Facility Master Plan Recommendations

The following mechanical and electrical discussion is provided based on the project recommendations outlined in the June 1, 2010 Facilities Master Plan Executive Report.

A majority of the new construction work contemplated under the Facilities Master Plan will take place in a single city block located to the east of the existing campus, which will be referred to as the east campus for the purposes of this discussion. The work in this area has been contemplated in two separate projects, primarily to allow construction of the new Evidence Building prior to demolition of the existing Evidence Building to make way for the new County Administration building.

From a mechanical and electrical perspective it is preferable to utilize a single plant to support both buildings and we would encourage the County to consider a single phased project for the construction of this campus rather than multiple projects. In either case, the design of the initial phase will need to include provisions to allow expansion of the common plant equipment and systems under the subsequent phase, which will fiscally burden the initial phase of the project(s).

Existing Energy Plant Mechanical Systems

Based on the size and functions of the new east campus, we estimate the additional mechanical load requirements to be 4,000 – 4,500 MBH of heating and 175 – 225 tons of cooling.

The existing Energy Plant has sufficient heating capability to support the development of the east campus. Currently, the diversity of the existing load allows heating of the existing campus through the operation of one of the large boilers (CP-3 or CP-4). Diversity of existing and future campus load would allow operation of a single large boiler during the shoulder seasons and operation of both boilers during the winter months to support the additional load of the new east campus.

However, the existing chilled water plant will not support the increased load imposed by the addition of approximately 110,000 square feet of office, laboratory, and storage space. Therefore the existing chiller plant would need to be updated or augmented to support the additional cooling load.

One advantage of augmenting the existing plant would be the operational efficiencies gained for the existing campus load through the installation of a new, more efficient chilled water plant. In addition to the lack of space in the existing plant for expansion, one major disadvantage of augmenting and connecting to the existing plant is the distance between the new east campus load and the existing plant. Efficiencies could be gained by heating the new east campus through the installation of more efficient low temperature heating system. Therefore we propose consideration be given to a new heating and cooling plant situated at or near the new east campus.

Existing Energy Plant Electrical Systems

The existing infrastructure consists of three electrical services that effectively serve the existing Energy Plant, Public Safety Building and plant operations, Original Courthouse, Courthouse Annex, and the Jail. The three electrical services are fed from three transformers totaling 2000 KVA. These transformers are located immediately north of the existing Energy Plant and are primary metered with a single power company meter. The maximum demand at the primary meter was measured in 2007 at just over 950 KVA, which indicates these services are of sufficient capacity to serve substantial future HVAC equipment load addition at the existing Energy Plant. However, the services are relatively complex and are not situated for easy physical expansion. Retrofit will likely be limited by access, floor space and connection spaces.

Based on the size and location of the new east campus, we believe the existing plant power systems could be retrofitted to serve the new east campus heating and cooling loads, but retrofit of the existing systems would not be as cost efficient as all new electrical gear in a new plant. Distance from the existing Energy Plant to the new east campus would also require local power services to each of the new buildings at the east campus.

East Campus Power Supply

New power services will be required to the new east campus facilities. If the proposed facilities are built to the scale recommended in the Facilities Master Plan Executive Report, we anticipate the east campus will require approximately 1200 KVA of transformer and 2000 amps of 480v services divided proportionately between the new structures. If the HVAC energy supply is provided from the existing Energy Plant via retrofit, the east campus electrical requirements are anticipated to be reduced by approximately 400KVA and 500 amps of 480v service.

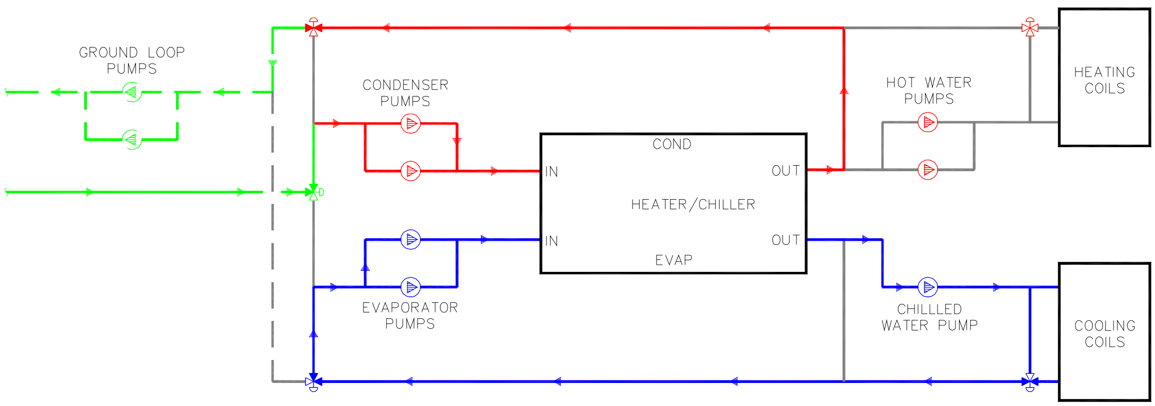
If Black Hills Power continues to allow combined billing accounts for their multi-facility clients, there is little benefit of primary metering for the new east campus facilities (or similarly for the existing campus facilities). In that case each facility should have a dedicated service transformers and an associated meter with dedicated data line from the meter. Should Black Hills Power advise the combined billing method will no longer be continued, consideration should be given to a primary metering scheme similar to the existing campus configuration.

