NY-GEO 2026

March 24-25, 2026 | Brooklyn, NY

The Design Process:

From Concept to Commissioning

Speaker: Don Penn, PE, AEE Fellow, CGD, CGI

Don Penn Consulting Engineer

DP
CE

DESIGN & COMMISSIONING TRACK • SALON ABC • 4:00-5:00 PM

The Design Process: *From Concept to Commissioning*

This presentation examines engineering best practices for HVAC and geothermal system commissioning, with a focus on risk mitigation, design validation, and long-term performance. Participants will review common causes of commissioning failure, including compressed project schedules and incomplete installations, and evaluate the impact on system efficiency and warranty compliance. The course emphasizes critical pre-design considerations such as owner maintenance capability, operating schedules, and system selection strategy. Technical design topics include load modeling, borefield configuration, reverse return piping, and flushing and purging requirements. The importance of contractor qualification and construction administration in maintaining design intent is also addressed. Finally, the program discusses retro-commissioning as a performance assessment tool to protect energy efficiency and equipment life throughout the building lifecycle.

The Design Process: *From Concept to Commissioning*

Learning Objectives

At the conclusion of this program, participants will be able to:

1. **Identify common causes of HVAC and geothermal commissioning failures** and evaluate associated risks to system performance, energy efficiency, and warranty compliance.
2. **Analyze pre-design considerations**, including owner maintenance capability, operating schedules, and system preferences, and assess how these factors influence geothermal system selection and complexity.
3. **Apply best-practice engineering design principles**, including load modeling, borefield configuration strategies, reverse return piping, and specified flushing and purging requirements.
4. **Evaluate the role of construction administration and retro-commissioning** in verifying design intent, improving installation quality, and protecting long-term operational performance.

The Design Process: *From Concept to Commissioning*

Why Commissioning Often Fails

- Project completion and occupancy occur simultaneously
- Equipment installation and startup incomplete
- Controls not fully programmed or tested
- Limited time for functional testing

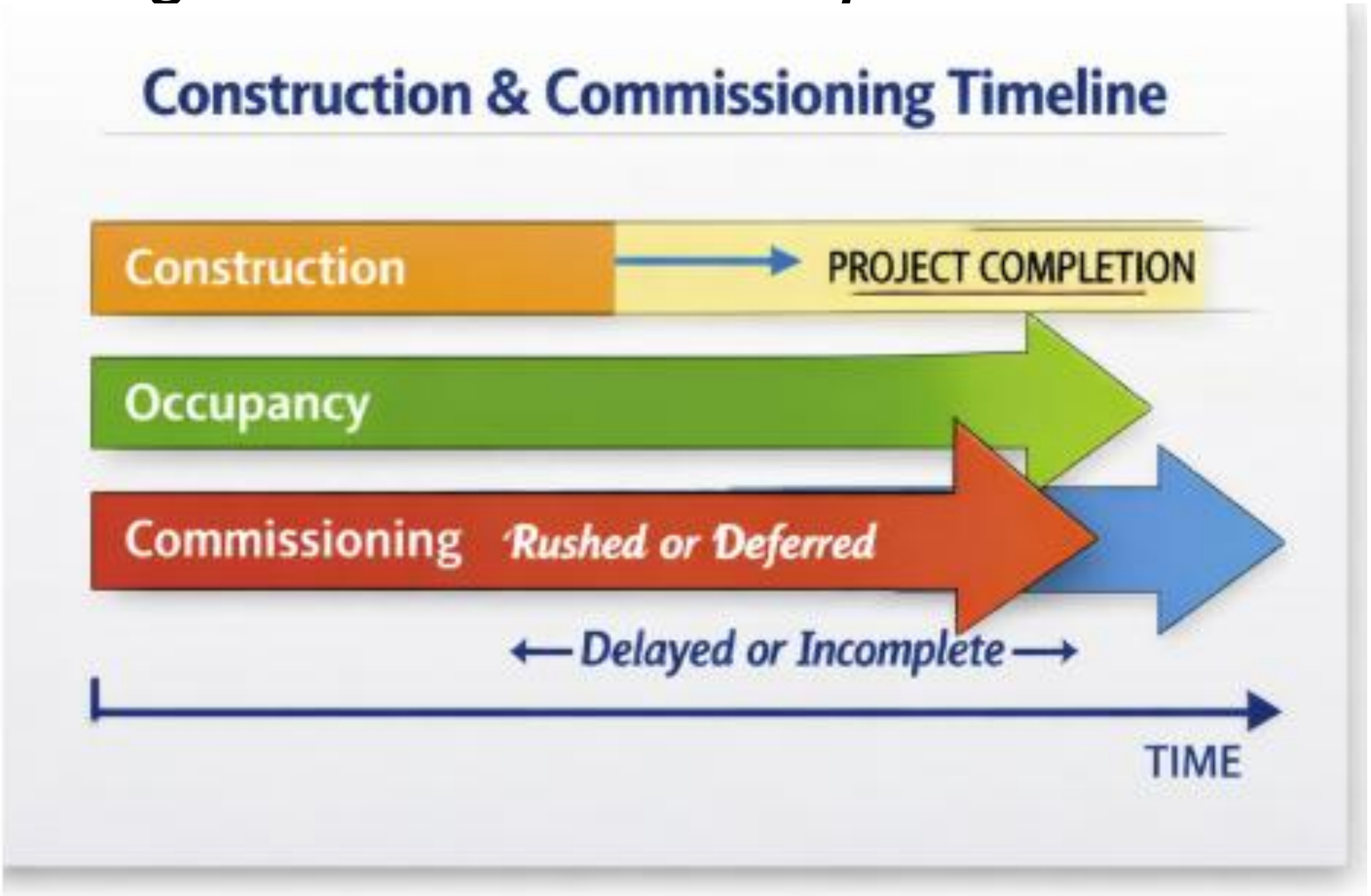
Consequences of Incomplete Commissioning

