



Retrofit of the Local 150 of International Union of Operating Engineers Headquarters Campus

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– Timeline

- Project start date: October 22, 2009
- Project end date: October, 2010
- Percent complete: > 50%

– Budget

- Total project funding: \$4,975,221
- DOE share: \$2,459,971 (49.4%)
- Awardee share: \$2,515,250 (50.6%)
- Funding received in FY09: N/A
- Funding for FY10: \$2,303,638

– Barriers

- As significant progress has already been made (> 50%) no barriers to successful completion presently exist.

– Partners

- International Union of Operating Engineers Local 150
- Smart Geothermal Fund 1, LLC
- Architectural Consulting Engineers

Using Indie Energy Smart Geothermal™ technologies, the project will accomplish several key objectives that will serve as a catalyst for widespread adoption of GHP technology:

1. Demonstrate the reduced first cost impact of smart geothermal design and technology.
 - Result: Geothermal field size reduced by 10.8% (\$192,771 savings)
2. Demonstrate smart geothermal innovations in system efficiency, especially in the building-earth interaction.
 - Simulated result: Up to 30% improvement (peak load reduction)
3. Demonstrate an economical and repeatable approach to district, hybrid retrofit GHP systems.
 - Result: 1 of 3 buildings retrofit conversion 90% complete; 2nd building permitted
4. Demonstrate innovative financing that leverages verifiable system cost savings to provide compelling return on investment to investors while reducing first cost barriers.
 - Result: \$1,000,000 in outside capital sources (reduction in first cost to end-user)
5. Demonstrate Indie Energy's GeoPod™ system, which proves GHP system performance and energy savings through standards-based measurement and verification.

- Scientific/technical approach

- To define the savings potential of a district and hybrid system retrofit with a high resolution simulation tool that reflects the minute-by-minute interactions between:
 1. The geothermal field and;
 2. The building HVAC system.
- Calibrate simulation of geothermal field with high powered, site specific thermal response test. Results are used to tune simulation.
- Calibrate simulation of proposed HVAC system with existing utility bills. Historic consumption is used to tune simulation.
- Calibrated model is used to define optimal sub-field loading of district geothermal field (see schematic).

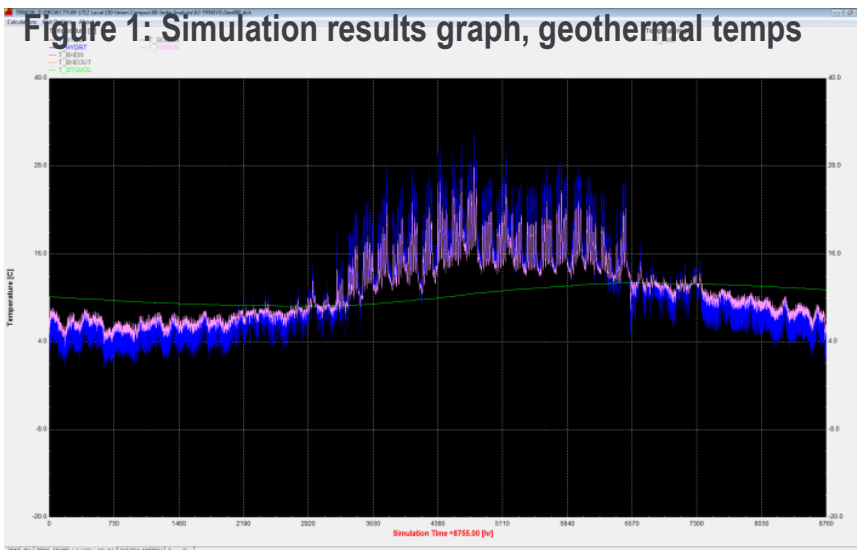


Figure 2: Geothermal field schematic with subfields



- Logged over 400 hours of simulation time enacting district and hybrid system design and model calibration.
- Per the planned decision point DP #1, the calibrated simulation approach yields the defined district geothermal scope of 83 boreholes at 650 feet,.
- Per the planned decision point DP#2, the calibrated simulation approach yields hybrid system scope requiring existing chillers to be isolated but intact for peak degree day operation only, while existing boilers will remain tied in and controlled automatically to bump hydronic heating temperatures.
- Design document development stage has been enacted with third party oversight by MEP engineer working directly for building owner.
 - Decision points #3 and #4 completed
 - Permits for geothermal drilling
 - Approval of schematic design
 - Mechanical and electrical permit drawings, decision point #5, are 90% complete (2 of 3 buildings are permitted)