Primary power to the east campus will require some reconfiguration of existing power systems. The existing Jail Annex and Parking Structure primary is fed from an east-west distribution line in the alley between St Joseph and Kansas City streets, and transitions to underground primary prior to routing under Second Street. This underground line will be required to be revised and this revision will involve relocation of a utility-owned line. The electric services to the facilities at the new east campus should be able to be provided via underground services and fed from the same overhead distribution line in the east alley. We anticipate the west end of this overhead line would be reconfigured for new underground services to the east campus facilities. In addition, we anticipate the relocated service to the Jail Annex would need to be routed south along the east end of the new Evidence Building and west along Kansas City Street to facilitate reconnection to the existing Jail Annex primary service at the southeast corner of the existing Parking Structure.

East Campus Energy Supply

If a decision is made to provide a new Energy Plant for the east campus, we recommend the mechanical system be based on a central geothermal heater/chiller plant generating heating and chilled water for use with conventional VAV air handling systems. The benefits of this system are similar to distributed water-to-air ground-source heat pump systems, but without the associated issues of distributed system maintenance.

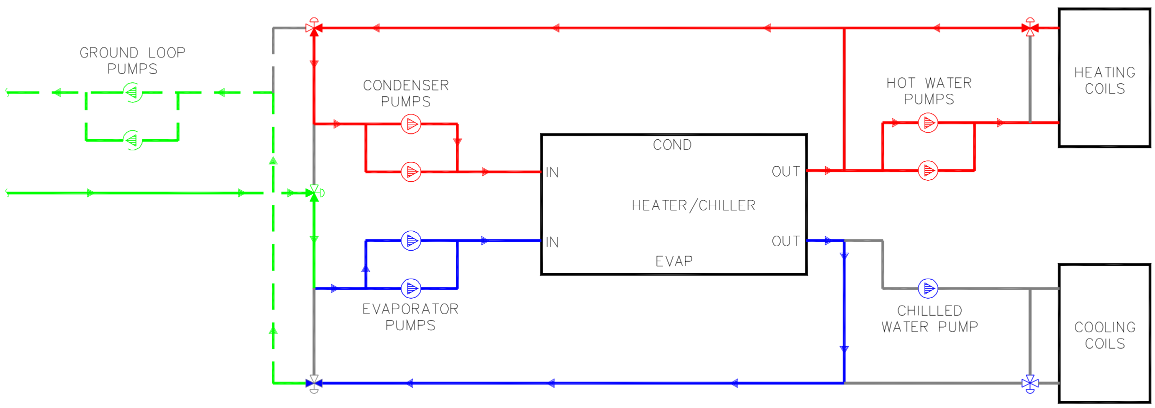
A central geothermal plant is essentially a heat recovery chiller connected to a ground-source heat exchanger. Chilled water is produced through the evaporator and heat is rejected through the condenser similar to the operation of a standard water-cooled chiller. The main difference in the geothermal plant application is condenser heat rejection to a ground loop heat exchanger rather than a cooling tower. Figure 1 shows a simple schematic diagram of this operation.



<u>Figure 1.</u> Central Geothermal Plant in Cooling Mode

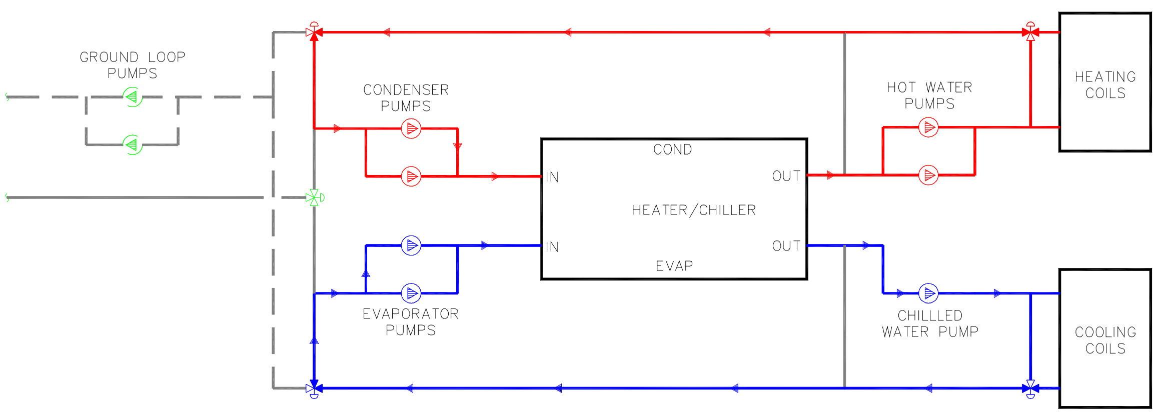
Another major difference with a central geothermal plant is the use of the chilled water equipment to produce heating water for the building. When the plant is controlled in heating priority mode, hot water is produced by the condenser at an elevated temperature sufficient to be used as a heat source for the building (120-140 degrees F). In this mode of operation (Figure 2), valve positions are modulated to open the evaporator to the ground loop in order to absorb energy from the ground.