- Commissioning delayed or never completed
- Substandard system performance
- Increased energy use
- Reduced equipment life
- Owner dissatisfaction

Substantial Completion vs. Commissioning

- Commissioning should be completed prior to substantial completion
- Outstanding items must be clearly documented
- Owner must understand risks of early occupancy
- Warranty implications if issues arise later

The Design Process: *From Concept to Commissioning*



Post-Occupancy & Retro-Commissioning

- Post-occupancy commissioning may occur within warranty period
- Retro-commissioning is valuable for existing buildings
- Identifies inefficiencies and improper adjustments
- Provides “health check” of owner’s investment

The Design Process: *From Concept to Commissioning*

Pre-Design Phase: Owner Alignment

- Evaluate owner’s maintenance capabilities
- Identify manufacturer and system preferences
- Understand prior geothermal experience
- Ensure Owners Facilities team and maintenance staff buy-in

Pre-Design: Operational Understanding

- Evaluate building type and usage
- Obtain operating schedules
- Understand load profiles and occupancy patterns
- Document owner input and obtain acknowledgment

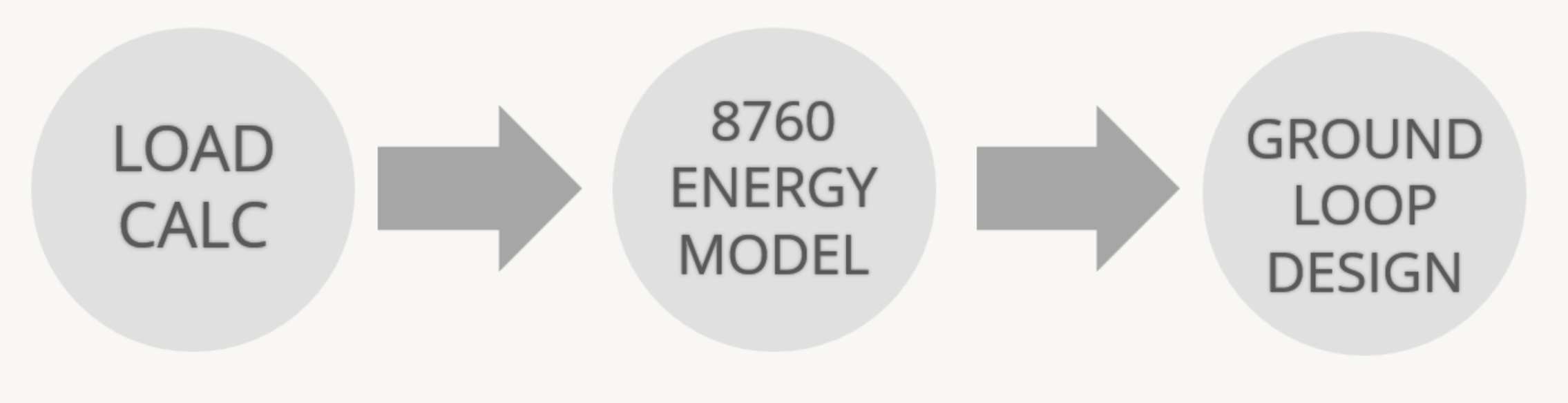
Specifications: Setting the Project Up for Success

