition of batteries and storage.
- Demonstration of decarbonization to local Louisville community.

AVAILABLE ROOF SPACE & RACKING MODALITY

Solar systems benefit from economies of scale – generally, the larger the system, the cheaper it is per kW. The first constraint on system size is the available space on the property. Since ground mounts are typically the least expensive racking modality, we evaluate this first followed by rooftop and then parking canopies. Between the parking lot and walking trail, the Police and Courts Building can fit a 257kW-DC south-facing ground mount.

Electric Vehicle (EV) Chargers

The Police & Municipal Court has 8 administrative police vehicles and 21 patrol vehicles. The 8 administrative vehicles have varying use but typically aren't used as heavily. The patrol vehicles are used constantly and other than shift changes are typically not at the Police & Municipal Court.

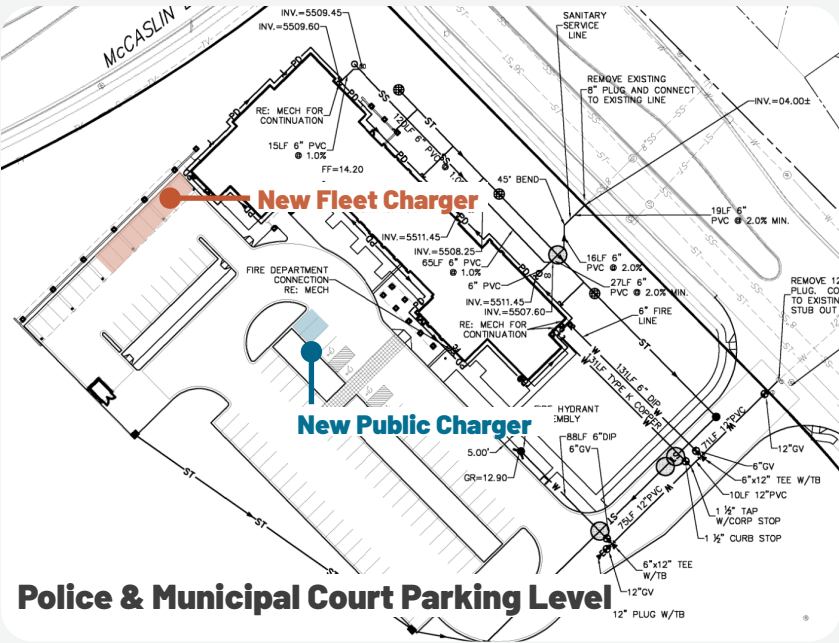
Per conversations with the city and Deputy Police Chief, this study will not address the electrification of police patrol fleet vehicles. At the time of this report, there is not a feasible electric vehicle that will meet the needs for police patrol fleet use. Additional details on this can be found in Appendix 5. This study will address electric vehicle chargers for the administrative vehicles.

We recommend installing 6 chargers and upgrading the electrical infrastructure to support the administrative police vehicles. Currently, no direct replacement for the police administrative vehicles if high performance is required. Depending on the departments preferences and use case, it may be possible to use existing EVs on the market. If not, it is anticipated police performance enhancements for EVs will be available in the next 5 to 10 years. The table below shows the number of recommended chargers if current administrative vehicles were replaced with EVs.

Existing Public Charging Stations	Existing Public Charger Level	Quantity of New Level 2 Public Chargers	Quantity of New Level 3 Public Chargers	Quantity of New Level 2 Fleet Chargers	Quantity of New Level 3 Fleet Chargers
0	N/A	1	0	4	1

At this site the chargers were split into two groups, public and fleet. The number of fleet chargers selected to be installed here were based on the number of vehicles stored on-site. In addition, one of the fleet chargers was selected to be a Level 3 charger to allow for quick recharge of a fleet vehicle if needed. An example of such a use case maybe for the plow vehicle used to clear the parking lot.

The quantity of public chargers selected for this site was minimal because there is limited public visitation at the site. No public Level 3 chargers were selected to be installed at this location.



Decarbonization Measures | Electrical and Structural Impacts

Electrical Impacts

ELECTRIFICATION WITHIN EXISTING SERVICE

The existing service to the Police and Municipal Court is 208 Volts (V), 3 phase, 1600 Amps (A).

Utility data was analyzed for the date range 11/2021 – 10/2022. This data shows the existing annual maximum demand of the Police and Municipal Court service is 117kW. Remaining existing capacity available for electrification projects (building HVAC or EV) is approximately 1151A, equating to approximately 333kW of additional equipment.

Of note, there is a basement remodel underway. Load addition associated with this basement remodel is captured in the 6-18-21 100% CD drawing package. It is assumed that any major electrification project would be performed sufficiently after the completion of the basement remodel project to allow for actual utility or metered load data to be used to set a building baseline.

Electrification of the 3 RTU's, installation of an Air Source Heat Pump within the 'garage/storage' and installation of the proposed L2 EV charging is expected to be achievable within the constraints of the existing service, provided that the load increase due to the basement remodel does not exceed approximately 80kW.

Of specific note, neither the L3 EV charging nor the proposed PV array can be accommodated without a service upgrade.

ELECTRIFICATION WITH UPGRADED SERVICE

A viable service upgrade solution has been conceptually designed. The service upgrade would install a new 480V, 3 phase, 1200A service. The existing power distribution system would be re-energized by the supply of a 500kVA power transformer. The new service switchboard and power transformer would be located approximately to the west of the existing electrical room outside the building. The service upgrade allows the following loads to be added to the electrification scope:

- Level 3 EV charging
- Garage back-up resistance heat
- Solar PV interconnect

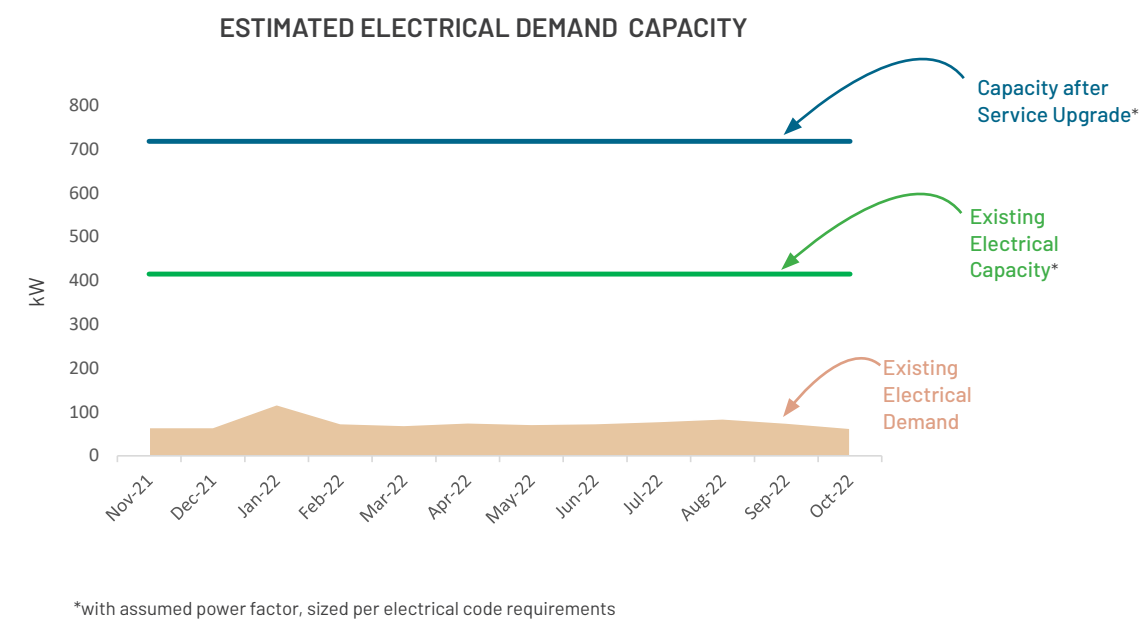
GENERATOR IMPACTS

The Police & Municipal Court includes a 150kW fossil gas standby generator, which provides backup power to code required loads as well as non-code required loads via panel EM1A. Loads are not segregated between code required and non-code required as required by current electrical codes. Any upgrade to the generator or associated generator power system may trigger a requirement to segregate the distribution, at the discretion of the AHJ.

The existing RTU-1 is served from the generator backed panel EM1A. RTU-1 is not required by code to be backed up, so is considered to be 'optional standby'. Generator sizing requires prescriptive load calculations which assume that all loads are operating concurrently at 100%. There is insufficient capacity within the existing generator to meet the prescriptive code calculation for a fully electrified RTU-1. An code allowable alternate is to utilize a 'load shed system' on optional standby load. In the event that the generator were overloaded, the sheddable load would be disconnected. We have taken this approach to allow the electrification of RTU-1 without replacing the generator. The likelihood of this occurring is considered remote (noting that the existing demand of the entire facility is 117kW and the generator only serves approximately 1/3 of the facility load).

There has been discussion about Level 3 EV charging being a critical load. To this end, a separate cost has been obtained to add a standalone diesel generator and Automatic Transfer Switch (ATS) to serve just the Level 3 charging load. Integration of this into the existing facility generation system is not practical given the size of the EV charging load and the voltage mismatch between the 208V generator and 480V Level 3 EV charger.

As noted on the previous page, electrification of the Police Patrol fleet and the accompanying EV chargers have not been included in this study. Allowing the Police Patrol fleet to charge at this site would require additional electrical service upgrades. This should be studied at a later date once more is known regarding Police Patrol fleet electrification.



Structural Impacts

Upgrades for the electrified heat pump RTUs will increase the overall load at the building roof but will not trigger structural upgrades to the existing bar joist support framing. The support framing per the original structural drawings were designed for 6" slab supporting the original RTU's for load distribution and acoustics. Even though RTU-1 replacement is heavier than the original unit, we do not anticipate triggering a structural upgrade for the replacement unit. The other replacement units weigh less than the original equipment and the roof framing is adequate for the revised loads. In addition, the existing openings in the deck for the supply and return ducts will be maintained with no need for added framing.

Structural upgrades are not required for the balance of the remaining mechanical equipment replacements in the building.

Decarbonization Measures | Proposed Electrification

Electrification Options



FULL ELECTRIFICATION – Full electrification at the Police & Municipal Court, including all-electric RTUs and electric unit heater. EV charging costs are not included in this option. **This option requires an electrical service upgrade. Includes costs associated with new generator to serve fully electrified loads.**

	Load & Carbon Reduction	Grid Friendly Electrification	Renewables
	Occupancy Sensors Controls Optimization Duct Air Sealing Envelope Air Sealing Lighting Controls Plug Load Reduction	Electrification Hybrid Electrification Full	On-Site Ground Mount PV
Total Cost	\$20k	\$4M	\$1M
Base Cost	N/A	\$1M	N/A
Net Cost of Electrification	N/A	\$3M	N/A

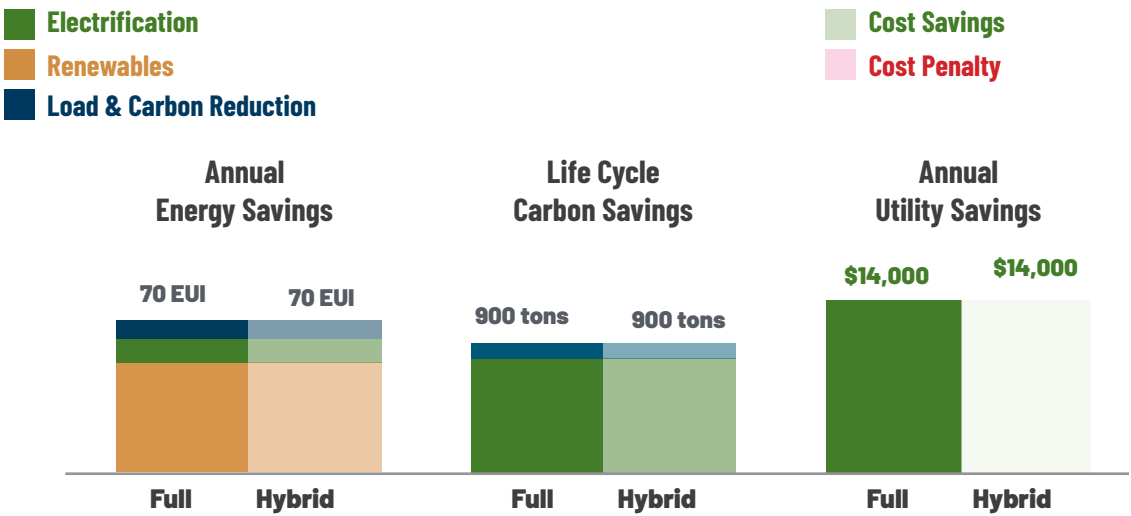


HYBRID ELECTRIFICATION – Hybrid Electrification includes all-electric RTUs. Garage unit heater to be replaced with heat pump, but gas backup to remain. EV charging costs are not included in this option. **Includes costs associated with connecting new equipment to existing generator.**

	Load & Carbon Reduction	Grid Friendly Electrification	Renewables
	Occupancy Sensors Controls Optimization Duct Air Sealing Envelope Air Sealing Lighting Controls Plug Load Reduction	Electrification Hybrid Electrification Full	On-Site Ground Mount PV
Total Cost	\$20k	\$2M	\$1M
Base Cost	N/A	\$1M	N/A
Net Cost of Electrification	N/A	\$1M	N/A

Proposed Annual Measure Savings

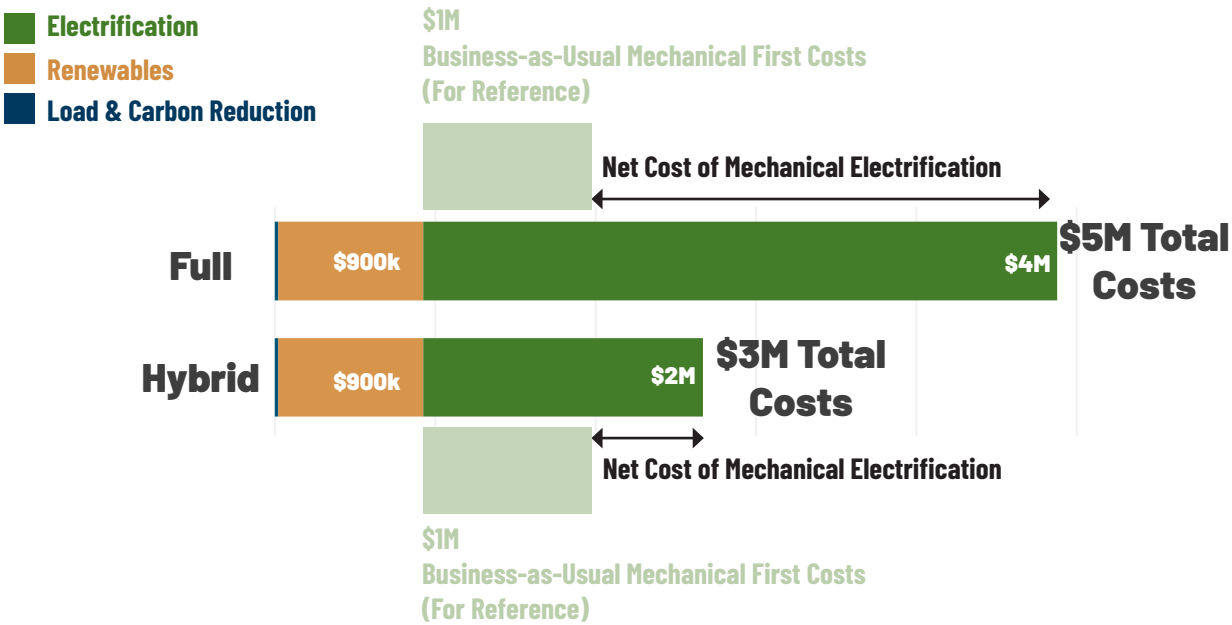
Energy, carbon, and utility cost savings of the proposed options are shown here. Note that both options show the same savings because the gas backup only operates during emergencies for the hybrid scenario. The renewable system is able to offset a significant amount of energy.