In the ideal situation, the heating and cooling loads would be coincident and balanced such that no energy transfer would be necessary through the ground loop field (Figure 3), allowing the plant to function as a Dedicated Heat Recovery Chiller. The central geothermal plant will be the most efficient



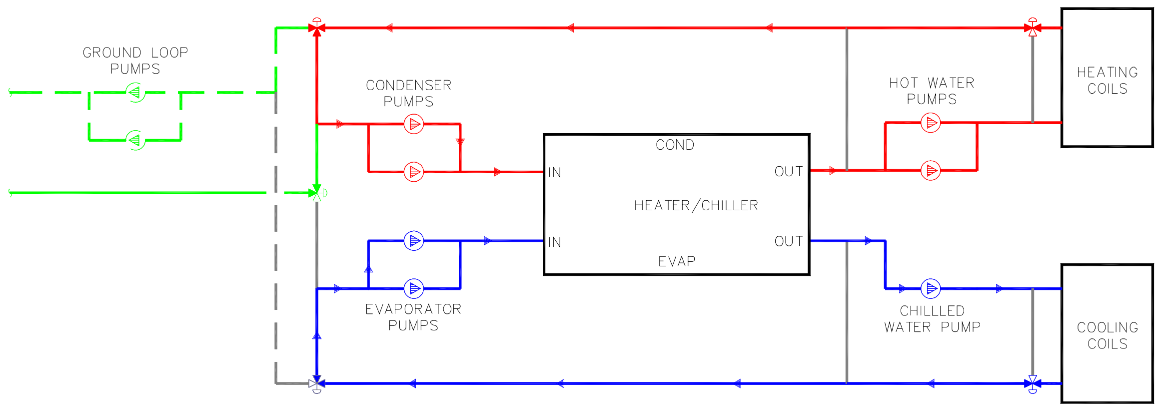
<u>Figure 2.</u> Central Geothermal Plant in Heating Mode

during this mode of operation because it is merely redistributing energy within the building. However, because heating and cooling loads are seldom balanced within a building, this situation rarely occurs for long periods of time.

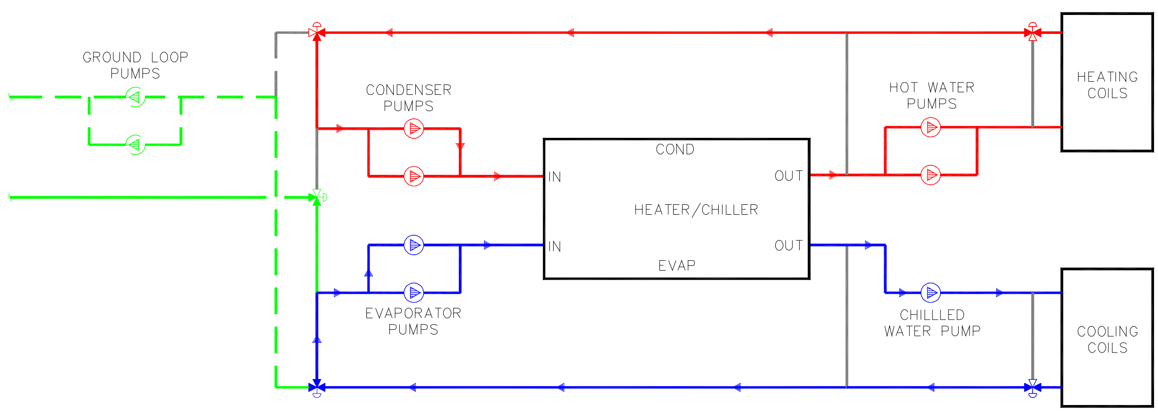


<u>Figure 3.</u> Central Geothermal Plant with Coincident Balanced Loads (Ground Loop Pumps Off)

Plant efficiency will also be higher in the shoulder seasons when the coincident loads will most likely occur. During those times the valves are modulated to allow heat to be absorbed or rejected to the ground loop depending on which side has excess capacity. Examples of these modes of operation can be seen in Figures 4 and 5.



<u>Figure 4.</u> **Central Geothermal Plant with Excess Cooling Load (Rejecting Heat to the Ground)**



<u>Figure 5.</u> **Central Geothermal Plant with Excess Heating Load (Absorbing Heat from the Ground)**

We have reviewed the conceptual east campus plan and believe there is adequate space beneath the central parking lot for a ground loop heat exchanger large enough to support the new campus loads, assuming geological conditions are similar to other projects in the area. However, for larger projects such as this we recommend borehole thermal response testing (i.e. thermal conductivity) testing be conducted at the anticipated borehole depth to determine in-situ heat exchanger capacity and the overall design parameters to be used in sizing the borefield. Although ground-source systems are very energy efficient, the heat exchangers can be very expensive to install and borehole thermal response testing will provide valuable design data that may potentially reduce the overall borefield size and associated cost.

If a ground loop heat exchanger is anticipated in the design of a new plant, the County should budget $8,000-15,000 for borehole thermal response testing, depending on depth and quantity of test bores (one or two holes will provide sufficient data). The test bores should be positioned to allow incorporation into the production field in order to minimize the overall cost of the testing and final borefield installation.