- Specify flushing and purging requirements and method (sequence)
- Minimum flushing velocity ≥ 6 ft/s
- Clearly define contractor responsibilities
- Include QA requirements for equipment suitability
- As built requirements defined
- ***Provide requirement for licensed surveyor to locate the top of each bore, valves, change of direction fittings and pipe every 20-50 feet .***

The Design Process: *From Concept to Commissioning*

Load Analysis & Borefield Modeling

- Perform 8760-hour load calculations
- Import data into borefield design software
- Evaluate long-term thermal balance / Optimize borefield sizing



Borefield Design Best Practices

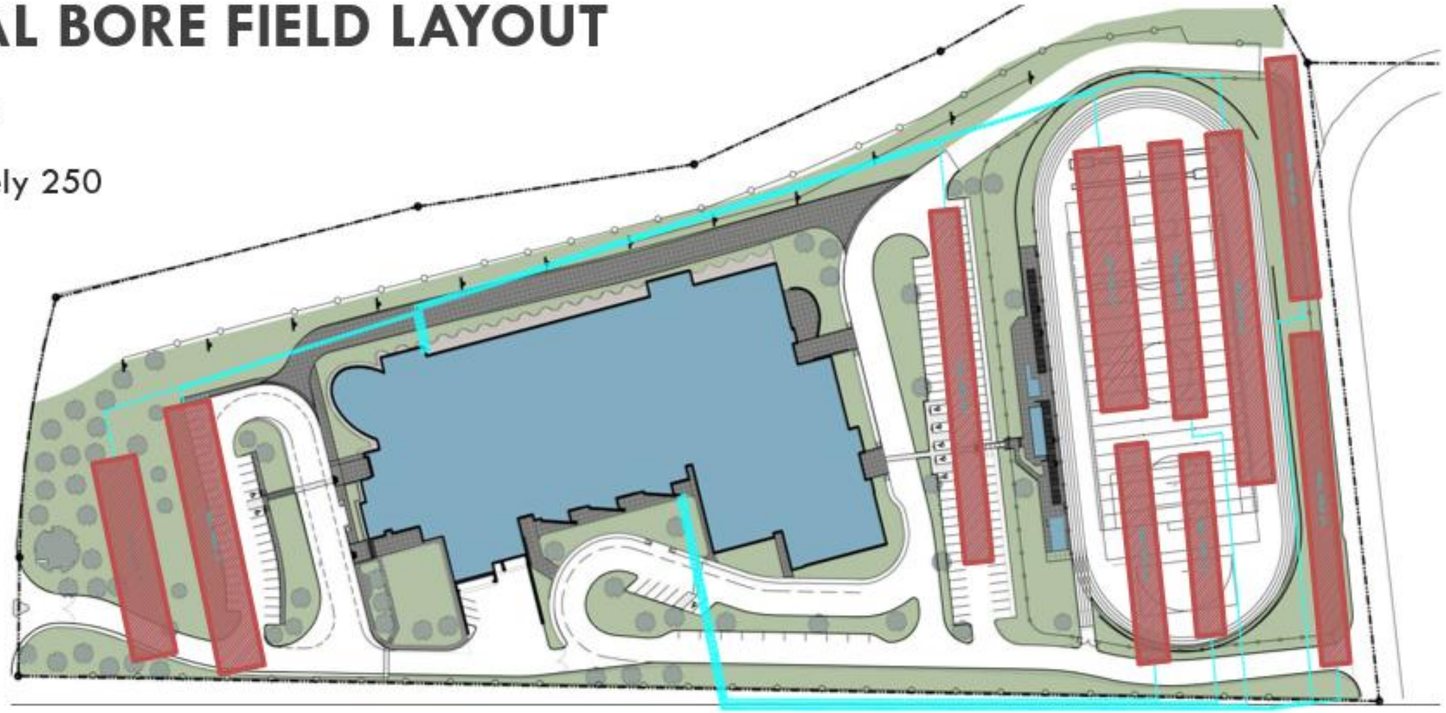
- Reverse return piping for self-balancing
- Avoid balancing valves in vaults or borefields
- Consider modular vs. central borefields
- Design aligned with maintenance capabilities