Proposed Total Measure Costs

Proposed measure costs are shown below, including any structural and electrical upgrades needed for each option. They are also Rough Order of Magnitude (ROM) numbers, with a +/-20% range.

The total cost is the total amount that will need to be allocated for budgetary purposes. The net cost represents the total cost minus the replacement cost that would've been spent to replace the existing units with like-for-like fossil fuel units. Note that there is a significant net cost premium for full electrification due to electrical upgrades.



Decarbonization Measures | Construction Pricing Context &Constructibility

Construction Pricing Context

The MEP scope narratives described in previous sections and included in the appendices were used by McKinstry’s construction division to provide Rough Order of Magnitude (ROM) pricing. This early ROM budgeting process sought to be reasonable but conservative wherever possible. **Typically for ROM-level pricing a range of +/- 20% is applied to the total construction and start up costs.** This range can be reduced, and the pricing further refined, via a deeper understanding of existing building conditions and detailed design. Note this does not account for escalation, which is addressed separately. This pricing represents the total construction and startup cost to Louisville, including:

- General contractor markup
- Design fees
- Engineering energy analysis
- Controls
- Equipment startup, commissioning, testing, and balancing
- Placeholders for miscellaneous trades (e.g. carpentry).
- Allowances specific to each building for construction conditions (e.g. crane time)

All construction costs are in 2023 dollars unless noted otherwise.

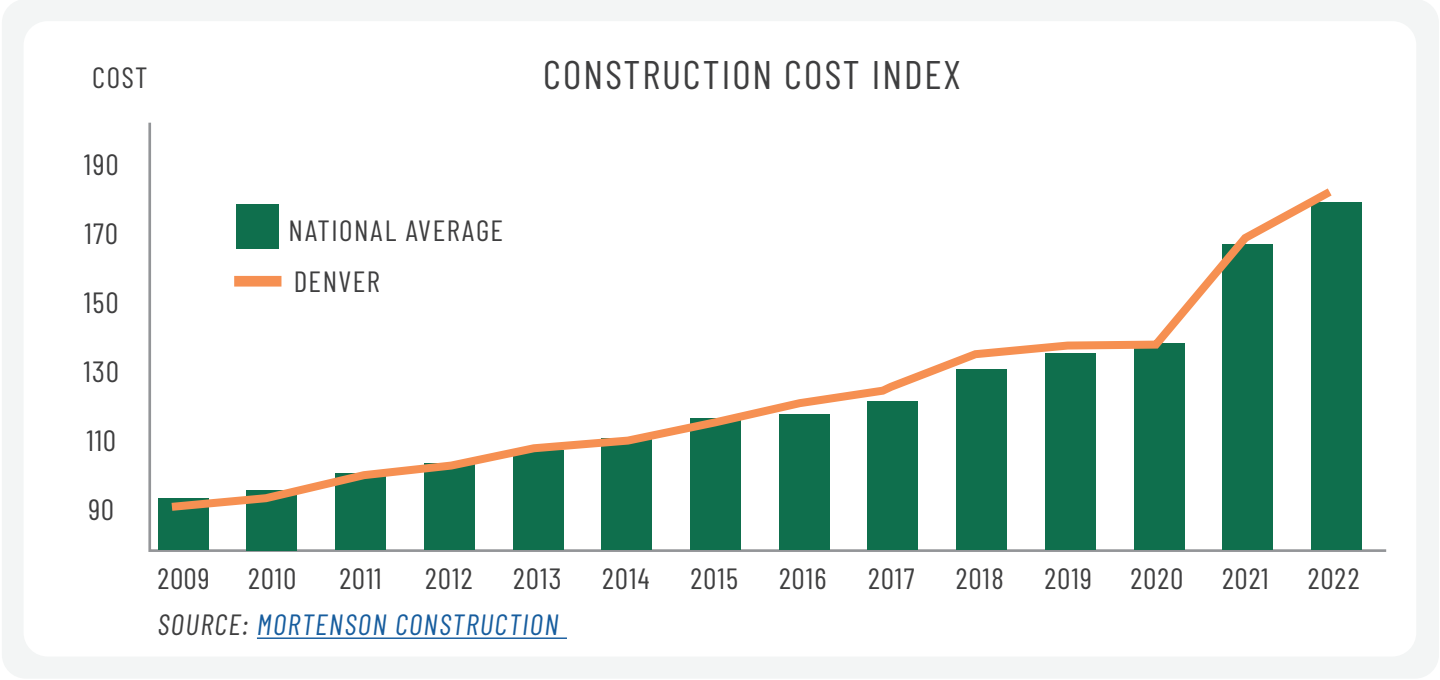
Using These Construction Costs

Throughout this report, differentiation is made between “total construction costs” and “net cost over business-as-usual fossil fuel systems”The distinction between the two is:

- Total costs: these are the total construction costs. This is the total amount of money that will need to be allocated for budgetary purposes.
- Net Cost: these are the total construction costs minus the replacement costs that would’ve been spent to replace the existing units with like-for-like fossil fuel units. These numbers represent the true cost of this decarbonization effort.

Note the numbers in the 2023 City Budget are budget numbers, and do not represent all costs for replacing the existing units. As such, they should not be used when determining the costs of decarbonization. In addition, the cost estimates in this report assume miscellaneous equipment (e.g. expansion tanks, etc.) need to be replaced. This assumption should be validated in detailed design, and could result in the total construction cost being lower if equipment can be reused.

As shown in the graph by the Mortenson, construction costs have been steadily rising since 2009. However, costs rose drastically from 2020 to 2022 (approximately 35%) due to global supply chain issues and unforeseen consequences of the COVID-19 pandemic.



Constructibility

Recent upheavals in the global supply chain and labor workforce have caused uncertainty in the construction market. Our construction teams are seeing the following trends as of March, 2023:

ELECTRICAL LEAD TIMES:

- Most commodity items, such as conduit, wire, fittings, etc. are readily available.
- Lead times for Switchboards are being quoted 50-80 weeks. Panel-boards can be 20-40 weeks depending on complexity.

MECHANICAL LEAD TIMES:

- 26-30 weeks for larger and more customized equipment (50 ton RTUs)
- Equipment needs to be ordered earlier in detailed design process to accommodate long lead times. Requires additional coordination earlier in design.

In order to combat these lead time challenges, design teams may need to be flexible with their specifications and the products/manufacturers they are selecting.

LABOR MARKET:

While we are seeing a general relaxing of labor shortages in other markets around the country, the contractor and labor shortages continue to persist in the Denver market.

Next Steps | Implementation, Next Steps

Implementation

A preliminary implementation timeline is shown below, based on the 2023 Capital Improvement Plan (CIP). Given the CIP replacement schedule, the Police & Municipal Court fits well within the 2030 timeline, meaning it is on schedule to implement decarbonized measures. The summary below is the implementation recommendation based on age of equipment as well as additional thoughts on emerging technologies and sequence of upgrades.

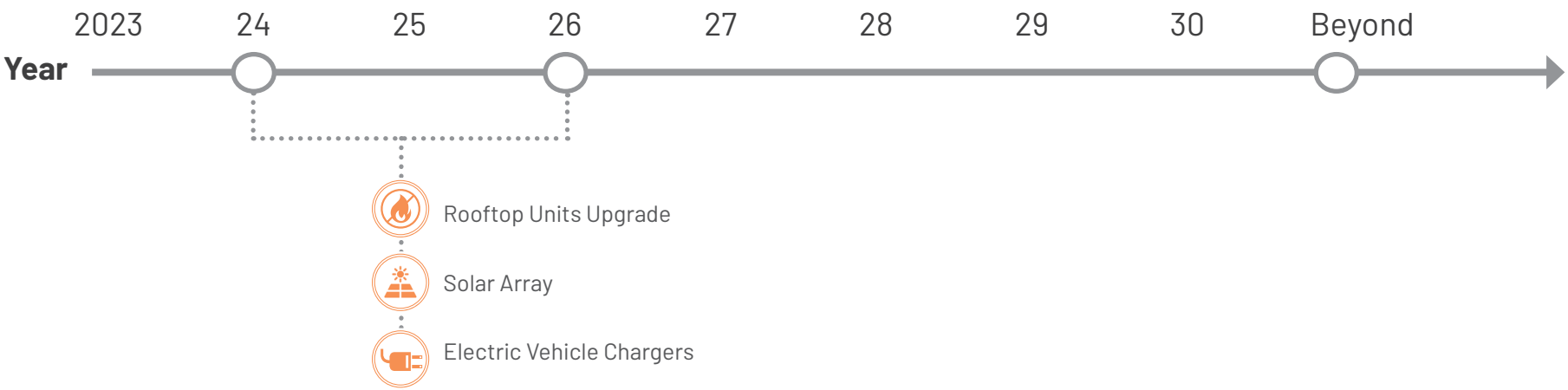
AIRSIDE

- As RTUs reach end of life, replace with pump alternatives. These replacements can be made over time as they will not trigger electrical or structural upgrades.

RENEWABLES

- Install 257 kW ground mount PV Array.

Preliminary Implementation Timeline





Appendix

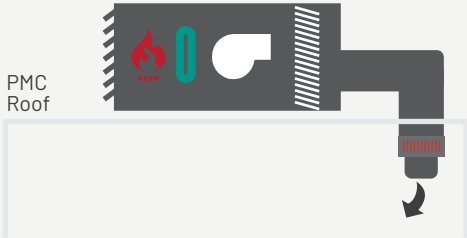
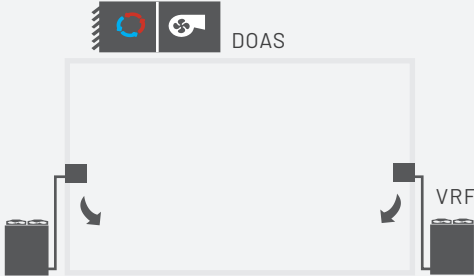
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2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating



Appendix

1. Mechanical System Matrix Options
2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating

HVAC System Matrix: Police & Municipal Court

	Existing System	Recommendation	High Performance Retrofit Alternate
General	Gas Rooftop Units	Rooftop Heat Pumps	VRF condenser farm on roof or grade. Zone fan coils with heat recovery. DOAS - ventilation.
Plant Equipment			
Extent of Retrofit	-	Minimal Reuse all downstream equipment	Extensive. Remove existing VAV boxes and electric reheat coils. Reuse existing medium pressure ductwork for ventilation air.
Electrical Impacts	-	Service Upgrade Probably Needed	Service Upgrade Probably Needed
Limiting Factor	-	None	Too Invasive
Verdict	-	Proceed w/ Detailed Scoping	Fast Fail



Appendix

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4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating

Police and Municipal Court – Mechanical Scope Narratives

Option 1 – Full Electrification

Demo Scope of Work:

- Includes removal and disposal of (3) RTUs and (1) gas-fired unit heater
 - Assumes cut, cap and make safe gas piping from each RTU and UH

New Scope of Work:

- Includes (3) new 30-ton air to air heat pumps
 - Includes new curbs
 - Assumes existing ductwork and any sound attenuation to remain and be reused
 - Assumes any condensate off RTUs may drain to existing roof receptors
- Includes (1) new 25 kW electric unit heater

Option 2 – Hybrid Electrification

Demo Scope of Work:

- Includes removal and disposal of (3) RTUs
 - Assumes cut, cap and make safe gas piping from each RTU

New Scope of Work

- Includes (3) new 30-ton air to air heat pumps
 - Includes new curbs
 - Assumes existing ductwork and any sound attenuation to remain and be reused
 - Assumes any condensate off RTUs may drain to existing roof receptors
- Includes (1) new mini-split heat pump system
 - Includes new refrigerant and condensate piping

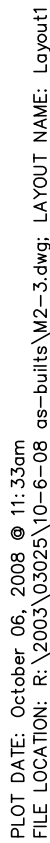
Mechanical General Inclusions, Clarifications, & Exclusions

- Includes allowance for crane/rigging
- Includes allowance for permits
- Includes allowance for carpentry
- Carrying Seattle labor rates
- Pricing in today's dollars
- Excludes temp HVAC and plumbing
- Excludes overtime work
- Excludes parking
- Excludes any new sound attenuation scope. Assumes ductwork and existing sound attenuation to remain.
- Excludes duct smoke detectors and wiring
- Excludes any heat tracing
- Excludes good faith survey
- Excludes demolishing gas distribution lines/piping back to meter



- Excludes condensate drain piping to roof drains. Assumes piping directly down onto roof.

NARRATIVE:



NOTES
1.
2.
3.
4.
5.

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BOULDER • TELLURIDE

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LOUISVILLE POLICE AND MUNICIPAL COURT
Via Appia & McCaslin Blvd. Louisville, CO 80027

Louisville, CO 80027

Via Appia & McCaslin Blvd.