Based on the potentially low internal heat gains of the new east campus (people, lighting, etc.), it may not be economical to provide a standalone central geothermal plant. The low internal heat gains may result in a heating dominant building, in which case the County may want to consider a hybrid central geothermal scheme involving a smaller borefield supplemented by another heat source for thermal peak shaving. This energy buffer could be a new condensing boiler or an interconnection could be made to the existing campus Energy Plant. One potential advantage of an interconnection may be the possibility of supplying energy back to the existing campus rather than exchanging energy with the borefield.

Depending on the operating mode, the new central geothermal plant may be more efficient than the existing chiller plant. If this is the case, the new plant could be used as the primary cooling source for the combined campus and the existing plant could be staged on to provide additional cooling when required. This same concept could be applied to the heating side of the existing campus, except that the existing heating coils are sized for higher temperature operation (180 degrees F), which generally cannot be achieved with this type of equipment.

That said, the existing campus could utilize the lower temperature heating water in shoulder seasons when heating demands are less or during other times when a lower heating water temperature is supplied according to a boiler reset schedule. So an interconnection may serve two purposes – as an energy buffer for the new system to allow a reduction in the size of borefield, and to provide supplemental energy when required by the central geothermal system. An interconnection would likely also have the added benefit of increasing the efficiency of the existing system.

The existing ice storage system also needs to be considered in the overall plan. The ice chillers are inefficient when making ice from a power standpoint, but there are fiscal efficiencies to the strategy because of the preferential electrical rate and lack of demand charges during the off-peak utility hours of ice production. A new central geothermal plant would also qualify for the same preferential rate, but would operate the equipment in a more efficient temperature range, so fiscal efficiencies would be increased.

This would be particularly true in the case of an interconnection if there was a requirement for chilled water in the winter. If the chilled water demand was significant and coincident with the heating requirements of the east campus, the system might be able to heat the new east campus without a borefield (i.e. functioning as a Dedicated Heat Recovery Chiller). However, the existing central campus utilizes airside economizers in the winter, so there generally is not a use for chilled water coincident with the heating requirements for the new east campus. In addition, the borefield will most likely be required to qualify for the BHP Energy Storage rate, which would be required to achieve the energy costs expressed in this section of the overall Facility Audit report.

All of the ideas outlined above will be very dependent on the logistics of the development of the east campus and feasibilities will change depending on the load of each building and the timing of those loads. This level of detail on the new campus is yet not available and these alternatives will need to be evaluated when more detailed information is available (i.e. Design Development stage of project). In addition, any interconnection to the existing campus will likely require an analysis of existing system glycol, due to the fact the chilled, heating, and source water systems are hydraulically connected, but thermally isolated in most central geothermal plants.

East Campus Energy Supply

Rough costs comparing the energy cost of natural gas boilers versus a central geothermal plant are presented in the following table. Note that these costs are provided for discussion and comparison purposes only and should not be construed as predictions of the overall energy cost for the new east campus. Plant and building operation, timing of internal heat gain, weather conditions, and seasonal adjustments to utility costs will have an effect on the data expressed in the table.

The costs are based on the existing campus blended historical interruptible natural gas rate, the current Black Hills Power General Service Large and Energy Storage rates, estimated efficiencies of the existing and new boiler plants, and the estimated efficiencies of a new central geothermal plant. The efficiencies of the central geothermal plant will vary with system temperature, so the values expressed in the table are based on varying operational conditions. The last two lines in the table include the cost benefit of the 'free' chilled water generated during the production of heating water, assuming a coincident requirement for chilled water (i.e. when operating as a Dedicated Heat Recovery Chiller).

Estimated Cost per Decatherm of Energy Production

129/140 Deg F	105/120 Deg F	105/120 Deg F	Condenser Temperature (EWT/LWT)
42/35 Deg F	**35/25 Deg F**	**54/44 Deg F**	**Evaporator Temperature (EWT/LWT)**
2.7/4.3	**3.1/5.2**	**4.0/7.0**	**COP (Heating Only/Heating and Cooling)**
$9.30	$9.30	$9.30	Existing Boiler Plant (at specified HWS temperature)[1]
$8.53	$8.11	$8.11	New High-Efficiency Boiler Plant (at specified HWS temperature)[1, 2]
$13.04	$11.62	$9.46	New Geothermal Heater/Chiller Plant Heating Only (On-Peak)[2, 3]
$4.50	$4.05	$3.37	New Geothermal Heater/Chiller Plant Heating Only (Off-Peak)[2]
$8.34	$7.14	$5.67	New Geothermal Heater/Chiller Plant Heating and Cooling (On-Peak)[2, 3]
$2.90	$2.83	$2.37	New Geothermal Heater/Chiller Plant Heating and Cooling (Off-Peak)[2]

1. Includes estimated pumping energy based on lowest tier of BHP GSL Combined Billing Rate (no fan energy or demand charges are included).
2. Efficiency and produced energy cost vary based on water temperatures.
3. Includes estimated pumping energy based on BHP ES Rate (estimated $0.05/kWh demand charges included for On-Peak, but no fan energy).