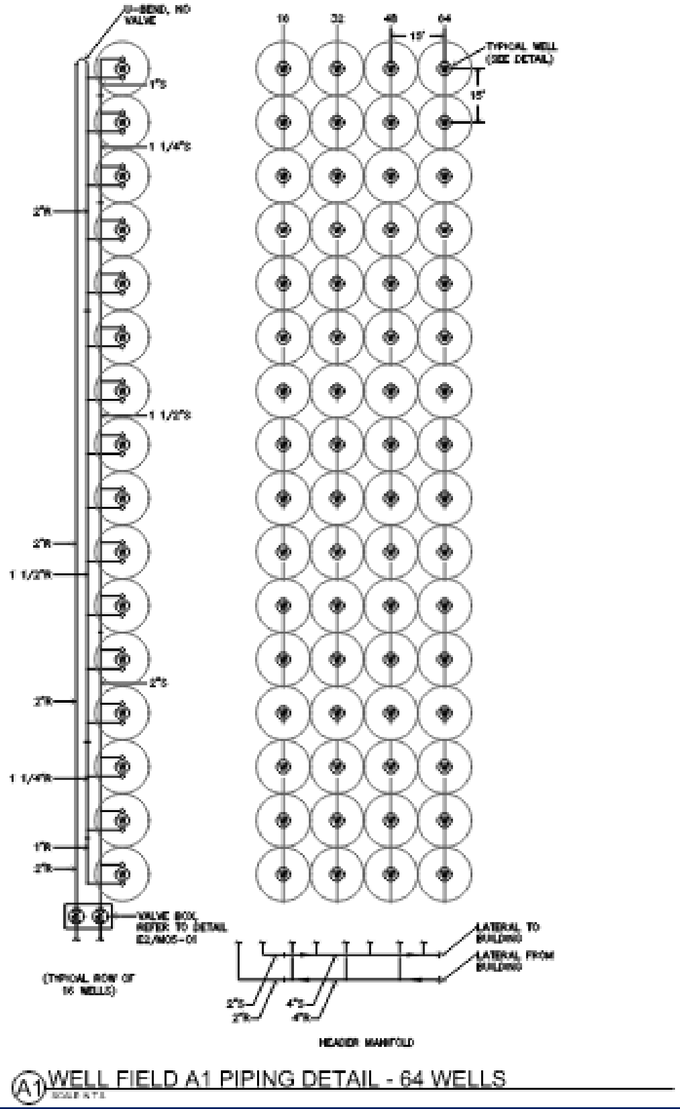
The Design Process: *From Concept to Commissioning*