HVAC GENERAL NOTES:

1. CONTRACTOR SHALL INSPECT SITE TO THOROUGHLY FAMILIARIZE HIMSELF WITH THE AREA OF WORK. THESE DOCUMENTS DO NOT REFLECT AS-BUILT CONDITIONS. ANY DISCREPANCIES BETWEEN THESE DOCUMENTS AND THE AS-BUILT CONDITIONS SHALL BE REPORTED TO THE ARCHITECT/ENGINEER FOR RESOLUTION PRIOR TO BID PRICING. NO EXTRAS WILL BE ALLOWED DUE TO LACK OF KNOWLEDGE OF EXISTING CONDITIONS.
2. RECTANGULAR DUCTWORK, SUPPLY, RETURN, AND TRANSFER SHALL BE SHEETMETAL AND SHALL BE INSULATED WITH 1" THICK POLYURETHANE FOAM INSULATION SHEETMETAL AND WRAPPED WITH 2" DUCT WRAP. EXHAUST DUCTWORK SHALL BE SHEETMETAL AND SHALL BE UNINSULATED. ALL DUCTS SHALL MEET OR EXCEED ASME/ANSI STANDARDS FOR 2" PRESSURE CLASSIFICATION. GIVEN DIMENSIONS ARE INSIDE DIMENSIONS.
3. ALL DUCTWORK SHALL BE SEALED AIRTIGHT WITH DUCT SEALANT (SMACNA SEAL GLASS "A") AND SHALL CONFORM TO LOCAL BUILDING CODES.
4. FLEXIBLE DUCTWORK SHALL BE INSULATED AND SHALL BE THE SAME SIZE AS THE NECK OF THE DUCTWORK. FLEX DUCT SHALL NOT EXCEED 8'-0" IN LENGTH AND SHALL CONFORM TO LOCAL BUILDING CODES.
5. ALL LOW PRESSURE DUCT SPIN-IN FITTINGS SHALL BE CONICAL AND SHALL HAVE MANUAL VOLUME DAMPERS.
6. RECTANGULAR BRANCH DUCT TAKEOFFS SHALL HAVE 45° TAKEOFFS AND ROUND DUCT TAKEOFFS SHALL BE CONICAL.
7. ALL ELBOWS, BOTH HORIZONTAL AND VERTICAL, SHALL BE LONG RADIUS ELBOWS WHEREVER POSSIBLE. ELBOWS SHALL HAVE TURNING SPACES WHERE SHOWN.
8. BALANCE AIR SYSTEM TO QUANTITIES SHOWN, AND SUBMIT A MINIMUM OF (6) COPIES OF THE BALANCE REPORT TO THE ENGINEER FOR REVIEW.
9. ALL NEW FRESH AIR INTAKES SHALL BE A MINIMUM OF 10'-0" FROM ANY NEW EXHAUST OR FLUE OUTLETS, PLENUMS, VENTS, ETC., PER LOCAL BUILDING CODE REQUIREMENTS.
10. PROVIDE FLEXIBLE CONNECTION ON INTAKE AND DISCHARGE OF MECHANICAL EQUIPMENT. FLEX CONNECTION SHALL CONFORM TO LOCAL BUILDING CODE PROVISIONS.
11. CEILING SPACE IS USED AS A RETURN AIR PLENUM AND SHALL CONFORM WITH LOCAL BUILDING CODE PROVISIONS.
12. CONTRACTOR TO PROVIDE TRANSFER TO FIVE TERMINAL UNITS, COLS, FANS OR OTHER EQUIPMENT.
13. ALL DUCTWORK VISIBLE THROUGH RETURN AIR GRILLES IS TO BE PAINTED FLAT BLACK.
14. COORDINATE LOCATIONS OF THERMOSTATS AND TEMPERATURE SENSORS WITH ARCHITECT PRIOR TO INSTALLATION.
15. COORDINATE ALL NEW WORK WITH WORK OF OTHER TRADES.
16. ALL RETURN GRILLES SHALL HAVE SOUND BOOTS. REFER TO DETAIL 10/M4.1.
17. REFER TO THE EMERGENCY POWER GENERATOR MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR GENERATOR EXHAUST PIPE MATERIALS AND INSTALLATION SPECIFICATIONS.

SCALE: $1/8" = 1'-0"$

DRAWN BY: MJB

CHECKED BY: MRR

PROJECT No: 2003007 30

ISSUE DATE: 06 27 03

REVISIONS:

10 27 27

3 10-05-05

SUBJECT TOPIC:

ROOF

HVAC PLAN

SHEET NUMBER:

.....

M2 3

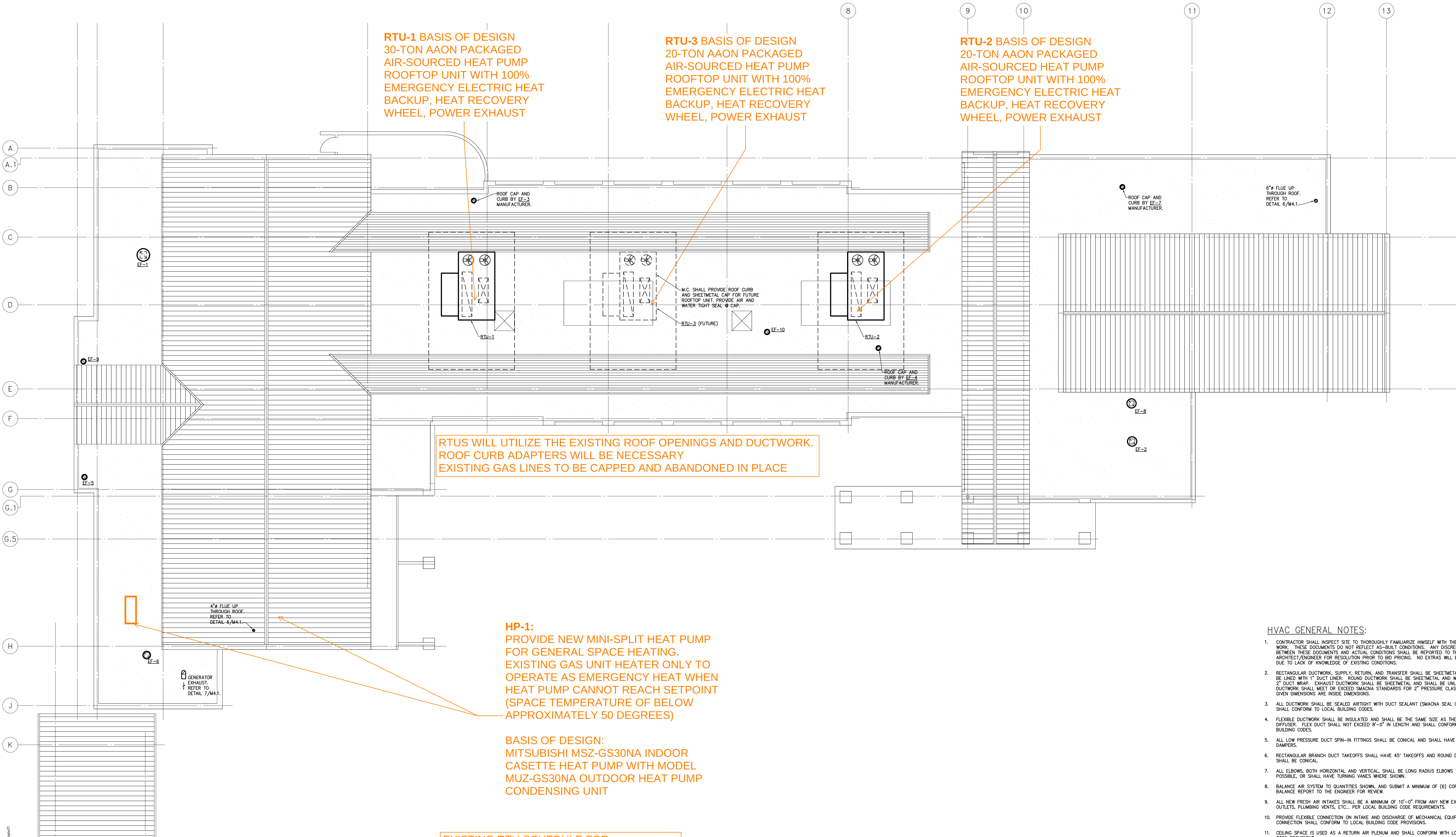
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LOUISVILLE POLICE AND MUNICIPAL COURT - MECHANICAL PRICING DOCUMENT

OPTION 2 - HYBRID ELECTRIFICATION

NARRATIVE:

- PARTIAL ELECTRIFICATION OF THE BUILDING TO THE MAXIMUM ALLOWABLE WITHOUT INCREASING THE EXISTING SERVICE SIZE BY REPLACING EXISTING GAS-FIRED EQUIPMENT WITH NEW ELECTRICAL EQUIPMENT.
- RTU-1, RTU-2, AND RTU-3 WILL BE REPLACED WITH PACKAGED HEAT PUMP RTUS WITH HEAT WHEELS AND 100% ELECTRIC RESISTANCE EMERGENCY HEATING CAPABILITY
- EXISTING UNIT HEATER IN GARAGE TO BE USED FOR EMERGENCY HEAT ONLY. PROVIDE NEW HEAT PUMP FOR GENERAL HEATING.



HVAC GENERAL NOTES:

1. CONTRACTOR SHALL INSPECT SITE TO THOROUGHLY FAMILIARIZE HIMSELF WITH THE AREA OF WORK. THESE DOCUMENTS DO NOT REFLECT AS-BUILT CONDITIONS. ANY DISCREPANCIES BETWEEN THESE DOCUMENTS AND AS-BUILT CONDITIONS SHALL BE REPORTED TO THE ARCHITECT/ENGINEER FOR RESOLUTION PRIOR TO BID PRICING. NO EXTRAS WILL BE ALLOWED DUE TO LACK OF KNOWLEDGE OF EXISTING CONDITIONS.
2. RECTANGULAR DUCTWORK, SUPPLY, RETURN, AND TRANSFER SHALL BE SHELTERED AND SHALL BE WRAPPED WITH 2" DUCT WRAP. DUCTWORK SHALL BE SHELTERED AND WRAPPED WITH 2" DUCT WRAP. EXHAUST DUCTWORK SHALL BE SHELTERED AND SHALL BE UNWELDED. ALL DUCTWORK SHALL MEET OR EXCEED ASMA STANDARDS FOR 2" PRESSURE CLASSIFICATION. GIVEN DIMENSIONS ARE INSIDE DIMENSIONS.
3. ALL DUCTWORK SHALL BE SEALED AIRTIGHT WITH DUCT SEALANT (ASMA SEAL CLASS "A") AND SHALL CONFORM TO LOCAL BUILDING CODES.
4. FLEXIBLE DUCTWORK SHALL BE INSULATED AND SHALL BE THE SAME SIZE AS THE NECK OF THE DIFFUSER. ALL DUCT SHALL NOT EXCEED 8'-0" IN LENGTH AND SHALL CONFORM TO LOCAL BUILDING CODES.
5. ALL LOW PRESSURE DUCT SPIN-IN FITTINGS SHALL BE CONICAL AND SHALL HAVE MANUAL VOLUME DAMPERS.
6. RECTANGULAR BRANCH DUCTS SHOULD HAVE 45° TAKEOFFS AND ROUND DUCT TAKEOFFS SHALL BE CONICAL.
7. ALL ELBOWS, BOTH HORIZONTAL AND VERTICAL, SHALL BE LONG RADII ELBOWS WHEREVER POSSIBLE, OR SHALL HAVE TURNING VANES WHERE NOT POSSIBLE.
8. BALANCE AIR SYSTEM TO QUANTITIES SHOWN, AND SUBMIT A MINIMUM OF (6) COPIES OF THE BALANCE REPORT TO THE ENGINEER FOR REVIEW.
9. ALL NEW FRESH AIR INTAKES SHALL BE A MINIMUM OF 10'-0" FROM ANY NEW EXHAUST OR FLUE OUTLETS, PLUMBING STACKS, ETC., PER LOCAL BUILDING CODE REQUIREMENTS.
10. PROVIDE FLEXIBLE CONNECTION ON INTAKE AND DISCHARGE OF MECHANICAL EQUIPMENT. FLEX CONNECTION SHALL CONFORM TO LOCAL BUILDING CODE PROVISIONS.
11. CEILING SPACE IS USED AS A RETURN AIR PLenum AND SHALL CONFORM WITH LOCAL BUILDING CODES.
12. CONTRACTOR TO PROVIDE TRANSITION TO VAV TERMINAL UNITS, COILS, FANS OR OTHER EQUIPMENT.
13. ALL DUCTWORK VISIBLE THROUGH RETURN AIR GRILLES IS TO BE PAINTED FLAT BLACK.
14. COORDINATE LOCATIONS OF THERMOSTATS AND TEMPERATURE SENSORS WITH ARCHITECT PRIOR TO INSTALLATION.
15. COORDINATE ALL NEW WORK WITH WORK OF OTHER TRADES.
16. ALL RETURN GRILLES SHALL HAVE SOUND BOOTS. REFER TO DETAIL 10/4-1.
17. REFER TO THE EMERGENCY POWER GENERATOR MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR GENERATOR EXHAUST PIPE MATERIALS AND INSTALLATION SPECIFICATIONS.

EXISTING RTU SCHEDULE FOR REFERENCE																														
HEATING & COOLING – POWER EXHAUST)																														
PLAN CODE	MANUFACTURER & MODEL NUMBER	COOLING CAPACITY (NOTE 1)								HEATING CAPACITY				SUPPLY FAN				EXHAUST FAN		ELECTRICAL						DIMENSIONS				REMARKS
		NOMINAL TONS	TOTAL MBH	SENSIBLE MBH	AMBIENT °F	EAT		LAT	MBH INPUT @ S.L.	MBH OUTPUT @ A.L.	EAT DB	LAT WB	CFM	MIN. O.A. CFM	HP	ESP	CFM	HP	VOLT/Ø/HZ	COMP. RLA	COND FLA	S.F. FLA	E.F. FLA	MCA	HEIGHT (IN)	LENGTH (IN)	WIDTH (IN)	WEIGHT (LBS)		
						DB	WB																							
RTU-1	CARRIER 48AKE030	30	318.5	245.0	95.0	80.0	60.0	55.1	48.5	525.0	327.2	35.6	102.0	11,060	2,390	15.0	1.0	10,000	(2)Ø2.0	208/3/60	57.1 & 39.1	(2) Ø 6.5	42.0	23.60	178.7	91"	165"	92"	5,100	NOTES: 1,2,3,5
RTU-2	CARRIER 48AKE020	20	223.7	185.6	95.0	82.1	60.0	55.2	48.5	525.0	327.2	16.4	110.6	7,800	2,630	5.0	1.0	7,000	(2)Ø2.0	208/3/60	39.1 & 25.6	(2) Ø 6.5	14.6	23.6	126.1	91"	165"	92"	4,700	NOTES: 1,2,3,5
RTU-3	CARRIER 48AKE020	20	213.5	188.6	95.0	83.8	60.0	52.5	47.3	350.0	218.1	10.6	71.6	6,820	2,840	5.0	1.0	6,000	(2)Ø2.0	208/3/60	39.1 & 25.6	(2) Ø 6.5	14.6	23.6	126.1	91"	165"	92"	4,700	NOTES: 2,3,4
NOTES:																														
1. PROVIDE UNIT WITH FACTORY FABRICATED ROOF CURB. MOUNT ROOF CURB ON 6" CONCRETE HOUSKEEPING PAD. PAD FOOT PRINT SHALL BE 6" LARGER THAN ROOF CURB IN EACH DIRECTION.																														
2. UNIT HEIGHT INCLUDES 14" ROOF CURB.																														
3. PROVIDE STAINLESS STEEL HEAT EXCHANGER AND BURNER.																														
RTU-3 IS A UNIT SIZED TO SERVE THE FUTURE BASEMENT BUILD-OUT. EQUIPMENT SIZE, CAPACITY, ETC. IS SHOWN FOR REFERENCE AND SHALL BE CONFIRMED.																														
5. PROVIDE A SPRING-ISOLATED CURB. MASON INDUSTRIES MODEL CMAB OR EQUIVALENT.																														



Appendix

1. Mechanical System Matrix Options
2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating

Police and Municipal Court – Electrical Scope Narratives

Option 1 – Full Electrification

- a. General: Electrification of HVAC equipment and addition of EV chargers staying within the limits of the existing electrical equipment.
- b. 30 Day Metering: None required. Will use utility data and as-built load calculations for existing loads.
- c. Electrical Demolition:
 - i. Demolish feeders to RTU-1, RTU-2 & RTU-3.
- d. Electrical New Work:
 - i. Service upgrade:
 - 1. Coordinate with utility to remove existing utility transformer and install new 1MVA (proposed) 480V secondary utility transformer
 - 2. Install new 1600A SWBD-1 and utility metering (bussing is oversized for PV interconnect)
 - 3. Install new 1200A service.