As can be seen in the table, the lowest energy costs are obtained with coincident heating and cooling loads on a central geothermal plant. Note that a reduction in the heating water supply temperature

(140 deg F to 120 deg F) reduces chiller temperature lift requirements, resulting in improved equipment efficiencies and lower operational costs. Also note utility demand charges have a negative effect on these costs, potentially making this system the most expensive to operate during heating only on-peak utility hours.

In reality, the overall cost would be lessened with thermal peak shaving through the use of a high-efficiency condensing boiler or connection to the existing campus boiler plant. In addition, the demand charges are based on the peak demand for the month, which become less of a factor on a per unit basis with increased use of the equipment. The cost per unit of produced energy for each system varies with operational temperatures, but the cost per unit of purchased energy for the central geothermal system also varies according to utility peak hours, while the cost of energy from natural gas remains the same (the price of natural gas will be subject to seasonal and yearly swings, but the values in the table are calculated the historic blended rate obtained through the analysis of utility bills at the existing Energy Plant).

Figure 6 shows a monthly energy analysis of a simple model of an office building similar in size to the buildings proposed for the east campus. The analysis compares a central geothermal plant (Alt 1 – first column of each month) and a more traditional condensing boiler and water-cooled chiller plant (Alt 2 – second column of each month).

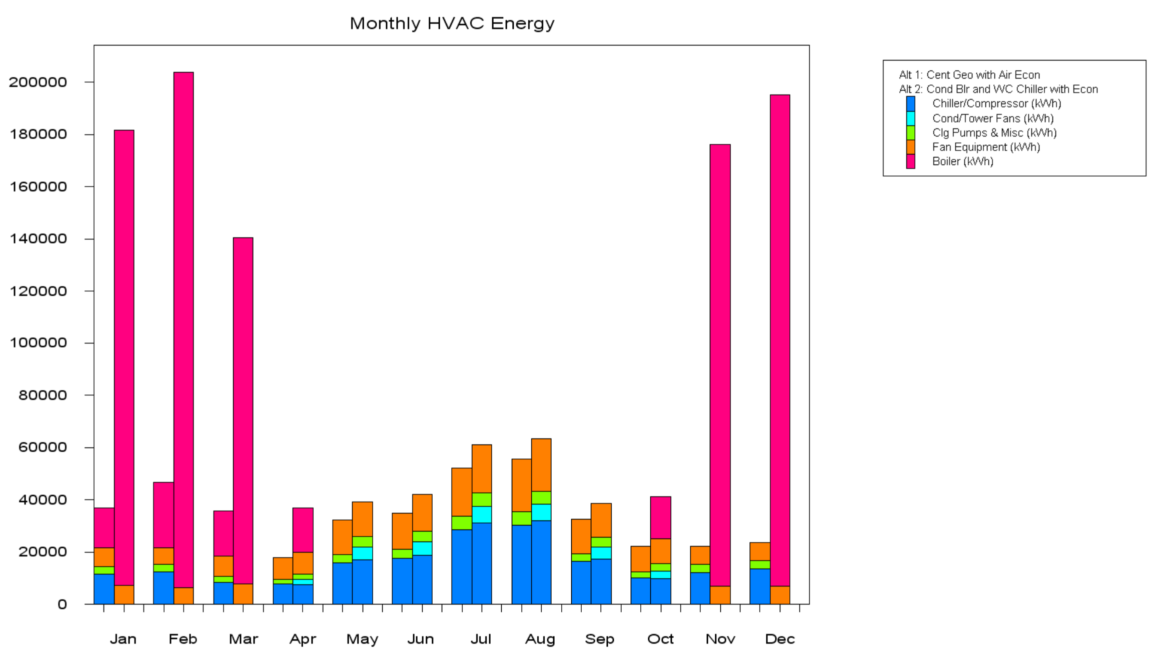
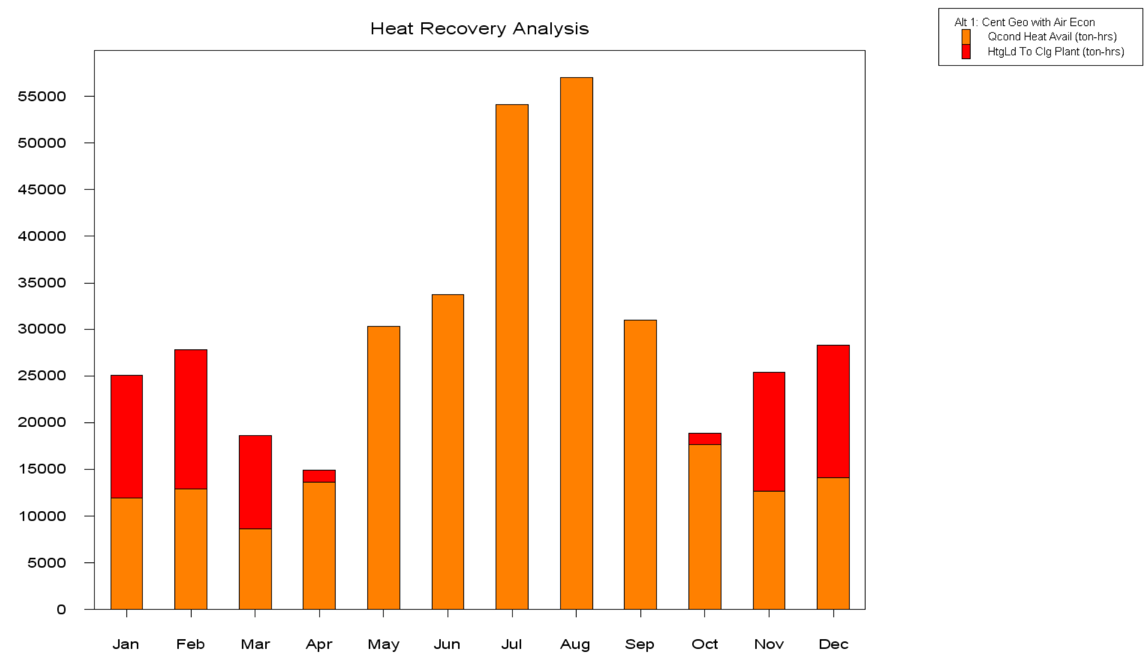
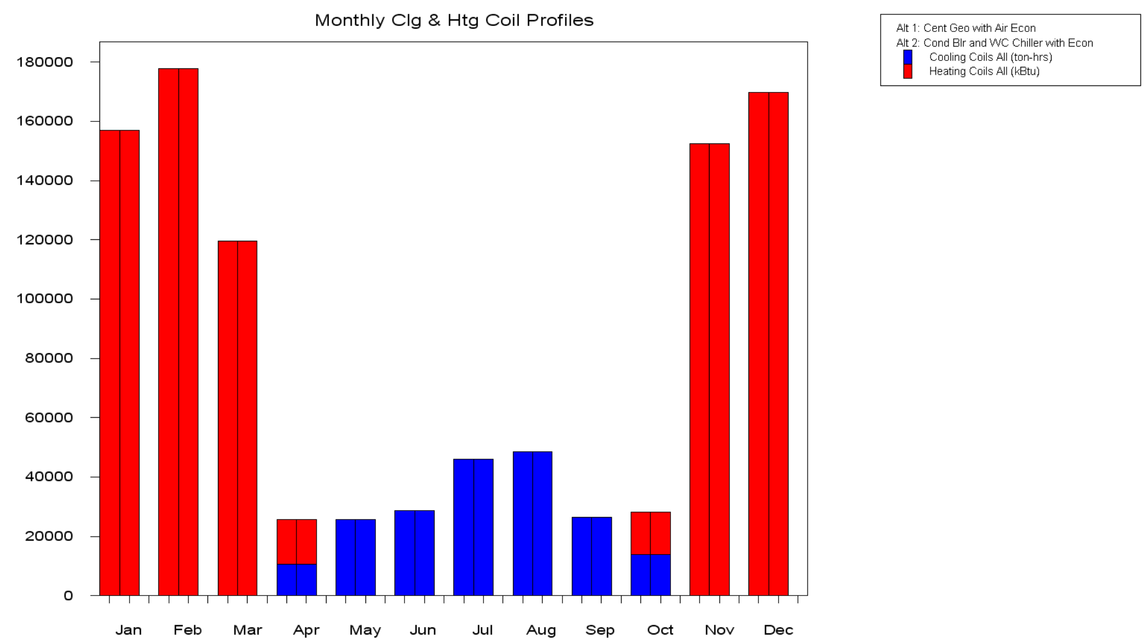