GEOTHERMAL BORE FIELD LAYOUT

468 Geothermal Bores

Bores are approximately 250 feet deep

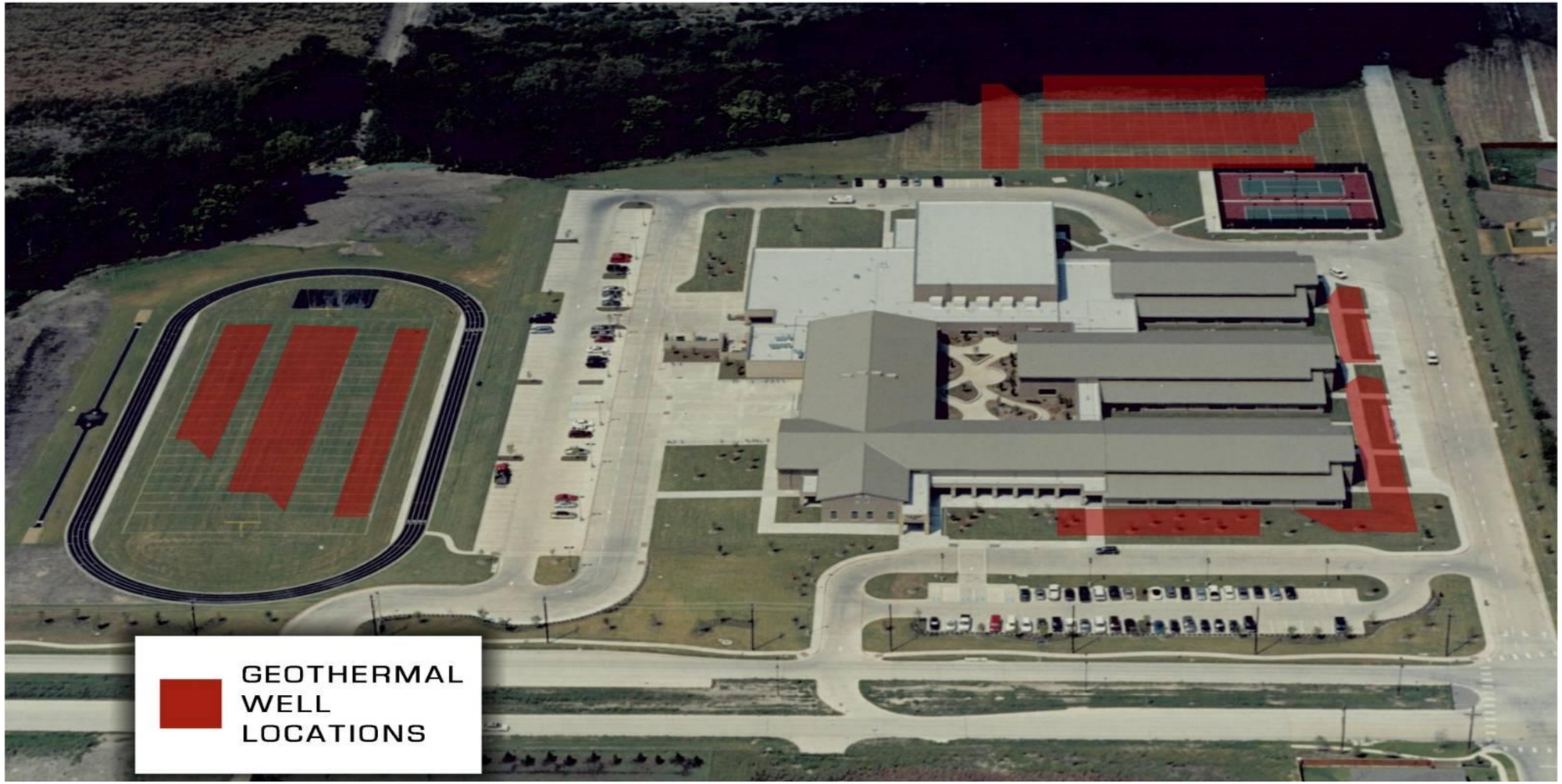




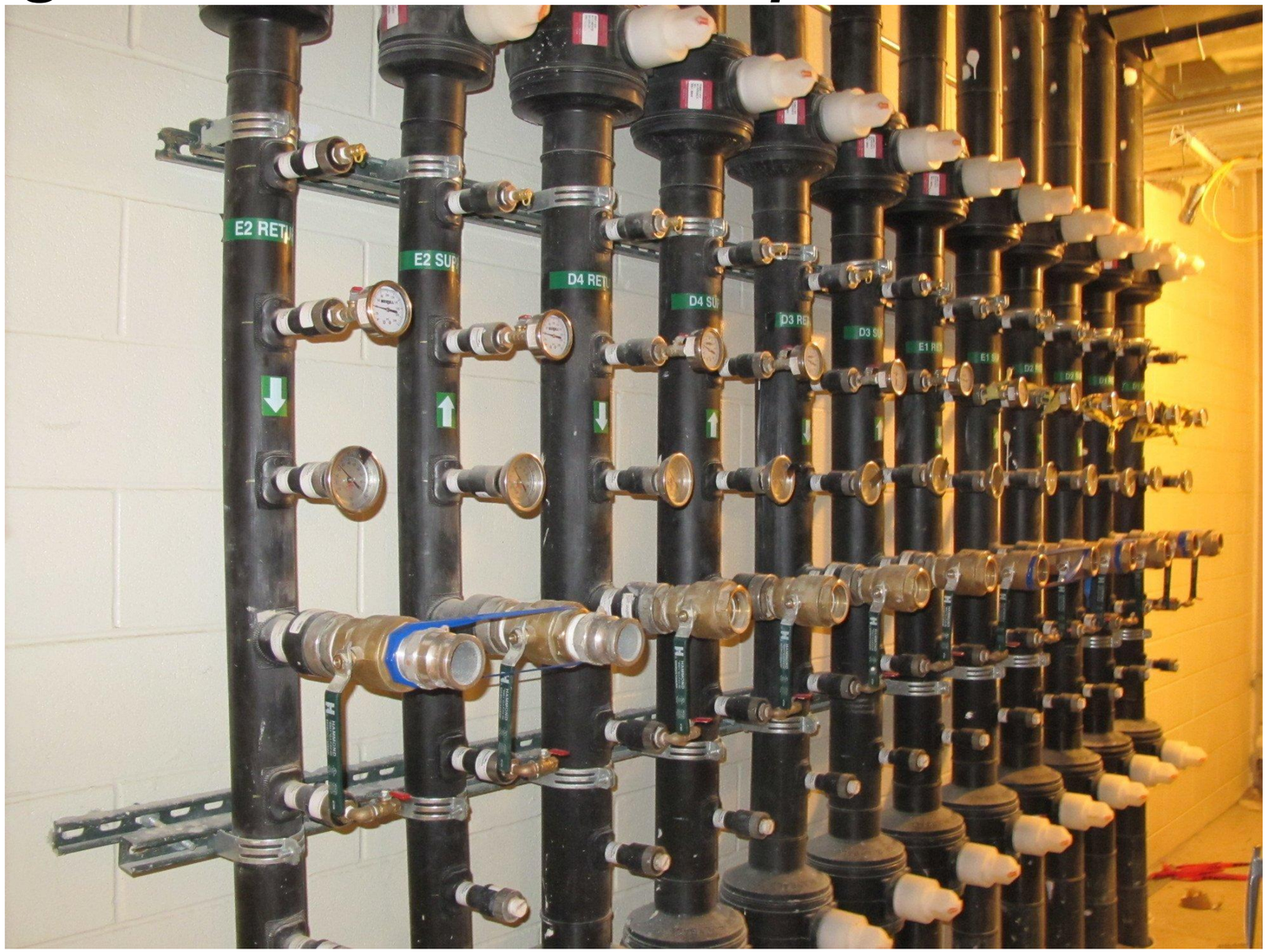
A1 WELL FIELD A1 PIPING DETAIL - 64 WELLS

The Design Process: *From Concept to Commissioning*

MODULAR BOREFIELD DESIGN



The Design Process: *From Concept to Commissioning*



The Design Process: *From Concept to Commissioning*

The Design Process: *From Concept to Commissioning*