208V distribution

- ii. Pad mount transformer:
 - 1. Install new 500kVA dry-type NEMA 3R transformer T-1
 - 2. Install 800/3 feeder from SWBD-1 to T-1
 - 3. Install new 1600/4 transformer secondary feeder from T-1 to existing MDC. You may reuse existing conduits where possible.
- iii. New 208V panel serving EVSE loads
- iv. New infrastructure to serve RTU-1, including:
 - 1. New 250A CB on generator
 - 2. New 250A 4 pole ATS and controls with generator load management and load shed capability
 - 3. New 250A CB in MDC
 - 4. New 250/3 fused disconnect
 - 5. New 250/3 feeders as shown in drawing

480V distribution

- v. New infrastructure to serve RTU-2, including:
 - 1. New 80/3 feeder & disconnect (existing conduit may be reused)
- vi. New infrastructure to serve RTU-3, including:
 - 1. New 80/3 feeder & disconnect (existing conduit may be reused)
- vii. New infrastructure to serve EUH-2, including:
 - 1. New 40/3 feeder

- viii. New infrastructure to serve EWU-1, including:
 - 1. New 50/3 feeder
- ix. New infrastructure to serve PV array, including:
 - 1. New 400A CT enclosure, Xcel approved
 - 2. New 400A fused disconnect
 - 3. New 350/4 (reduced neutral, to EGC size) to location of PV combiner, as shown on site plan.
- x. New infrastructure to serve EVSE-L3-1, including:
 - 1. New Cummins diesel generator, minimum 70kW standby rating with oversized alternator (minimum 100kVA).
 - 2. New 100A 3P ATS
 - 3. New 80/3 feeders between equipment as shown on one-line

Option 2 – Hybrid Electrification

- a. General: Electrification of HVAC equipment and addition of EV chargers staying within the limits of the existing electrical equipment.
- b. 30 Day Metering: None required. Will use utility data and as-built load calculations for existing loads.
- c. Electrical Demolition:
 - xi. Demolish feeders to RTU-1, RTU-2 & RTU-3.
- d. Electrical New Work:
 - xii. New 208V panel serving EVSE loads
 - xiii. New infrastructure to serve RTU-1, including:
 - 1. New 250A CB on generator
 - 2. New 250A 4 pole ATS and controls with generator load management and load shed capability
 - 3. New 250A CB in MDC
 - 4. New 250/3 fused disconnect
 - 5. New 250/3 feeders as shown in drawing
 - xiv. New infrastructure to serve RTU-2, including:
 - 1. New 200A CB in MDC
 - 2. New 200A feeders as shown in drawings
 - xv. New infrastructure to serve RTU-3, including:
 - 1. New 200A CB in MDC
 - 2. New 200A feeders as shown in drawings

Exclusions

- Applicable sales, use and B&O tax
- Performance and Payment Bonds
- Utility company charges.
- Refurbishing existing lighting (cleaning, re-lamping, re-trimming, repair, restoration).

- Roof and building envelope penetrations, waterproofing.
- Moving, placing and (re)-calibrating owner equipment.
- Mechanical and plumbing control devices, including wiring, conduit, and components.
- Correcting existing code violations
- Hidden conditions.
- Removing, re-installing and replacing ceiling tiles.
- Opening and repairing walls and ceilings for electrical work.
- Patching and painting.
- Access panels.
- Temporary power and lighting
- Handling hazardous material including but not limited to asbestos, lead and PCB's.
- Overtime and shift premiums.
- Work stoppages, hindrances, multiple trim passes and out-of-sequence installation.
- Electrical engineering, calculations, drawings, peer review services.
- Structural and Seismic Engineering
- Material cost escalation.
- Plywood and specialty backing.
- Low voltage systems (telecom, CCTV, access control, audio visual, etc.).
- Any work not specifically included in this proposal.
- No thermostat relocations are included

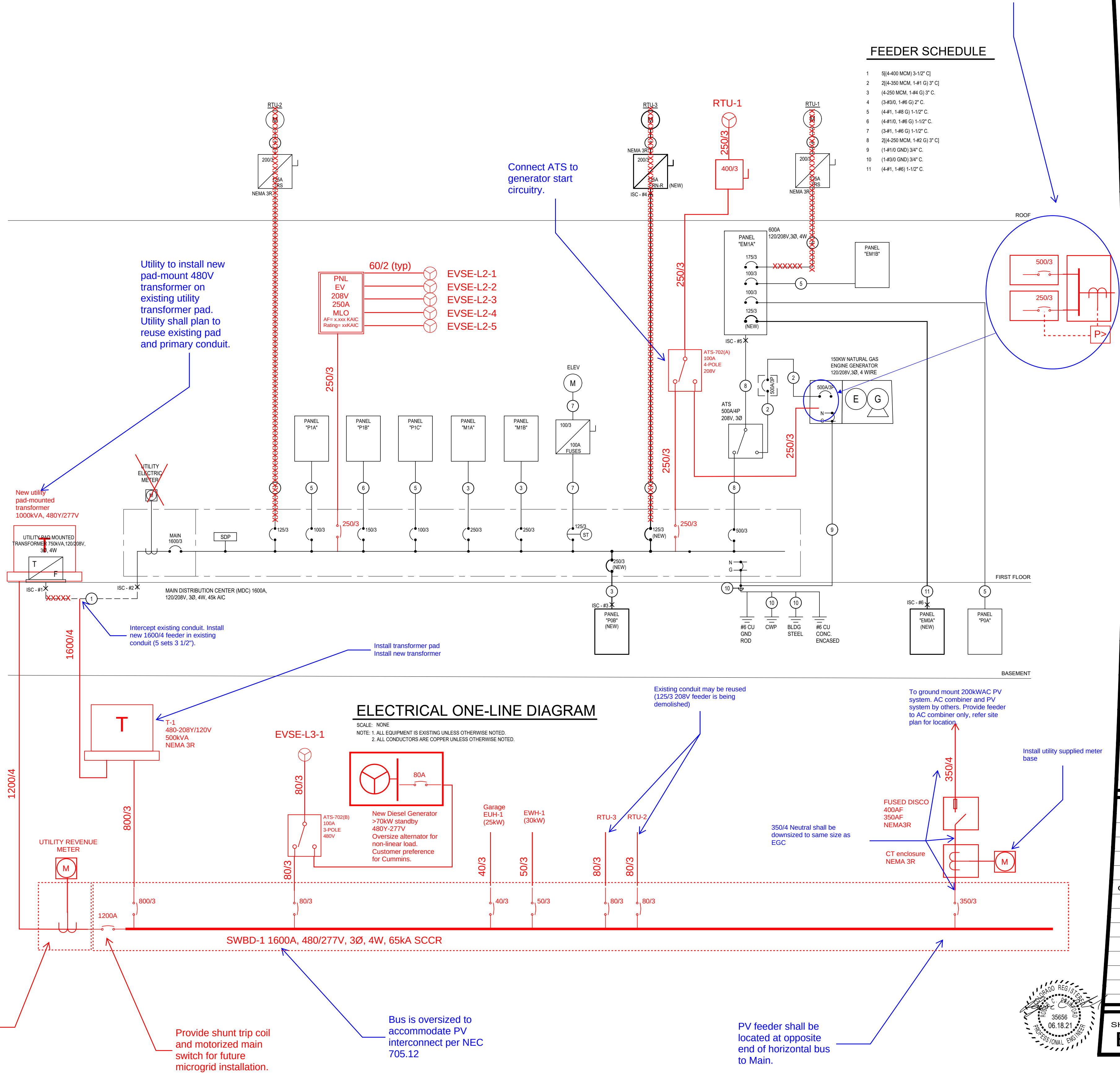
OPTION 1 - FULL ELECTRIFICATION - SERVICE UPGRADE ONE-LINE

GENERAL NOTES
1. Verify if existing ATS is 3 pole or 4 pole. ATS-702(A) shall match existing ATS. If 3 pole, ensure N-G bond is not installed in generator (as shown on this record drawing)

Provide new generator mounted or adjacent circuit breaker(s) compliant with NEC 700.10 requirements for circuit separation.

Provide NEC 700.4 compliant load shedding system for optional standby load. This may be provided as part of the 702 ATS or independently (as shown).

Isc CALCULATION - 3 PHASE									
Point #1 - At The Utility Transformer									
Isc = 38,100									
Point #2 - At the Main Distribution Center "MDC"									
f =	[1.732	X	length	X	Isc(Prev)]	/	[# runs	X	wire factor
f =	1.732	X	130	X	38,100	/	5	X	24,298
f =	0.348								
M =	1/(1+)								
M =	0.742								
Isc =	Isc(Prev) x M								
Isc =	28,997								
Point #3 - At Panel "PBB"									
f =	[1.732	X	length	X	Isc(Prev)]	/	[# runs	X	wire factor
f =	1.732	X	120	X	28,997	/	1	X	16,483
f =	1.758								
M =	1/(1+)								
M =	0.363								
Isc =	Isc(Prev) x M								
Isc =	10,514								
Point #4 - At RTU									
f =	[1.732	X	length	X	Isc(Prev)]	/	[# runs	X	wire factor
f =	1.732	X	90	X	28,997	/	1	X	7,292
f =	2.880								
M =	1/(1+)								
M =	0.251								
Isc =	Isc(Prev) x M								
Isc =	7,285								
Point #5 - At Panel "EM1A"									
f =	[1.732	X	length	X	Isc(Prev)]	/	[# runs	X	wire factor
f =	1.732	X	15	X	28,997	/	2	X	16,483
f =	0.110								
M =	1/(1+)								
M =	0.901								
Isc =	Isc(Prev) x M								
Isc =	26,127								
Point #6 - At Panel "EM2A"									
f =	[1.732	X	length	X	Isc(Prev)]	/	[# runs	X	wire factor
f =	1.732	X	120	X	26,127	/	1	X	7,292
f =	3.980								
M =	1/(1+)								
M =	0.218								
Isc =	Isc(Prev) x M								
Isc =	5,756								



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Greenville, SC 29611 (P) 502.956.2599
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LOUISVILLE
POLICE

MARKLEY
DESIGNS
ARCHITECTURE - PLANNING - CONSULTING
970.673.8248
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ELECTRICAL ONE-LINE DIAGRAM
LOUISVILLE POLICE DEPARTMENT
BASEMENT REMODEL
982 W Via Appie Way, Louisville, CO

PROJECT NO:	20080
DRAWN BY:	MKD
CHECKED BY:	DXJ
REVISIONS	
100% CD	6-18-21

SHEET
E1.4

OPTION 2 - HYBRID ELECTRIFICATION - NO SERVICE UPGRADE ONE-LINE

GENERAL NOTES

1. Verify if existing ATS is 3 pole or 4 pole. ATS-702(A) shall match existing ATS. If 3 pole, ensure N-G bond is not installed in generator (as shown on this record drawing)

Provide new generator mounted or adjacent circuit breaker(s) compliant with NEC 700.10 requirements for circuit separation.

Provide NEC 700.4 compliant load shedding system for optional standby load. This may be provided as part of the 702 ATS or independently (as shown).



Markley
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ELECTRICAL ONE-LINE DIAGRAM

LOUISVILLE POLICE DEPARTMENT

BASEMENT REMODEL

9922 W Via Appia Way, Louisville, CO

PROJECT NO:	20080
DRAWN BY:	MKD
CHECKED BY:	DXJ
REVISIONS	
100% CD	6-18-2

SHEET
E1.4

ISC CALCULATION - 3 PHASE

Point #1 - At The Utility Transformer

ISC =	39,100
-------	--------

Point #2 - At The Main Distribution Center "MDC"

f =	1.732	X	length	X	isc[prev] /	(# runs	X	wire factor	X	voltage)	
f =	1.732	X	120	X	39,100	/	1	X	24,296	X	208
=	0.546										
M =	1/(1+)										
M =	0.742										
isc =	isc[prev] x M										
isc =	38,997										

Point #3 - At Panel "PDB"

f =	1.732	X	length	X	isc[prev] /	(# runs	X	wire factor	X	voltage)	
f =	1.732	X	120	X	28,997	/	1	X	16,463	X	208
=	1.796										
M =	1/(1+)										
M =	0.303										
isc =	isc[prev] x M										
isc =	10,514										

Point #4 - At RTU

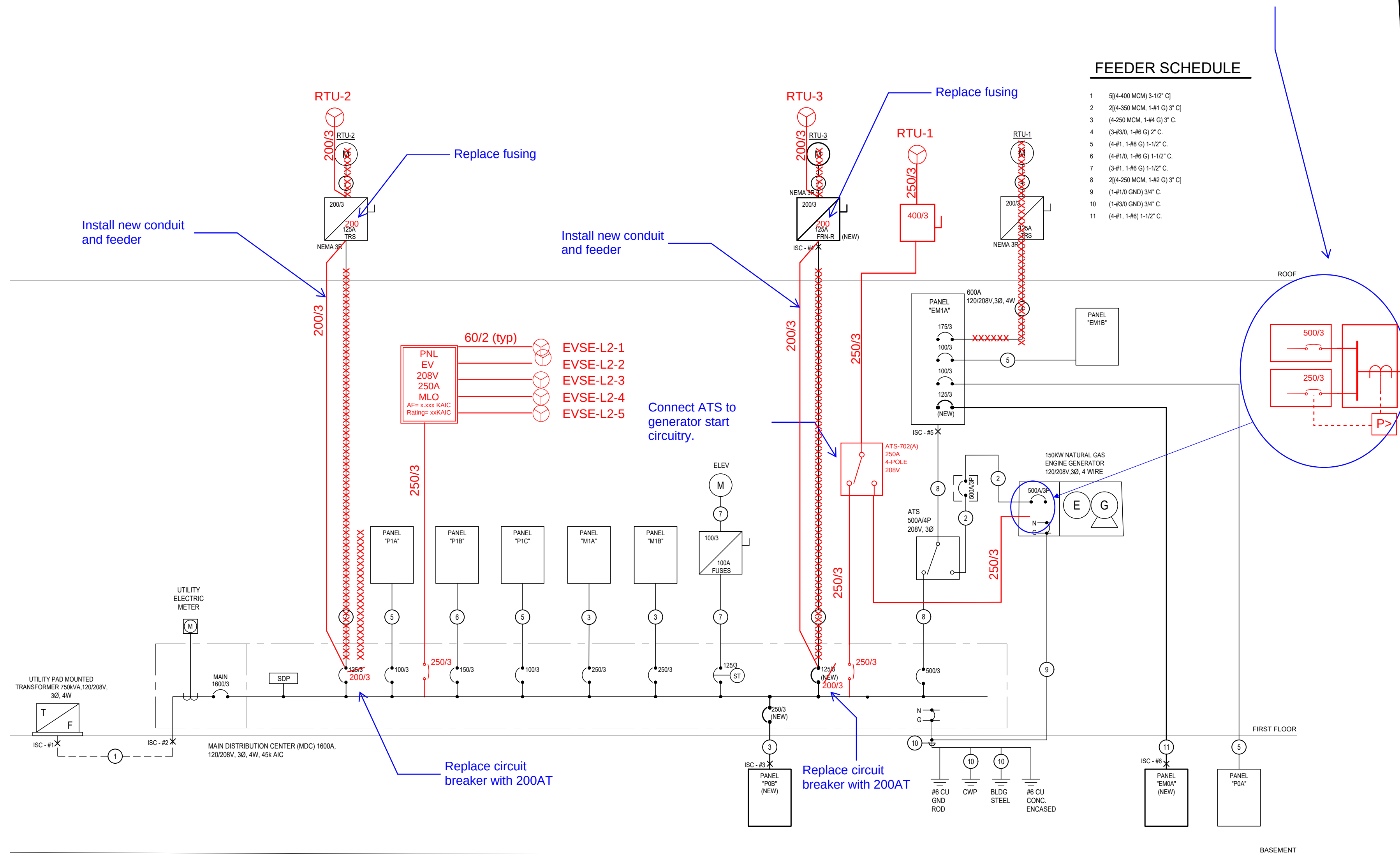
f =	1.732	X	length	X	isc[prev] /	(# runs	X	wire factor	X	voltage)	
f =	1.732	X	90	X	28,997	/	1	X	7,292	X	208
=	2.880										
M =	1/(1+)										
M =	0.251										
isc =	isc[prev] x M										
isc =	1,785										