__Figure 6.__ **Comparison of Energy Plants**

The analysis indicates chiller use during all months for the central geothermal plant scenario with a significant reduction in boiler use due to the increased efficiencies of plant and the heating energy recovered from chiller operation as indicated by the red bars in Figure 7. This occurs even though the coil loads are the same in both cases (Figure 8).



<u>Figure 7.</u> Heat Recovery in Central Geothermal Plant



<u>Figure 8.</u> Cooling and Heating Coil Load Profiles

Note that the analysis depicted in Figures 6 - 8 is specific to this simple building model and the associated energy plant simulations. Internal heat gains and building occupancy hours will play a significant role in sizing the equipment, design of the plant, and the resultant performance of the HVAC system. Therefore, we recommend a full energy analysis of proposed mechanical systems be conducted during the early stages of the project.

Energy Plant Phasing

Some analysis must also be given to the phasing of the new Energy Plant, such that it aligns with the phasing of the overall project. It is anticipated the new Evidence Building will be the first structure constructed on the site, so the new Energy Plant will most likely need to be contained within that structure. In addition, the connector from the Parking Structure to the new Administration Building will not be present when the new Evidence Building is constructed. This presents a logistical problem with using the connector as a possible path for energy supply from the existing plant.

If interconnection with the existing Energy Plant is determined to be the most feasible option, one thought would be to provide the borefield and central geothermal plant when the Evidence Building is constructed and then provide the interconnection to the existing campus when the Administration Building is constructed. If this idea is implemented, the minimum size of the borefield should be based on the heating and cooling requirements of the new Evidence Building or sized to support the eventual needs of the east campus (whichever is greater). In either case the entire borefield should be installed during the initial phase of construction in order to minimize mobilization costs and to avoid repaving the parking lot when the Administration Building is constructed.