Contractor Qualifications Matter

- Specify experienced mechanical contractors
- Specify qualified/experienced well drillers and loop installers
- Minimum of 3 approved contractors per trade
- Proven geothermal experience is critical…IGSHPA Certified/Trained
- Instills a team mindset between Engineer and Contractor

The Design Process: *From Concept to Commissioning*

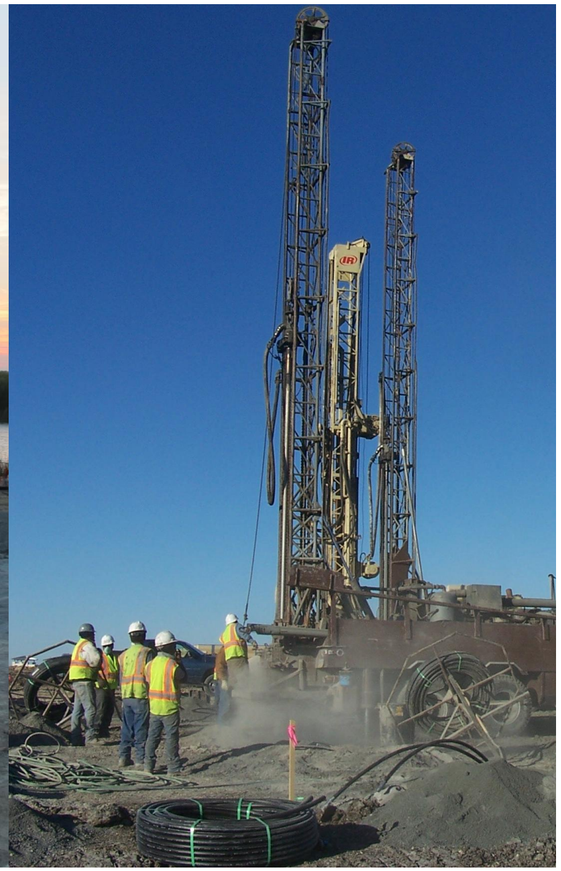
Construction Administration:

Critical to Success

- Include CA services in contract
- Use qualified, experienced staff… IGSHPA CGI
- Frequent site observations
- Document all field observations

Field Observations & Quality Control

- Observe drilling and loop installation
- Verify fusion alignment and rollback
- Butt fusion vs. socket fusion verification
- Monitor loop pressures
- Unscheduled site visits



The Design Process: *From Concept to Commissioning*

Key Takeaways

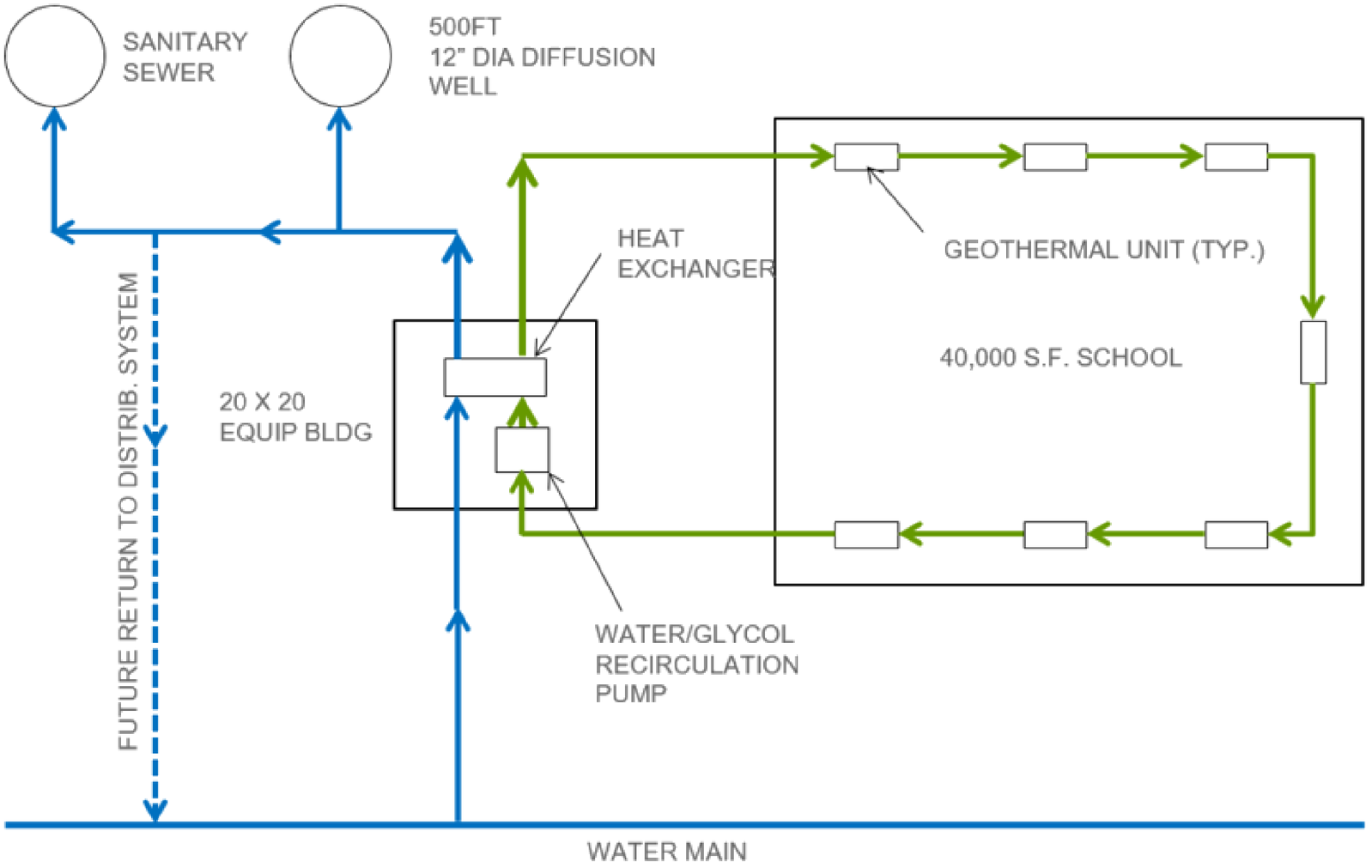
- Commissioning must be prioritized, not postponed
- Owner alignment is critical from pre-design
- Specifications and contractor selection matter
- Strong construction administration ensures success
- Retro-commissioning protects long-term performance