Point #5 - At Panel "EMA1A"

f =	1.732	X	length	X	isc[prev] /	(# runs	X	wire factor	X	voltage)	
f =	1.732	X	15	X	28,997	/	2	X	16,463	X	208
=	0.110										
M =	1/(1+)										
M =	0.901										
isc =	isc[prev] x M										
isc =	26,127										

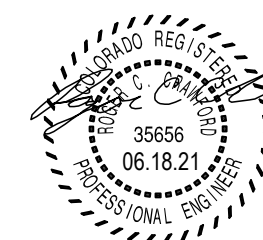
Point #6 - At Panel "EMA2"

f =	1.732	X	length	X	isc[prev] /	(# runs	X	wire factor	X	voltage)	
f =	1.732	X	120	X	26,127	/	1	X	7,292	X	208
=	3.580										
M =	1/(1+)										
M =	0.219										
isc =	isc[prev] x M										
isc =	5,704										



ELECTRICAL ONE-LINE DIAGRAM

SCALE: NONE
NOTE: 1. ALL EQUIPMENT IS EXISTING UNLESS OTHERWISE NOTED.
2. ALL CONDUCTORS ARE COPPER UNLESS OTHERWISE NOTED.



PANEL "MKD" (EXISTING)		VOLTAGE 120 / 208 V 3 Ø 4 W							
FLUSH	MAN 10003	MLO	X						
SURFACE	BUS 1000A	FEED THRU	A/C 45,000A						
TYPE	DESCRIPTION	BKR	CR	LOAD (VA)S	CR	BKR	DESCRIPTION	TYPE	
				A Ø	B Ø	C Ø			
SPACE		1	0	0		2	SPACE		
SPACE		3		0	0	4	SPACE		
SPACE		5		0	0	6	SPACE		
SPACE		7	0	0		8	SPACE		
SPACE		9		0	0	10	SPACE		
SPACE		11		0	0	12	SPACE		
M	RTU-2	125	13	12480	12480	14	125	RTU-3	M
M		15		12480	12480	16			M
M		17		12480	12480	18	3		M
SPACE		19	0	0		20		SPACE	
SPACE		21	0	0	0	22		SPACE	
SPACE		23		0	0	24		SPACE	
LRMG	ATS	300	25	47352	0	26		SPACE	
LRMG		27		48434	0	28		SPACE	
LRMG		3	29		47079	0	30	SPACE	
G	PANEL M1A	250	31	19200	19200	32	250	PANEL M1B	G
G		33			10200	10200	34		G
G		3	35		10200	10200	36		G
G	PANEL P1B	150	37	10000	8040	38	150	ELEVATOR	M
G		39		10000	8040	40			M
G		3	41		10000	8040	42		G
G	PANEL P1A	100	43	9600	9600	44	100	PANEL P1C	G
G		45		9600	9600	46			G
G		3	47		9600	9600	48	3	G
RMG	PANEL P0B	250	49	12409	0	50		SPACE	
RMG		51		9741	0	52		SPACE	
LRMG		3	53		12684	0	54	SPACE	
				100361	158775	100362			
LOAD TYPE		CONNECTED KVA		TOTAL		DEMAND KVA		TOTAL	
		AD	BD	CD	ALL Ø'S	AD	BD	CD	ALL Ø'S
LIGHTING/CONTINUOUS		2.6	5.3	5.5	10.8	125%	3.3	6.6	7.3
RECEPTACLE (10KVA OR LESS)		3.3	3.3	3.3	10.0	100%	3.3	3.3	10.0
RECEPTACLE (OVER 10KVA)		4.8	2.6	1.5	8.9	50%	2.4	1.3	0.8
HVAC/MOTOR		36.1	54.6	56.0	166.7	100%	36.1	54.6	56.0
MOTOR(LARGEST)		0.0	0.0	0.0	0.0	125%	0.0	0.0	0.0
KITCHEN EQUIPMENT		0.0	0.0	0.0	0.0	100%	0.0	0.0	0.0
MISCELLANEOUS		0.0	0.0	0.0	0.0	100%	0.0	0.0	0.0
TOTAL KVA		160.4	108.8	160.4	478.5		108.8	108.8	161.1
		TOTAL AMPERES		1321.9		1321.3		1342.2	
LEGEND		L=LIGHTING		R=RECEPTACLE		M=HVAC/MOTOR		K=KITCHEN	

EQUIPMENT SCHEDULE											
KEY	EQUIPMENT	LOAD	VOLTS	Ø	BRANCH Ckt. CONNECTIONS	COND.	DISCONNECT	CIRCUIT	NOTES		
RTU-1	ROOF TOP UNIT	181.7 MVA	208	3	3-3/0, 1H6	2"	200A/3P	EMA-155	1		
RTU-2	ROOF TOP UNIT	136.1 MVA	208	3	3-3/0, 1H6	2"	200A/3P	EMA-155	1		
EF-1	EXHAUST FAN	1/3 HP	120	1	2#12, 1H25	3/4"	1#10	MA-35	1		
EF-2	EXHAUST FAN	1/6 HP	120	1	2#12, 1H25	3/4"	1#10	MA-32	1		
EF-3	EXHAUST FAN	56 K	120	1	2#12, 1H25	3/4"	1#10	MA-31	1		
EF-4	EXHAUST FAN	1/6 HP	120	1	2#12, 1H25	3/4"	1#10	MA-30	1		
EF-5	EXHAUST FAN	1/6 HP	120	1	2#12, 1H25	3/4"	1#10	MA-31H	1		
EF-6	EXHAUST FAN	1/6 HP	120	1	2#12, 1H25	3/4"	1#10	MA-31	1		
EF-7	EXHAUST FAN	60 K	120	1	2#12, 1H25	3/4"	1#10	MA-31	1		
EF-8	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-32	1		
EF-9	EXHAUST FAN	1/6 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-10	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-11	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-12	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-13	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-14	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-15	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-16	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-17	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-18	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-19	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-20	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-21	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-22	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-23	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-24	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-25	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-26	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-27	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-28	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-29	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-30	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-31	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-32	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-33	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-34	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-35	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-36	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-37	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-38	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-39	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-40	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-41	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-42	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-43	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-44	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-45	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-46	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-47	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-48	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-49	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-50	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-51	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-52	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-53	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-54	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-55	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-56	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-57	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-58	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-59	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-60	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-61	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-62	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-63	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-64	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-65	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-66	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-67	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-68	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-69	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-70	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-71	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-72	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-73	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-74	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-75	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-76	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-77	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-78	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-79	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-80	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-81	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-82	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-83	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-84	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-85	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-86	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-87	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-88	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-89	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-90	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-91	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-92	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-93	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-94	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-95	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-96	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-97	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-98	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-99	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		
EF-100	EXHAUST FAN	1/4 HP	120	1	2#12, 1H25	3/4"	1#10	MA-41	1		

LUMINAIRE SCHEDULE											
KEY	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	LAMP	QTY	WATT	TYPE	VOLTS	MOUNTING	NOTE	MAX. HGT.
A	PARABOLIC TROFFER 2'x4' SLAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	3	32	18	T8	120	5-1/4" RPD		45
A2	RECESSED 2'x4' LENSED TROFFER WITH 6'Y FLANGE	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	3	32	18	T8	120	5-1/4" RPD		45
A3	PARABOLIC TROFFER WITH 6'Y FLANGE 2'x4' SLAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	3	32	18	T8	120	5-1/4" RPD		45
A4	RECESSED 1'x4' LENSED TROFFER WITH 6'Y FLANGE	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	2	32	18	T8	120	5-1/4" RPD		62
D	RECESSED FLUORESCENT DOWNLIGHT OPEN APERTURE SLAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	2	26	DTT	120	6-5/8" RPD		54	
D1	RECESSED FLUORESCENT WALLWASHER OPEN APERTURE SLAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	2	26	DTT	120	6-5/8" RPD		54	
D2	RECESSED INCANDESCENT DOWNLIGHT OPEN APERTURE	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	1	100	AR	120	7-3/8" RPD		100	
D3	RECESSED INCANDESCENT ADJUSTABLE OPEN APERTURE SLOPED CEILING	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	1	250	PARAB	120	11-3/4" RPD		250	
D4	RECESSED FLUORESCENT DOWNLIGHT WITH LENS, LAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	1	26	DTT	120	7-3/8" RPD		26	
F4	GENERAL PURPOSE FLUORESCENT STRIP, 4' 2LAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	2	32	T8	120	SURFACE		62	
F8	GENERAL PURPOSE FLUORESCENT STRIP, 8' 4LAMP	LITHONIA	2P-2H-4-B-3/32-BLD-120-6EB	4	32	T8	120	SURFACE		114	
G											

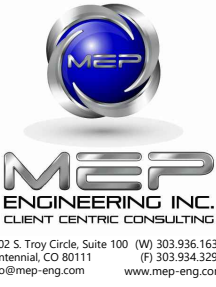
LIGHTING FIXTURE SCHEDULE												
LUMINAIRE								LAMPS				
ID	MANUFACTURER	MODEL	CATALOG NUMBER	DESCRIPTION	VOLTAGE	DIMMING	MOUNTING	QTY	TYPE	WATTS	LUMENS	COLOR TEMP(°)
AE	COLUMBIA LIGHTING	CFP	CFP24-4135-HE CFP24W-24	2X4 SURFACE EDGE LIT FLAT PANEL WITH EXTRUDED ALUMINUM FRAME AND MATTE WHITE FINISH WITH SMOOTH FRAME TO LENS TRANSITION CONNECT TO EMERGENCY CIRCUIT	120	0-10V	SURFACE MOUNT TO STRUCTURE	1	LED	32	4103	3000K/80
A1	COLUMBIA LIGHTING	CFP	CFP22-3335-HE CFP24W-22	2X2 SURFACE EDGE LIT FLAT PANEL WITH EXTRUDED ALUMINUM FRAME AND MATTE WHITE FINISH WITH SMOOTH FRAME TO LENS TRANSITION CONNECT TO EMERGENCY CIRCUIT	120	0-10V	SURFACE	1	LED	26	3469	3000K/80
A1E	COLUMBIA LIGHTING	CFP	CFP24-4135-HE	2X4 RECESSED EDGE LIT FLAT PANEL WITH EXTRUDED ALUMINUM FRAME AND MATTE WHITE FINISH WITH SMOOTH FRAME TO LENS TRANSITION CONNECT TO EMERGENCY CIRCUIT	120	0-10V	RECESSED IN GRID	1	LED	32	4103	3000K/80
BE	FINELITE	HIGH PERFORMANCE Z	HP2P20H83080MLG120DCFC10V***	2'X3' DIRECT LINEAR PENDANT FIXTURE WITH FLUSH DIFFUSE LENS AND PRECISION CUT EXTRUDED ALUMINUM BODY AND WHITE FINISH	120	0-10V	PENDANT MOUNT TO STRUCTURE COORDINATE HEIGHT	1	LED	36.6	3310	3000K/80
D	PRESCLUTE	LITERFRAME LF450ML	LF450ML-0M1-120-450ML30L-20K0-WT-DL	4" RECESSED SQUARE DOWNLIGHT WITH 22 GAUGE STEEL HOUSING, DIFFUSE LENS AND WHITE TRIM	120	0-10V	RECESSED IN GYP	1	LED	32.3	2356	3000K/80
DE	KUZCO LIGHTING	VEGA	V110323-8K	CONNECT TO EMERGENCY CIRCUIT ULTRA SLEEK DECORATIVE VANTY FIXTURE WITH BLACK FINISH	120	ELV	SURFACE MOUNT ABOVE MIRROR COORDINATE HEIGHT	1	LED	15	1200	3000K/80
G	PRESCLUTE	LITERFRAME LFRML	LFRML-0M1-120-45LFRML30L-20K0--FULL-WT-DL	6" RECESSED ROUND DOWNLIGHT WITH 22 GAUGE STEEL HOUSING, SEMI DIFFUSE REFLECTOR AND SELF TRIM	120	0-10V	RECESSED IN GYP	1	LED	32.7	2877	3000K/80
H	KUZCO LIGHTING	HELENA	P09117	SPUN METAL POWDER COAT FINISH DECORATIVE PENDANT WITH GRAPHITE EXTERIOR FINISH COORDINATE FIXTURE INTERIOR FINISH WITH OWNER PRIOR TO ORDERING	120	ELV	PENDANT MOUNT TO CEILING COORDINATE HEIGHT	1	LED	37	3000	3000K/80
X1	COMMERCIAL ELECTRIC	LED OVAL	EMLEDOV120277	EMERGENCY EGRESS FROGEYE FIXTURE WITH 90 MINUTE BATTERY BACK-UP	UNV	NA	UNIVERSAL	1	LED	1.6	166	4000K
X				EXIT SIGN TO MATCH BUILDING STANDARD - WHITE THERMOPLASTIC HOUSING WITH GREEN LETTERING AND 90 MINUTE BATTERY BACK-UP	UNV	NA	UNIVERSAL	1	LED			NA

VERIFY ALL MOUNTING, FINISHES AND OPTIONS WITH ARCHITECT PRIOR TO ORDERING

MECHANICAL EQUIPMENT SCHEDULE															
DESIGNATION	DESCRIPTION	VOLTAGE	PH	HP	KVA	FLA (MCA)	AIC (A)	ISC (A)	DATE	CONDUITORS	CONDUIT	SWITCH	CB	FUSE SIZE/TYPE	REMARKS
CP-1	CIRCULATION PUMP	120	1	-	80W	-	-	-	-	(2-#12, 1-#12 GND)	3/4"	STO	201	-	
CRAC-1	AIR CONDITIONING UNIT	208	1	-	-	(11.0)	-	-	-	(2-#12, 1-#12 GND)	3/4"	300	202	-	1
CU-1	CONDENSING UNIT	208	1	-	-	(14.0)	5500	1285	6/26/20	(2-#12, 1-#12 GND)	3/4"	300	152	-	
DP-1	DRAINAGE PUMP	120	1	1/3	-	-	-	-	-	(2-#12, 1-#12 GND)	3/4"	STO	201	-	4
EW-1	WATER HEATER	208	3	-	150KW	41.6	-	-	-	(2-#4, 1-#10 GND)	1"	600	600	60A FRN-R	
RTU-3	ROOF TOP UNIT	208	3	-	-	(104)	10000	7170	6/26/20	(2-#1, 1-#6 GND)	1-1/2"	2000	1250	125A TRN	2
RVAV-10	VARIABLE AIR UNIT	208	1	-	2KW	(12.00)	-	-	-	(2-#12, 1-#12 GND)	3/4"	300	152	15A FRN-R	1,3
RVAV-11	VARIABLE AIR UNIT	208	1	-	3.95KW	(18.9)	-	-	-	(2-#10, 1-#10 GND)	3/4"	300	252	25A FRN-R	1
RVAV-12	VARIABLE AIR UNIT	208	1	-	2KW	(12.00)	-	-	-	(2-#12, 1-#12 GND)	3/4"	300	152	15A FRN-R	1
RVAV-13	VARIABLE AIR UNIT	208	1	-	1.95KW	(9.92)	-	-	-	(2-#12, 1-#12 GND)	3/4"	300	152	15A FRN-R	1
RVAV-14	VARIABLE AIR UNIT	208	1	-	1.95KW	(9.92)	-	-	-	(2-#12, 1-#12 GND)	3/4"	300	152	15A FRN-R	1

REMARKS:

- UNIT TO BE CONTROLLED VIA WALL MOUNTED THERMOSTAT.
- SMOKE DETECTOR IN RETURN DUCT SHALL STOP THE SUPPLY AND RETURN/EXHAUST FANS AND CLOSE THE DAMPER IF IT SENSES SMOKE. MC TO PROVIDE AND INSTALL. EC TO WIRE TO FACP. COORDINATE WITH MECHANICAL AND FIRE ALARM CONTRACTORS.
- UNIT TO BE RELOCATED. MAINTAIN CIRCUITRY AND CONTROL WIRING CONTINUITY. EXTEND CONDUIT AND FEEDERS AS NECESSARY.
- UNIT TO BE CONTROLLED VIA INTERNAL FLUID.