Primary power running east-west in the alley between St Joseph and Kansas City streets could remain while the new Evidence Building and the north portion of the Administration Building are constructed. But the existing Jail Annex power will need to be rerouted around to the east and south of the new Evidence Building when the State's Attorney portion of the Administration Building is constructed. As such, consideration should be given to reworking overhead power and relocation of the Jail Annex electrical service during the construction of the new Evidence Building. Service to the existing Evidence Building could be removed after the new Evidence Building is commissioned and the existing building is demolished.

New Evidence Building

The primary function of the new Evidence Building will evidence storage, but programming will also likely require a significant laboratory function for the processing of evidence. The laboratory space in the existing Evidence Building has inadequate pressurization controls and we recommend a more efficient and appropriate system be installed in the new building. The new laboratory space should incorporate precise pressurization control through the use of venturi-style air control valves on the supply, general exhaust, and lab hood exhaust. The air control valves should have interconnected controls and should be able to adjust position instantaneously in order to maintain proper pressure control in the laboratory spaces.

Exhaust from the hoods should be connected to a manifold to allow the use of a single laboratory exhaust fan and minimize bypass requirements through the use of a single, larger fan. Given the proximity to a residential neighborhood, the exhaust fan should be appropriate for laboratory use, mounted on the roof, and able to generate a high plume for the laboratory hood exhaust. If hood exhaust requirements are great, consideration should be given to energy conservation techniques such as runaround heat recovery loops and/or multiple fans staged with a variable frequency drive on one of the fans. Any chemical hoods will be required to comply with NFPA 45, which means the manifold duct will likely be located on the roof with individual hood connections made outside the structure.

We also recommend separate air handling systems for office and laboratory spaces to allow proper pressure control in all areas while minimizing initial capital and ongoing operational costs. Consideration should be given to the use of an energy recovery ventilator for general laboratory supply and exhaust, but only after it is determined that wheel carryover will not present a health or safety concern. If an energy recovery wheel is incorporated into the system, we also recommend bypass dampers be included to allow economizer operation. All air intakes should be properly located away from exhaust points, in particular laboratory hood exhaust.

Plumbing systems in the laboratory spaces should include emergency eye wash and shower station(s). Proper laboratory waste systems should be employed where acids and alkalis are used. Plumbing requirements for the laboratory exhaust hoods should be verified with the laboratory planner and implemented as necessary. A centralized vacuum system should be provided with outlets located as specified by the laboratory planner. Laboratory gas system requirements should also be verified and may include hydrogen, nitrogen, helium, air, and argon. Consideration should be given to manifold distribution of these systems with cylinders stored in a central location. NFPA requirements should be observed in all cases.

Evidence storage areas should be properly conditioned to maintain the evidential value of the storage items. Any maintenance points such as VAV boxes, fans, and electrical panels should be located outside of laboratory spaces and evidence control and storage areas. Spaces containing biological hazards should be isolated and consideration should be given to HEPA filtration on exhaust systems serving these areas. Air intakes should be located in areas that are inaccessible to the public and upwind of any exhaust systems. Pressure control of spaces should be verified and applied as required.

Due to size requirements and the need for emergency power backup of 120/208v loads, we recommend a 3-phase, 208v service to this facility. This service could be supplied from the east-west overhead distribution line in the alley between Kansas City and St Joseph Streets. To capitalize on the energy storage rate offered for geothermal systems as proposed, separate metering will likely be required for the HVAC equipment qualifying for this rate. Per protocols, emergency power via backup generator should be provided for evidence areas, refrigerators and freezers, photography dark rooms, security equipment (including phones, security access, and CCTV systems), and other evidence processing equipment. In addition, uninterruptable power systems are recommended for backup of all computer systems including lab equipment, Automated Fingerprint Identification Systems (AFIS), Combined DNA

Identification System (CODIS), Laboratory Information Management System (LIMS), Drugfire, Integrated Ballistic Imaging System (IBIS), and LABNET. Laboratory programming will determine the applicability of these requirements.

New Administration Building

The new Administration Building will be primarily office space with some areas of storage. Mechanical system design for this building should be straightforward with systems similar to those installed at the existing campus.

We recommend the HVAC systems for the new Administration Building be based on Variable Air Volume (VAV) air handling systems designed with low temperature heating coils. Other mechanical distribution systems such as chilled beams and thermal displacement may help improve overall system efficiency, but we believe the County's familiarity with VAV systems outweighs the marginal energy gains and higher installation costs presented by these system alternatives. The use of economizers and energy wheels in the HVAC system should be decided based on the results of an energy analysis conducted during the Design Development phase of the project.

Due to the size of this structure, we anticipate a 3-phase, 480v electrical service to this facility which may also be powered from the alley. To capitalize on the energy storage rate offered for geothermal systems as proposed, separate metering will be required for the HVAC equipment qualifying for this rate. A second service transformer could be provided at 208v to serve other loads and could potentially be backed up by the new Evidence Building emergency generator to avoid the substantial electrical infrastructure cost a second generator system might impose.