Figure 3: Building one system schematic

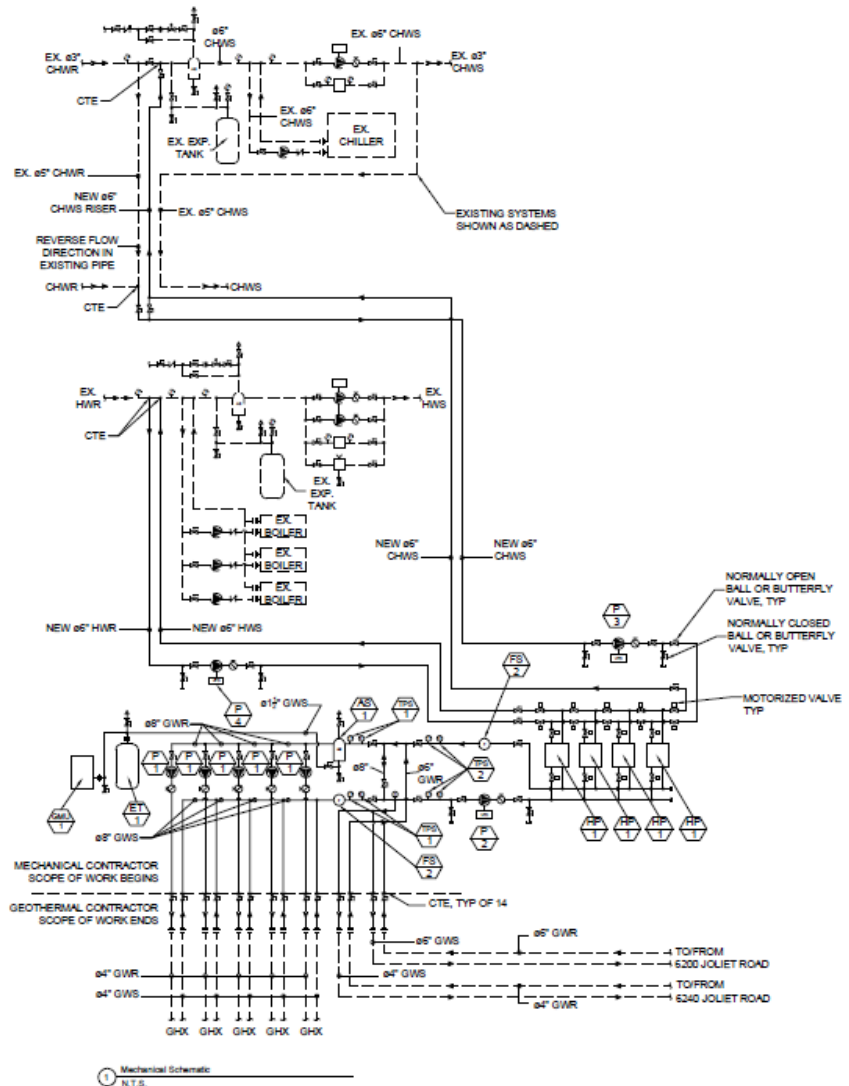
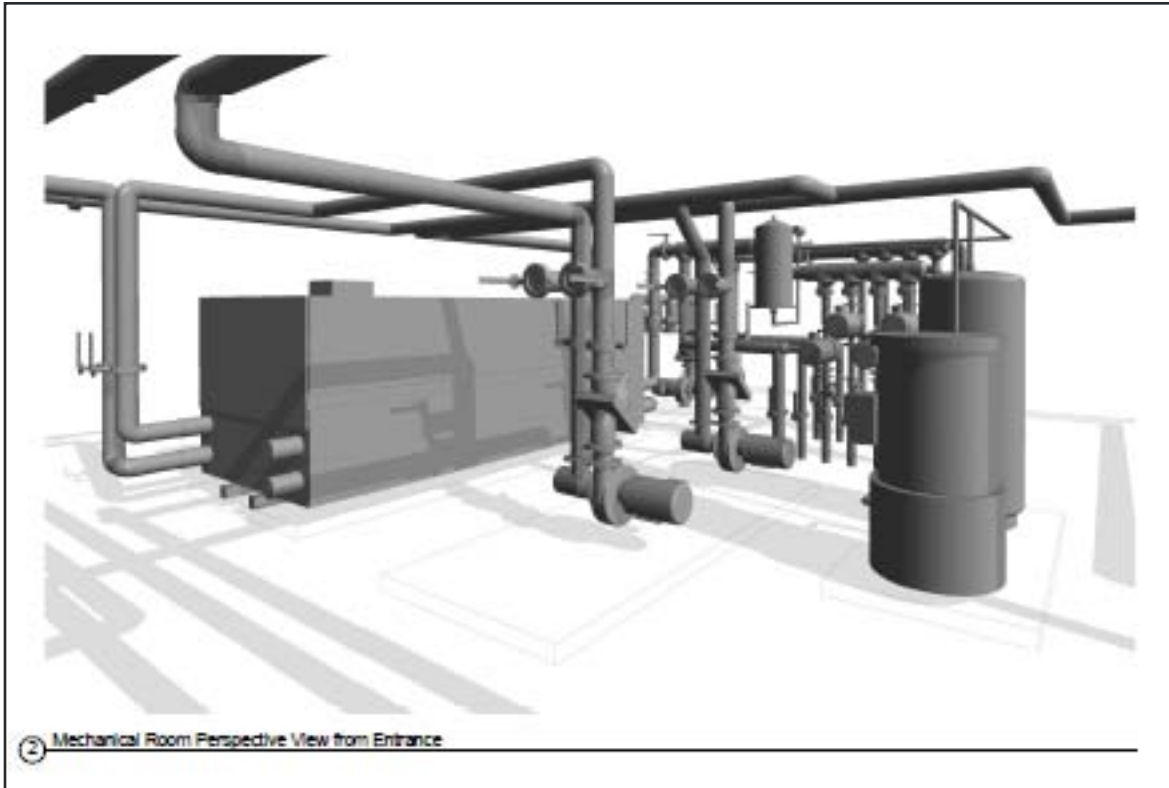