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MARKLEYDESIGNS.COM

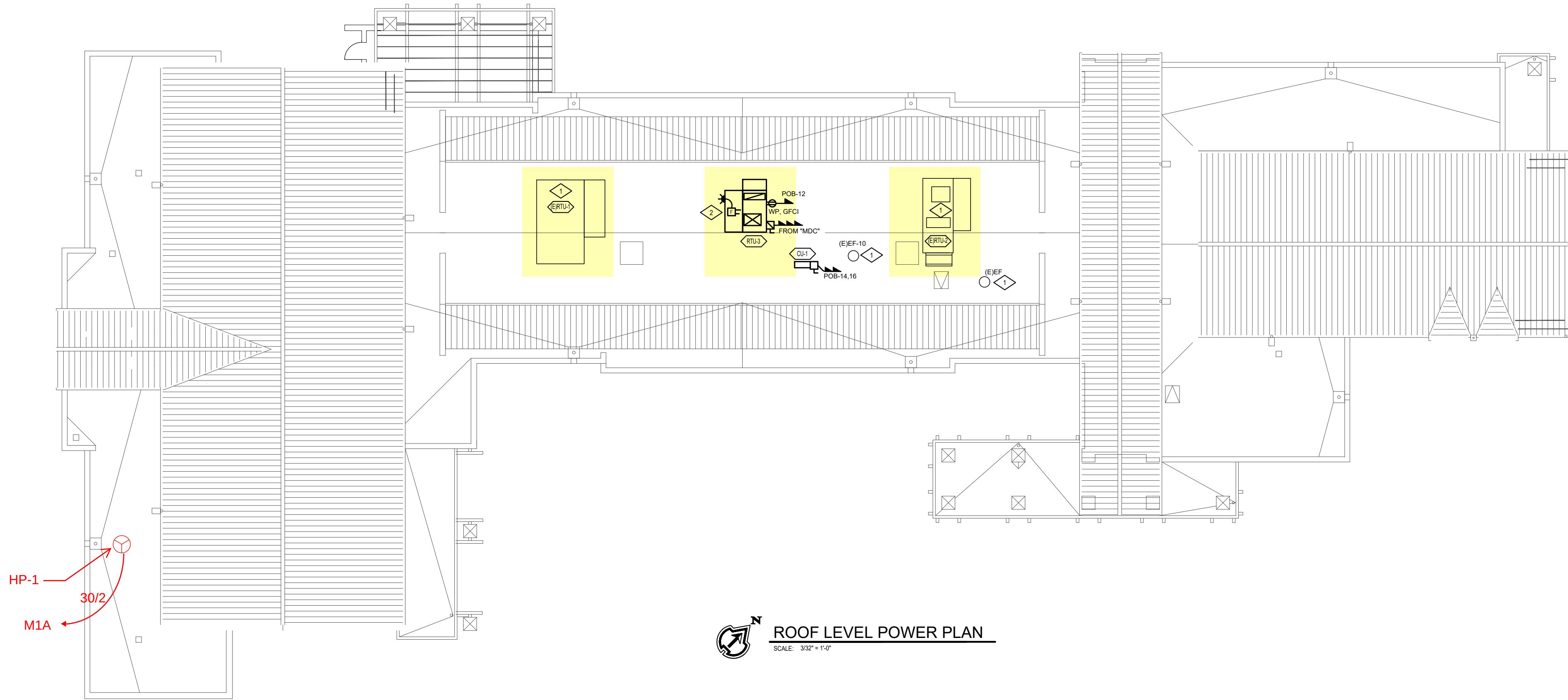
ELECTRICAL SCHEDULES

LOUISVILLE POLICE DEPARTMENT
BASEMENT REMODEL
982 W Via Appie Way, Louisville, CO

PROJECT NO:	20080
DRAWN BY:	MKD
CHECKED BY:	DXJ
REVISIONS	
100% CD	6-18-21

SHEET
E1.6





ROOF LEVEL POWER PLAN
SCALE: 3/32" = 1'-0"

GENERAL NOTES

1. ELECTRICAL CONTRACTOR SHALL REMOVE ALL SPARE AND UNUSED CIRCUITS FOUND DURING CONSTRUCTION. PROVIDE UPDATED TYPED PANEL SCHEDULES.
2. ELECTRICAL CONTRACTOR TO LABEL ALL SWITCHES AND RECEPTACLES, NEW AND EXISTING WITH CIRCUIT NUMBERS AND PANEL NAME. CIRCUIT NUMBERS AND PANEL NAMES SHALL BE CLEAR AND LEGIBLE ON COVER PLATES. ELECTRICAL CONTRACTOR SHALL COORDINATE COLOR OF COVER PLATES WITH BUILDING MANAGEMENT.
3. ELECTRICAL CONTRACTOR SHALL MAINTAIN CIRCUIT CONTINUITY OF ALL EXISTING TO REMAIN DEVICES UNLESS OTHERWISE NOTED.
4. COORDINATE EXACT LOCATIONS OF MECHANICAL AND PLUMBING EQUIPMENT WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN OF THE ASSOCIATED ELECTRICAL EQUIPMENT. PROVIDE DEDICATED ELECTRICAL CONNECTIONS TO ALL MECHANICAL AND PLUMBING EQUIPMENT UNLESS OTHERWISE INDICATED.

DRAWING NOTES

1. EXISTING DEVICE TO REMAIN.
2. PROVIDE REMOTE TEST SWITCH FOR DUCT DETECTOR. COORDINATE LOCATION WITH MECHANICAL CONTRACTOR.

EQUIPMENT LOCATION

ELECTRICAL GEAR IMPACTED BY PROJECT SCOPE



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ROOF POWER PLAN
LOUISVILLE POLICE DEPARTMENT
BASEMENT REMODEL
992 W Via Appia Way, Louisville, CO

PROJECT NO:	20080
DRAWN BY:	MKD
CHECKED BY:	DXJ
REVISIONS	
100% CD	6-18-21

SHEET
E3.1



DTJ DESIGN

ARCHITECTURE
LANDSCAPE ARCHITECTURE

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2350 W. 9th Ave., B-130
Denver, CO 80237
303.758.8095
303.758.8043 fax
info@innovative-electrical.com

LOUISVILLE POLICE AND MUNICIPAL COURT
Louisville, CO 80027
Via Appia & McCaslin Blvd.

SCALE: 1/8" = 1'-0"
DRAWN BY: JEM
CHECKED BY: VDF/LEY
PROJECT No: 2003007.30
ISSUE DATE: 06-30-03
REVISIONS:

SHEET TITLE:

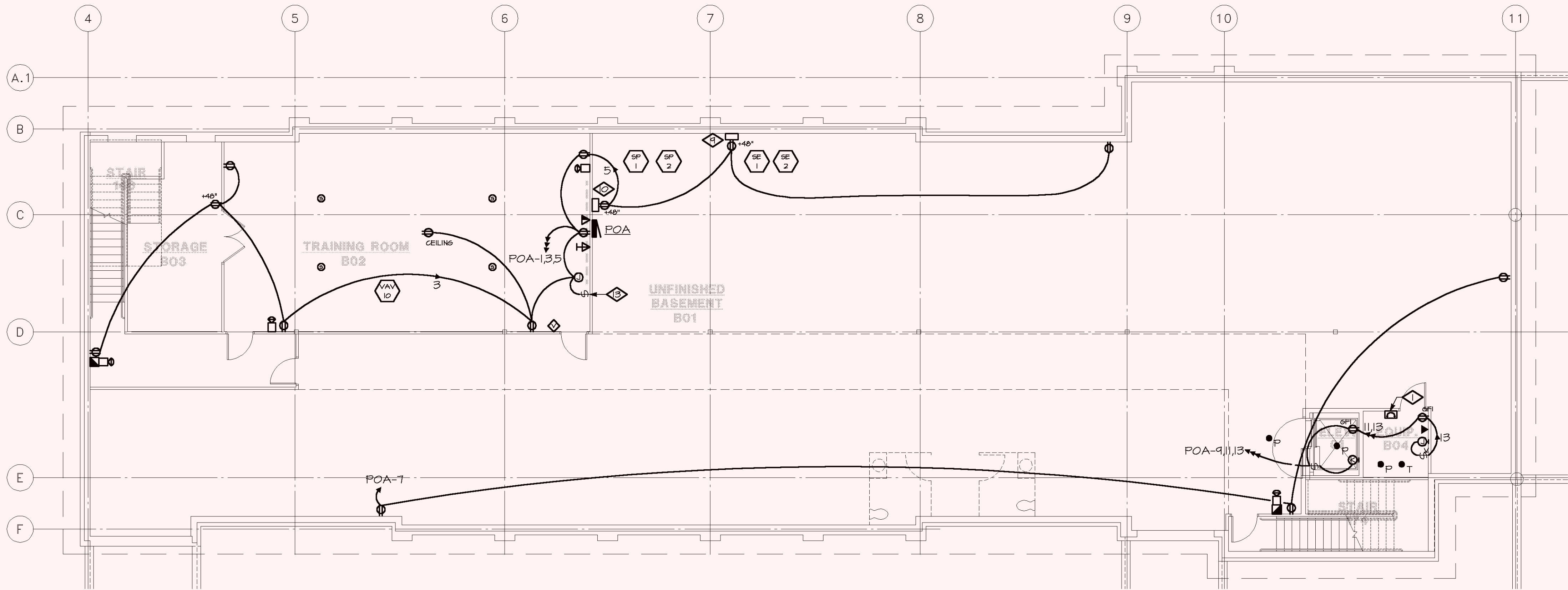
ELECTRICAL
POWER PLAN

SHEET NUMBER:

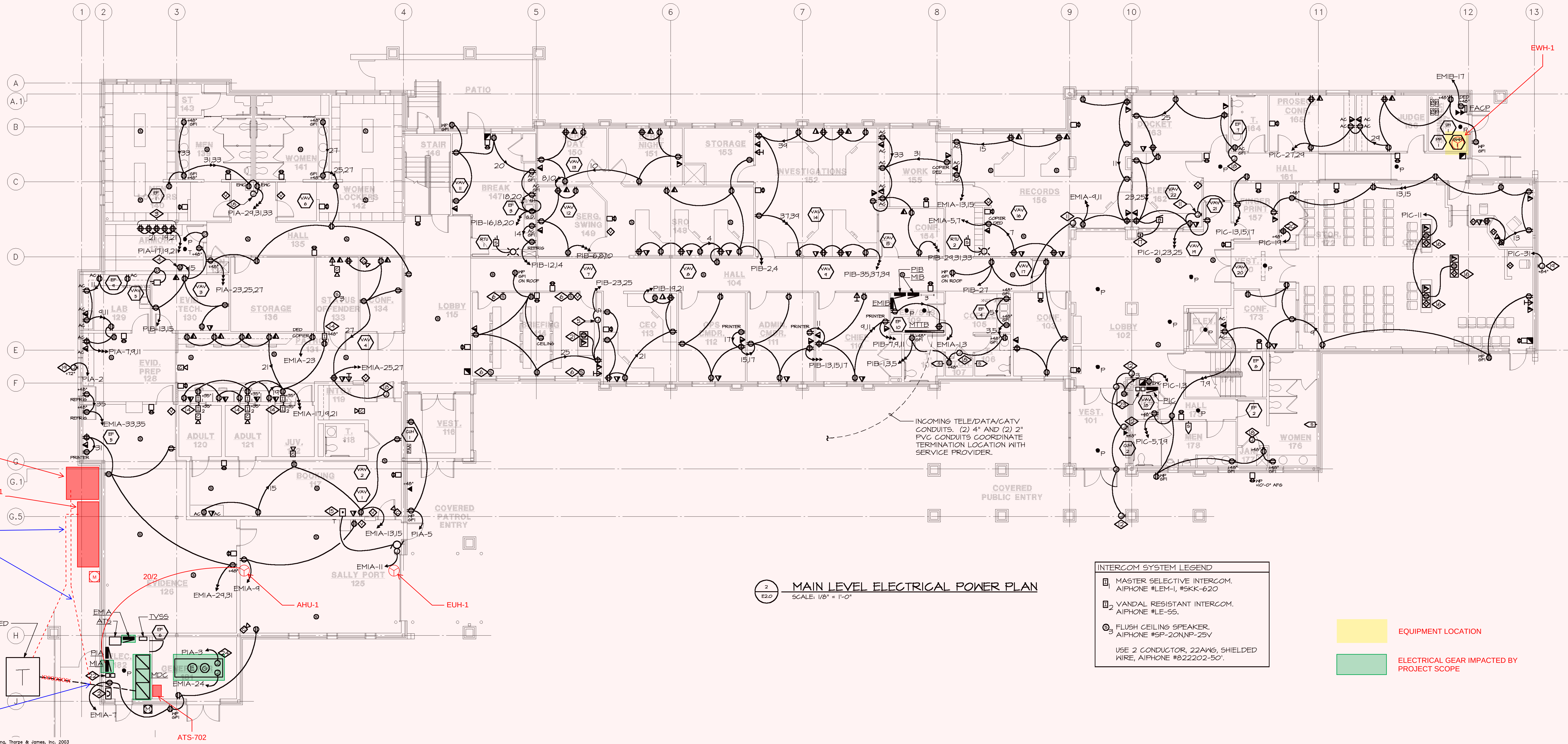
E2.0

DETAIL NOTES

- DISCONNECT FOR ELEVATOR. CIRCUIT BREAKER TO BE FURNISHED WITH SHUNT TRIP. 80A/3P, 208V, 3Ø.
- DISCONNECT FOR ENGINE GENERATOR. MOUNTED ADJACENT TO DOOR ENTRY.
- RECEPTACLE FOR RADIO BATTERY CHARGERS. COORDINATE MOUNTING HEIGHT.
- RECEPTACLE FOR ULTRASONIC CLEANER. CONFIRM POWER REQUIREMENTS, METHOD OF CONNECTION AND LOCATION PRIOR TO ROUGH IN.
- ELECTRICAL CONTRACTOR TO MAKE CONNECTION TO MOTORIZED PROJECTION SCREEN. PROVIDE CONTROLS AND RECOMMENDED BY THE MANUFACTURER.
- RECESSED WALL SPEAKERS, BY OTHERS.
- NOT USED.
- NOT USED.
- CONTROL PANEL FOR SEWAGE EJECTOR. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH PLUMBING CONTRACTOR.
- CONTROL PANEL FOR SUMP PUMPS. COORDINATE EXACT LOCATION WITH AND REQUIREMENTS WITH PLUMBING CONTRACTOR.
- J-BOX FOR ELECTRICAL STRIKE PUSH BUTTON. COORDINATE EXACT REQUIREMENTS WITH DOOR HARDWARE PROVIDER. ROUTE 3/4" CONDUIT FROM PUSH BUTTON TO STRIKE.
- PUSH BUTTON FOR AUTOMATIC DOOR OPENER. COORDINATE EXACT REQUIREMENTS WITH DOOR HARDWARE PROVIDER.
- POWER AND CONTROLS FOR MOTORIZED PROJECTION SCREEN. PROVIDE AND INSTALL CONTROLS AS RECOMMENDED BY THE MANUFACTURER.
- REFER TO INTERCOM LEGEND FOR SPECIFICATIONS.
- SALLY PORT GARAGE DOOR OPENER. PROVIDE AND INSTALL CONTROLS AS RECOMMENDED BY GARAGE DOOR OPENER MANUFACTURER. VERIFY CONTROL LOCATION PRIOR TO ROUGH IN.
- RECESSED FLOOR BOX FOR TELE/DATA, RECEPTACLE, AND MICROPHONE JACK. FLOOR BOX TO BE HUBBELL #PFBG3, WITH BRASS CARPET FLANGE AND BRASS STYLE LINE OPENING COVER. ROUTE 1" CONDUIT FROM TELE/DATA AND MICROPHONE JACK, AS RECOMMENDED BY LOW VOLTAGE CONTRACTOR.
- PUSH BUTTON AND BUZZER. COORDINATE PUSH BUTTON AND BUZZER LOCATIONS PRIOR TO ROUGH IN.
- JUNCTION BOX MOUNTED ABOVE ACCESSIBLE CEILING FOR TOILET AUTOMATIC FLUSH VALVE TRANSFORMER. TRANSFORMER FURNISHED BY PLUMBING CONTRACTOR AND INSTALLED BY ELECTRICAL CONTRACTOR. ALL LOW VOLTAGE WIRING BY PLUMBING CONTRACTOR.
- JUNCTION BOX FOR CONNECTION TO OWNER FURNISHED BUILDING MOUNTED SIGNAGE. ELECTRICAL CONTRACTOR TO MAKE FINAL CONNECTION.
- QUAD RECEPTACLE FOR OWNER FURNISHED COURT STEREO EQUIPMENT. VERIFY LOCATION PRIOR TO ROUGH IN.
- RECESSED FLOOR BOX FOR TELE/DATA AND RECEPTACLE FLOOR BOX TO BE HUBBELL #PFBG2, WITH BRASS CARPET FLANGE AND BRASS DUPLEX FLAP COVER PLATE. ROUTE 1" CONDUIT FROM TELE/DATA AS RECOMMENDED BY LOW VOLTAGE CONTRACTOR.
- CONTACTOR #1 AND TIME SWITCH.
- CONTACTOR #2 AND TIME SWITCH.
- CIRCUITS FOR CONNECTION TO ENGINE BLOCK HEATER, BATTERY CHARGER, AND BATTERY PAD WARMER. COORDINATE CONNECTION REQUIREMENTS WITH GENERATOR SHOP DRAWINGS.



1 LOWER LEVEL ELECTRICAL POWER PLAN
SCALE: 1/8" = 1'-0"



2 MAIN LEVEL ELECTRICAL POWER PLAN
SCALE: 1/8" = 1'-0"

INTERCOM SYSTEM LEGEND

- MASTER SELECTIVE INTERCOM. ALPHONE #LEM-1, #5KK-620
- VANDAL RESISTANT INTERCOM. ALPHONE #LE-55.
- FLUSH CEILING SPEAKER. ALPHONE #SP-20NNP-25V

USE 2 CONDUCTOR, 22AWG, SHIELDED WIRE, ALPHONE #822202-50.

EQUIPMENT LOCATION

ELECTRICAL GEAR IMPACTED BY PROJECT SCOPE



Appendix

1. Mechanical System Matrix Options
2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating



Appendix

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City of Louisville

Police & Municipal Court

Electric Vehicle Charging Narrative

Electric Vehicle Charging Narrative

Electric Vehicle Charging Narrative

Fleet & Electric Vehicle Charging

As part of the decarbonization study, the fleet vehicles were analyzed for replacement with EV equivalents. In addition, building electrical capacities were reviewed to determine if they have enough capacity to charge the fleet vehicles and if any electrical upgrades may be needed to the buildings.

EV Fleet Conversion

Based on current technology, transitioning from internal combustion engine (ICE) vehicles to EVs can substantially lower overall carbon emissions. A caveat to consider in assessing the environmental impact of EVs is the variation of electricity generation sources in a given area. The state of Colorado relies mainly on coal and natural gas. However, the share of these fuel sources as a percentage of total generation is decreasing. Alternative energy sources such as wind and solar are increasing rapidly. By using additional onsite renewable energy sources and phasing in vehicle replacement it will be possible for Louisville's fleet to be entirely carbon free.

In the current vehicle market mainly light duty vehicles are being produced. There currently is no manufacture that outfits an EV for police vehicle use. The market is rapidly changing so over the course of the next 5 years new innovation and demand should allow for this use.

EVs typically have a higher initial capital cost to purchase or lease when compared to ICE vehicles, EVs can cost less in the long-term due to lower fuel costs, different maintenance requirements, and longer vehicle lives. Therefore, it is important to consider the entire lifespan of a vehicle when investing in fleet vehicles. There are also limiting factors of EVs to consider, such as range and power needs of certain fleet vehicles, as well as the near-constant changes in the electric vehicle and infrastructure technology.

Charging Infrastructure

When planning for EV charging infrastructure, it is recommended to proactively plan for the number of charging stations needed by installing more electrical equipment (e.g. transformers and conduits) than is needed for the initial purchase of EVs. It is more cost effective to install excess electrical equipment during the initial installation than having to add electrical wires each time additional stations are required. This electrical equipment installation does not include purchasing all the charging stations that can fit with that equipment, but instead having the electrical capacity to purchase charging stations to meet future capacity needs without additional construction. The city has already thought about this and this report is the result of that forward thinking.

While there are three levels of EV charging infrastructure currently available, Level 2 (L2) charging is currently the most prevalent among them and requires electrical infrastructure upgrades to extend 240 volt AC service to locations where the EVs would charge. It charges at over twice the rate of level 1, adding 12 to 80 miles of range per hour charging. Level 3 (L3) charges are also becoming more common and can add from 80 to 500 miles of range per hour. Level 3 charging typically requires a 480 volt AC service. The level 2 and 3 chargers with the increased rate of charging can justify the costs to serve the needs of fleet management in a timely manner. Costs per unit can vary within these ranges depending on the installation and labor costs, warranties for equipment, and operation and maintenance costs for the equipment. Level 2 chargers provide good value for infrastructure investment when factoring in cost and time required to charge when compared to Level 3 chargers. Level 3 chargers can make sense when high use vehicles need quick recharging, though these chargers will cost more to install and incur a higher charging cost than level 2 chargers.

Electric Vehicle Charging Narrative

Another consideration for charging infrastructure is the daily charging schedule. Most of the buildings reviewed for this study are on a secondary general rate schedule. This rate schedule does not have time of use rates for electrical consumption or peak demand. This means depending on when and how many vehicles charge relative to the buildings peak demand, it may increase the demand charges the city pays. Xcel Energy does offer a EV charging rate plan that incentivize the intentional reduction of electricity use during peak energy demand periods, such as during hot summer days. This rate plane does require a separate service for just the charging stations. Planning for fleet recharging during off-peak periods can add up to thousands of dollars in savings.

Battery capacity

Battery technology is changing rapidly, resulting in increased charge capacity and lower operating cost per mile. Many manufactures now offer eight year/100,000 mile warranties on their EV batteries (generally covering defects and workmanship), and some offers an eight year/100,000 mile warranty on battery capacity. Auto manufacturer warranties and charge capacity have generally reduced consumer concern about battery life and range. As a result, the analysis of total ownership cost does not account for the cost of EV battery replacement, assuming that municipal vehicles will be retired at the warranty expiration.

Police and Municipal Courts (PMC)

The PMC has 8 administrative police vehicles and 21 patrol vehicles. The 8 administrative vehicles have varying use but typically aren't used as heavily. The patrol vehicles are used constantly and other than shift changes are typically not at the PMC. See the table below.

Use Type	Make	Model	Quantity
Admin	Chevy	Caprice	1
	Ford	Explorer	5
Detective	Chevy	Caprice	1
	Ford	Expedition	1
Patrol	Ford	Expedition	1
	Ford	Explorer	21

We recommend installing 6 chargers and upgrading the electrical infrastructure to support the administrative police vehicles. Currently, no direct replacement for the police administrative vehicles if high performance is required. Depending on the departments preferences and use case, it may be possible to use existing EVs on the market. If not, it is anticipated police performance enhancements for EVs will be available in the next 5 to 10 years. The table below shows the number of recommended chargers if current administrative vehicles were replaced with EVs.

Existing Public charging stations	Existing Public Charger Level	Quantity of New Level 2 Public Charger	Quantity of New Level 3 Public Charger	Quantity of New Level 2 Fleet Charger	Quantity of New Level 3 fleet Charger
0	N/A	1	0	4	1

At this site the chargers were split into two groups, public and fleet. The number of fleet chargers selected to be installed here were based on the number of vehicles stored onsite. In addition, one of the fleet chargers was selected to be a L3 charger to allow for quick recharge of a fleet vehicle if needed. An example of such a use case maybe for the plow vehicle used to clear the parking lot.



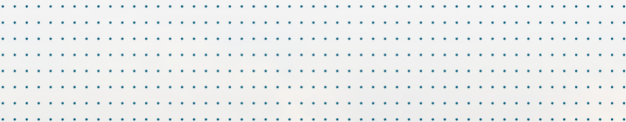
Electric Vehicle Charging Narrative

The quantity of public chargers selected for this site was minimal because there is limited public visitation at the site. No public L3 chargers were selected to be installed at this location.



Appendix

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City of Louisville Decarbonization Study

Louisville Police and Courts

RENEWABLES SUPPORTING ANALYSIS

LOUISVILLE, CO

AUGUST 18, 2023

Together Building a Thriving Planet



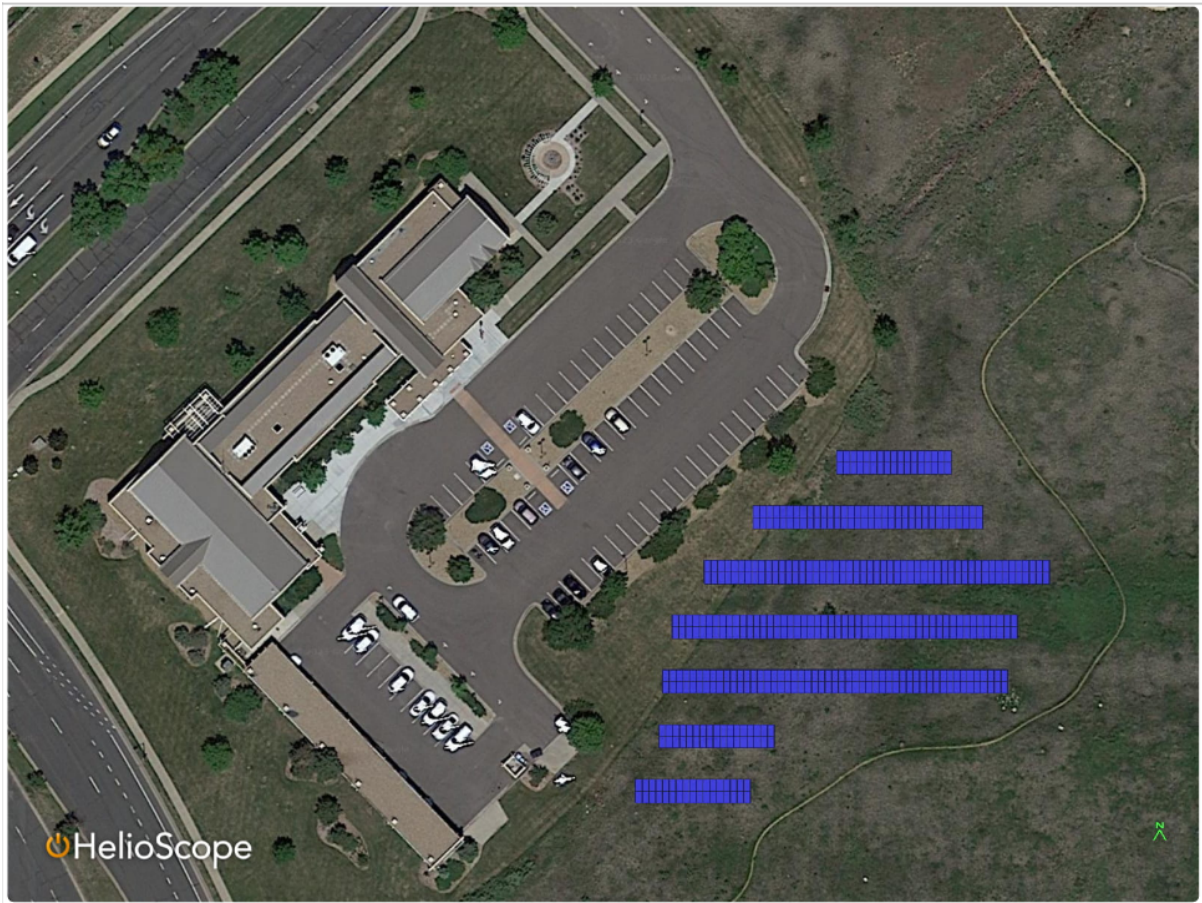
Louisville Police & Municipal Courts

The Louisville Police and Municipal Courts Building is a good candidate for a fixed-tilt ground mount solar PV system. The space between the parking lot and walking trail is open and unobstructed. Being near the walking trail makes the system highly visible, which is a great way for Louisville to showcase to the public all the work they are doing towards decarbonization. While the utility savings may not be the strongest out of all the buildings in this study, the system still pays back in under 20 years in all scenarios.