Original Courthouse

Given the desire to restore the facility and the availability of more efficient technology, we propose the existing mechanical systems be updated with unobtrusive energy efficient technology that would allow the restoration under the Historic Preservation Plan. We recommend the installation of a water-cooled heat recovery variable refrigerant volume system using the existing changeover heat exchanger system to provide a tempered water source to the new system. Refrigerant lines should be routed in wall and ceiling cavities and refrigerant zone valve control boxes need to be located in accessible areas for ease of maintenance. Reuse of the existing hot water convectors would provide heat for the perimeter offices and third floor courtroom.

Ventilation should be provided to all occupied spaces at space neutral conditions through the use of energy recovery ventilators with chilled and heating water coils providing additional tempering of the air. Consideration should be given to demand control ventilation strategies through the use of Variable Frequency Drives (VFD) on fans, ventilation zoning using VAV boxes, and occupancy sensors. Larger spaces such as courtrooms may require dedicated air handling systems, which could be located in the existing penthouses.

Existing mechanical and electrical and systems currently located above suspended ceilings will need to be relocated in order to implement the Historic Preservation Plan. Consideration should be given to reworking of the emergency power and emergency lighting within the facility, which is currently insufficient. In addition, the needs for emergency power to support critical operations should be re-evaluated during a major remodel. The emergency generator located within the existing Energy Plant is of sufficient capacity to support limited service and equipment backup additions.

Parking Structure

The addition of two levels on the existing Parking Structure will not involve much mechanical work other than installation of drains and extension of the existing dry standpipe system. Electrical work will include lighting and potentially the addition of an elevator. If an elevator is planned, a new service to the parking structure will likely be required, along with space conditioning of the elevator equipment room.

Electrical Systems and Energy Conservation Measures

The best readily available and proven energy efficiency equipment, lighting, and controls should be considered for all projects. Lighting utilizing the most efficient methods is now regularly applied in most projects; however, over the last few years the Federal government has mandated a phase-out of many low efficiency lamps, ballasts, and fixtures. As a result, it is essential the lighting design does not inadvertently specify lamps or equipment that will be made obsolete within the next few years, which could easily occur considering certain types of T8 lamps will become obsolete under current phase-out plans. Most office and public space lighting should be designed with a mix of fluorescent and Light Emitting Diode (LED) lighting technologies. The use of incandescent lighting should not be considered.

As demonstrated by ongoing retrofits by the County, occupancy sensor control of lighting in individual spaces is a cost effective and reliable technology. Each space should be designed with manual controls to provide individual comfort and automatic controls for energy conservation when the space is unoccupied or illuminated with natural daylight to an adequate level for the space or occupant. Specification of dimming and dimming ballasts should be minimized due to the poor life-cycle cost of ballast and lamping replacement, unless such dimming systems can demonstrate financial paybacks when utilized for a specific daylight harvesting application. The lighting design should also consider automatic shut off of task lighting when the space is unoccupied. Design approaches utilizing 24/7 illumination of spaces should be avoided unless requirements are minimized and utilize LED lamp sources.

Energy Star equipment should be prescribed where applicable and VFD controls should be prescribed for all motors over 5 hp used in operations with variable loads or in applications where motor speed reduction is commonplace.

Campus Access Security, Fire Alarm, HVAC Management and Communications

The existing campus has integrated security, fire alarm and communications between the central campus facilities and the existing Evidence Building, and is connected to the Public Safety Building by a fiber hub crossing Second Street. This fiber hub interconnection could likely be used to support new systems between the existing campus and the new east campus facilities. If this fiber hub cannot be used, a new fiber hub considering all campus systems interties should be implemented.

The existing campus Access Security (AS) system is proprietary to Honeywell and is currently located in the Buildings and Grounds facility. In order to effectively manage AS system operations, the AS system head end should be relocated with Buildings and Grounds when that portion of the east campus is constructed. In the interim, the new Evidence Building AS system should be connected back into the existing campus system when the new Evidence Building is constructed. The existing campus should be connected to the new east campus once Buildings and Grounds has been relocated, possibly using the same means as the interim connection to the new Evidence Building. These interconnections may be facilitated by new or existing fiber links in conjunction with LAN IP gateways.

The existing campus Fire Alarm (FA) is a proprietary Simplex system and there will be little benefit to extending this system to the new east campus. New systems should be designed and implemented based on the requirements of each facility.

The existing campus HVAC Building Management System (BMS) is also proprietary to Honeywell and is currently located at Buildings and Grounds operations. The BMS head end should be relocated with Buildings and Grounds operations and interim system connections should be provided similar to that described for the AS systems. Note that the BMS interconnection may need to support legacy systems if those controls are not retrofitted and allow implementation of the Energy Dashboard technology described under the Energy Plant section of the overall Facility Audit report.

To manage the campus Information Technology (IT) systems effectively, the campus system(s) should also be interconnected. The County IT team has indicated a need for a new redundant IT workbench and systems on the east campus, which should also be connected back to the existing system located at the existing Buildings and Grounds operation. Again, these interconnections may be facilitated by new or existing fiber links in conjunction with LAN IP gateways or via the extension of the line-of-site radio modems and LAN IP gateways to the HVAC control system.