Figure 4: Building 1 mechanical room in Revit 3D



ACCOMPLISHMENTS

- Completed full geothermal system analysis.
- Attained owner approval of schematic design for facility.
- Completed full design documents for two of three buildings.
- Received permits for geothermal field and two of three buildings.
- Completed construction of geothermal field.
- 90% complete on construction of first and largest of the three buildings.

SPECIAL EQUIPMENT

- Deployed modular high capacity water to water heat pumps with the following benefits:
 - Equipment footprint of just 105 SF is sufficient to retrofit 94,861 SF of existing VAV and multi-zone systems to geothermal.
 - Modular heat pump packaged controls allow simultaneous heating and cooling to independent hot and chilled water set points.
 - No sheet metal re-work required.
 - No more than 2 days of down time will be required for system change over.
- * So far there has been zero impact on daily operations of buildings.
- Developed independent subfield pumping and associated controls.
- Incorporated ionizing air filtration equipment to decrease outside air load while maintaining indoor air quality—permit approved.
- Brought 400 tons geothermal field piping into sub-grade mechanical room with no impact on existing structure.

QUALIFICATIONS

- Indie Energy has in-house professional engineering and project management expertise that supports its construction operation.



- The project management plan is focused on these main goals:
 - Achieving project objectives through realistic milestones and logical task structure.
 - Minimal impact on occupied spaces during construction and startup.
 - The capability to tie into existing conditioning equipment to remain operational until just before the geothermal heat pumps are ready for “plug and play” installation.
 - Project is being managed and implemented on the technical side by:
 - Robert Olden, VP of Engineering
 - Julianna Carney, PE, LEED AP
 - Dan Couillard, PE, LEED AP
 - Chaz Ott, Mechanical Engineer
 - Project is being managed on the construction side by in-house project supervisors.
- Schedule:
 - Project scheduled to be complete October, 2010.
 - Geothermal field complete.
 - HVAC retrofit of Building 2 scheduled to begin in June, 2010.
 - Initial start-up of Building 1 scheduled for June, 2010.
 - GeoPod M&V system designed and under construction.

- Describe deployment strategy:
 - Phased implementation based on quality metrics.
 - Provision of real-world data to research community.
 - Continuous improvement with customer to tune system for optimal comfort and efficiency.
 - Quantified energy savings for support of payments and CO₂e offsets for Energy Supply Agreement (ESA).
- Future research, development & deployment needs:
 - Produce case studies demonstrating project results (late 2010 / early 2011).
 - Continued R&D on sub-field optimization strategies, with controls.
 - Lessons learned report for retrofit and hybrid system design and implementation for maximum cost-benefit.

1. An integrated technology-systems approach to GHP systems can provide breakthroughs in feasibility for low-impact retrofitting.
2. District, optimized geothermal field design and control reduces first cost and increases efficiency.
3. Energy Supply Agreement (ESA) is a robust and verified delivery vehicle for GHP systems that reduces first cost to owner.
4. Provision of standards-compliant controls and M&V technology can validate cost and CO₂e savings, and enable third party capital investment.