1. Proposed Solar PV System Overview

Below is a high-level summary of the proposed system specifications. Please note, specific equipment manufacturers and models may change depending on availability and market conditions at the time of construction.

SITE NAME	SITE ADDRESS	SIZE (KW-DC)	SIZE (KW-AC)	SYSTEM TYPE	YEAR 1 PRODUCTION (kWh)
Louisville Police and Municipal Courts Building	992 W Via Appia Way Louisville, CO 80027	257.0	200.0	Fixed-tilt ground mount	433,189



Louisville Police & Municipal Courts

LOUISVILLE POLICE & MUNICIPAL COURTS EQUIPMENT AND QUANTITY SUMMARY

QUANTITY	EQUIPMENT DESCRIPTION
476	JA Solar, JAM72D30-540 (540W) – Bifacial Mono PERC Half Cell Double Glass Modules
4	CPS SCA50KTL-DO/US-480 - Inverters
1	30° Fixed-Tilt Ground Mount Racking System
1	AlsoEnergy Data Acquisition System (DAS) Package – PLCS400
1	Electrical Balance of Systems Package

AlsoEnergy Data Acquisition System (DAS) includes the equipment/functionality listed below.

- NEMA 4 Enclosure and Data Logger
- Cellular modem
- CT Based Revenue Grade Meter
- Inverter Direct Monitoring
- 5-year service plan
- A Meteorological Station consisting of the following:
 - Cell Temp Sensor
 - Pyranometer
- Publicly accessible web-based dashboard functionality

The Electrical Balance of Systems Package includes all components to create an electrically complete ground mounted solar PV installation. This includes grounding materials, wiring, conduit, MCT, panelboards/combiners, switchgear, fuses, and disconnects. For the purposes of this decarbonization study, this scope is split between the electrical and solar PV pricing. More details provided in Section 4.

2. Production Modeling

Array layouts and system production are modeled in Helioscope, an industry-standard design and energy modeling software package with 3-dimensional modeling capabilities. Through Helioscope, we can incorporate site-specific characteristics of buildings and shade producing obstructions to determine their impacts upon system layout and production. McKinstry further applies our knowledge of codes and regulations, industry best practices, and professional judgment to ensure that designs are code-compliant and strike a balance across customer preferences, production, constructability, and price concerns.

Helioscope provides robust PV system output modeling capabilities. We use these in conjunction with Typical Meteorological Year (TMY) weather datasets, real-world equipment specifications, proprietary 3rd-party-engineered dust and snow soiling models, and professional judgment to determine a system's annual kWh production. For City of Louisville, we are using the TMY, DENVER INTL AP, NSRDB (tmy3,l) weather data set and soiling conditions from the DNV-GL NOAA Lafayette station. Annual production is estimated at 433,189 kWh. Full Helioscope report below.

Louisville Police & Municipal Courts



Annual Production Report produced by Mountain Lyanda Dudley

Cohort 1 - Police & Courts Ground Mount_REV1 City of Louisville, 951 Spruce St, Louisville, CO 80027

Report

Project Name	City of Louisville
Project Address	951 Spruce St, Louisville, CO 80027
Prepared By	Mountain Lyanda Dudley lyandad@mckinstry.com

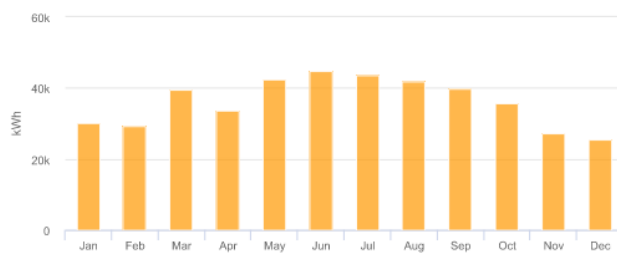
System Metrics

Design	Cohort 1 - Police & Courts Ground Mount_REV1
Module DC Nameplate	257.0 kW
Inverter AC Nameplate	200.0 kW Load Ratio: 1.29
Annual Production	433.2 MWh
Performance Ratio	84.6%
kWh/kWp	1,685.3
Weather Dataset	TMY, DENVER INTL AP, NSRDB (tmy3, I)
Simulator Version	5aee66451a-bd835f4a09-97ab2b5119-59c665659f

Project Location

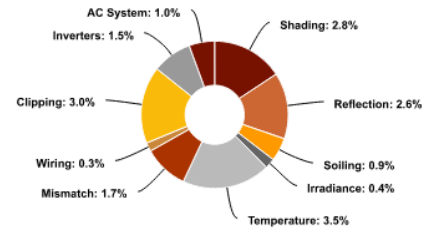


Monthly Production



Month	GHI (kWh/m²)	POA (kWh/m²)	Shaded (kWh/m²)	Nameplate (kWh)	Grid (kWh)
January	77.6	134.8	129.2	31,667.9	30,163.9
February	88.7	131.0	127.8	31,317.1	29,268.2
March	144.4	183.1	179.4	44,421.1	39,457.8
April	143.6	157.1	152.8	38,082.1	33,779.1
May	196.1	196.6	191.3	48,155.4	42,511.5
June	218.0	209.1	203.9	51,905.5	44,685.5
July	208.2	203.3	198.0	50,356.1	43,545.0
August	185.7	197.1	192.3	48,967.8	41,936.9
September	155.3	186.0	181.9	46,337.8	39,817.6
October	114.2	160.4	157.2	40,166.9	35,601.6
November	73.9	119.1	114.7	28,657.9	27,082.7
December	64.4	115.6	109.0	26,682.7	25,339.4

Sources of System Loss



Louisville Police & Municipal Courts



Annual Production Report produced by Mountain Lyanda Dudley

⚡ Annual Production			
	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,670.2	
	POA Irradiance	1,993.2	19.3%
	Shaded Irradiance	1,937.4	-2.8%
	Irradiance after Reflection	1,887.2	-2.6%
	Irradiance after Soiling	1,870.0	-0.9%
	Total Collector Irradiance	1,869.9	0.0%
Energy (kWh)	Nameplate	486,718.1	
	Output at Irradiance Levels	484,785.7	-0.4%
	Output at Cell Temperature Derate	468,025.0	-3.5%
	Output After Mismatch	459,838.8	-1.7%
	Optimal DC Output	458,268.0	-0.3%
	Constrained DC Output	444,438.9	-3.0%
	Inverter Output	437,565.0	-1.5%
	Energy to Grid	433,189.4	-1.0%
Temperature Metrics			
	Avg. Operating Ambient Temp	15.0 °C	
	Avg. Operating Cell Temp	25.2 °C	
Simulation Metrics			
		Operating Hours	4513
		Solved Hours	4513

☁ Condition Set

Description	Ground 30 deg											
Weather Dataset	TMY, DENVER INTL AP, NSRDB (tmy3, I)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type					U _{const}			U _{wind}			
	Fixed Tilt					29			0			
	Flush Mount					15			0			
	East-West					29			0			
	Carport					29			0			
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	3.5	3.5	2.5	1.5	0.5	-0.5	-0.5	-0.5	-0.5	-0.5	1.5	3.5
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle						Backtracking					
	30°						Disabled					
Module Characterizations	Module					Uploaded By		Characterization				
	JAM72D30-540/MB (JA Solar)					HelioScope		Spec Sheet Characterization, PAN				
Component Characterizations	Device						Uploaded By		Characterization			
	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)						HelioScope		Spec Sheet			
	CPS SCA60KTL-DO/480 (Chint)						HelioScope		Spec Sheet			

📦 Components		
Component	Name	Count
Inverters	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)	4 (200.0 kW)
Strings	10 AWG (Copper)	28 (4,131.2 ft)
Module	JA Solar, JAM72D30-540/MB (540W)	476 (257.0 kW)

🔌 Wiring Zones			
Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	17-17	Along Racking
Wiring Zone 2	-	-	Along Racking
Wiring Zone 3	-	-	Along Racking

🏗 Field Segments									
Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Portrait (Vertical)	15°	225.97102°	0.0 ft	1x1		0	
Field Segment 3	Fixed Tilt	Portrait (Vertical)	30°	180°	17.3 ft	2x17	14	476	257.0 kW

3. Annual Utility Savings and Value of Solar Energy

To analyze utility bill savings, we utilize Energy Toolbase, an industry-standard bill modeling software package. Energy Toolbase estimates bill savings based upon a site's electric load characteristics, PV system production (imported from Helioscope or other sources), and local utility tariffs and net metering policies. Xcel Energy tariffs and Net Metering tariff adjustments used in this analysis are:

- Secondary General (SG)
- Net Metering Service (Schedule NM)

Louisville Police & Municipal Courts

To properly calculate the annual utility savings associated with the solar PV, we need to analyze the building load after all electrification and carbon reduction measures are implemented. As noted in the Summary Report, there are two bundles of measures – Bundle 1 and Bundle 2. Each create a slightly different building load baseline. Therefore, both scenarios are listed below. Baseline utility year is 2019 and the assumed DOE building profile is Medium Office.

SCENARIO	ANNUAL SAVINGS	ENERGY SAVINGS	DEMAND SAVINGS
Bundle 1	\$28,510	\$24,520	\$3,990
Bundle 2	\$28,578	\$24,520	\$4,059

Neither Bundle 1 nor Bundle 2 qualifies for a rate switch to SPVTOU. To qualify for a rate switch to SPVTOU, the building must have a minimum 30% load factor for the trailing 12 months.

4. System Price and Financial Results

There are two main avenues City of Louisville can choose to finance these projects – cash purchase or tax-exempt lease purchase (TELP). As a tax-exempt entity, City of Louisville is eligible for direct pay in Year 1 at Energy Investment Tax Credit (ITC) rates. These rates are 30% for cash purchase and 25.5% for TELP.

At this early feasibility study stage of a portfolio, we focus on simple payback to get a high-level look at the project economics. Our simple payback calculation is based on Year 1 solar production, Year 1 annual utility savings, and the Solar*Rewards C&I incentive program. Should any of these projects move into the next stage of development, McKinstry would develop more detailed proformas and cash flows to include items like solar degradation, Operations & Maintenance, discount rates, and more.

McKinstry aims to recommend solar systems that will pay back in the system lifetime, between 25-30 years. In all funding scenarios, this system would pay back within the solar lifetime.

SCENARIO	SYSTEM PRICE	ANNUAL SAVINGS	UTILITY INCENTIVE	SIMPLE PAYBACK (YRS)
Cash Purchase or Tax-Exempt Lease Purchase (TELP)	\$760,000	\$28,510- \$28,578	\$17,328	16.6
TELP with IRA	\$566,200			12.3
Cash Purchase with IRA	\$532,000			11.6

Please note that because there is overlap in service upgrades with other measures being proposed in this study, all PV scope from the AC panelboard to interconnection is included in the electrical scope & price, and not in the pricing below. Additionally, pricing below assumes Louisville moves forward with a system at the Library and the Recreation & Senior Center; there are cost efficiencies in material, installation, and construction management scopes using a portfolio approach.

Another metric that may be useful as the City of Louisville considers the best way to decarbonize is levelized cost of electricity (LCOE). This is defined as capital cost divided by the estimated system lifetime production with units of \$/kWh. It can help the City of Louisville compare the value of owning onsite solar versus

Louisville Police & Municipal Courts

subscribing to renewable utility programs like Renewable Connect and Windsource. The table below shows LCOE with and without the Solar*Rewards C&I incentive.

SCENARIO	LCOE -	LCOE -
	NO UTILITY INCENTIVES (\$/KWH)	W/ UTILITY INCENTIVES (\$/KWH)
Cash Purchase or Tax-Exempt Lease Purchase (TELP)	\$0.057	\$0.031
TELP with IRA	\$0.043	\$0.016
Cash Purchase with IRA	\$0.040	\$0.014

5. Future Considerations and Next Steps

Should Louisville decide to move forward with the Police & Municipal Courts ground mount system, next steps would involve a geotechnical study, utility locates, land survey, racking and electrical bid sets, an interconnection application to Xcel, a subcontractor RFP to get final pricing, and any other due diligence items necessary to de-risk the project and ready it for implementation.

6. Assumptions, Inclusions, and Exclusions

- Codes and Utility Standards:
 - NEC 2020
 - IBC 2018
 - IFC 2018
 - Xcel Energy Blue Book (7/31/2022 Version)
 - Xcel Energy DG Tech Manual (10/28/2021 Version)
- Tax-exempt
- Prevailing wage
- Scope from AC combiner to interconnection is included in the electrical scope and pricing
- Pricing assumes a portfolio approach; Louisville will move forward with a solar PV system at both the Library and the Recreation & Senior Center
- Pricing includes payment & performance bond
- Terms & Conditions listed in the Xcel Energy Interconnection Agreement
- Current labor rates
- Modeling:
 - TMY, DENVER INTL AP, NSRDB (tmy3,l) weather file
 - 1.5% production gain for ground mounts with bifacial modules
 - Soiling data from DNV-GL
- Design Loads
 - Wind speed:
 - Risk Category II: 145mph
 - Exposure: C
 - Ground snow load: 30 psf

Louisville Police & Municipal Courts

- Risk Category II: 1.0 importance factor
- No interconnection upgrade costs
- No grounding transformers
- Major equipment warranties
 - Modules – 12 years
 - Inverters – 10 years
 - DAS – 5 years
 - AC Combiners – 5 years
 - LEDs – 5 years
- No extended warranties
- No ongoing DAS Costs
 - Any ongoing fees beyond year 5 are excluded (both Cell Service and Data Subscription Monitoring fees).
- No backup generation
- Favorable soil conditions. No hard drilling or special footers/foundations required.
- No hazardous soils or materials (asbestos, PFAS, etc.). Should monitoring, mitigation, abatement, and/or disposal be required, Louisville would be responsible for this additional scope.
- Xcel Energy Solar*Rewards C&I Incentives:
 - Tier 1: <250kWac = \$0.04/kWh for 20 years



Appendix

1. Mechanical System Matrix Options
2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating

Police & Municipal Court Cost Estimates

These are “all-in costs” and represent the total cost of construction. These are the amounts that will need to be allocated for budget purposes. They are also Rough Order of Magnitude (ROM) numbers, with a +/-20% range. See the “Construction Pricing Context” section in the report body for more detail.

OPTION 1 (All-Electric): POLICE & COURT

Scope	Total Cost
HVAC Rooftop Units and Ductwork	\$ 992,000
HVAC Piping	\$ 19,000
Electrical	\$ 2,420,000
Total:	\$ 3,431,000

OPTION 2 (Hybrid): POLICE & COURT

Scope	Total Cost
HVAC Rooftop Units and Ductwork	\$ 978,000
HVAC Piping	\$ 39,000
Electrical	\$ 717,000
Total:	\$ 1,734,000

Electrical Add-Alts:	
L3 EVSE	\$ 144,000
L3 Add Generator	\$ 440,000
PV Connection	\$ 144,000
L2 EV Charging	\$ 315,600