The Design Process: *From Concept to Commissioning*

Case Study: Buck Elementary School – Long Island, NY

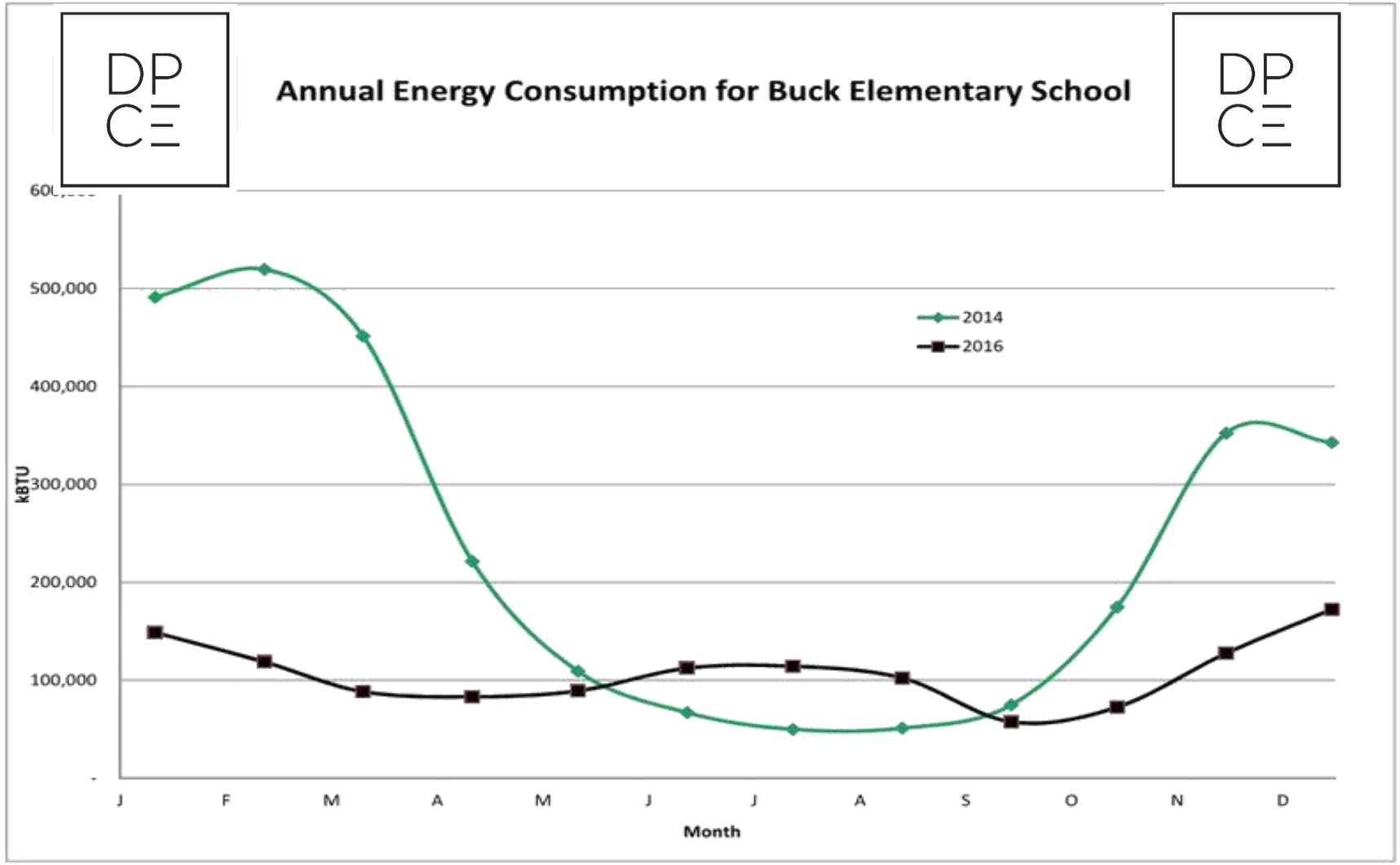
- Project overview
- Design strategy
- Installation approach
- Performance outcomes
- Lessons learned

The Design Process: *From Concept to Commissioning*

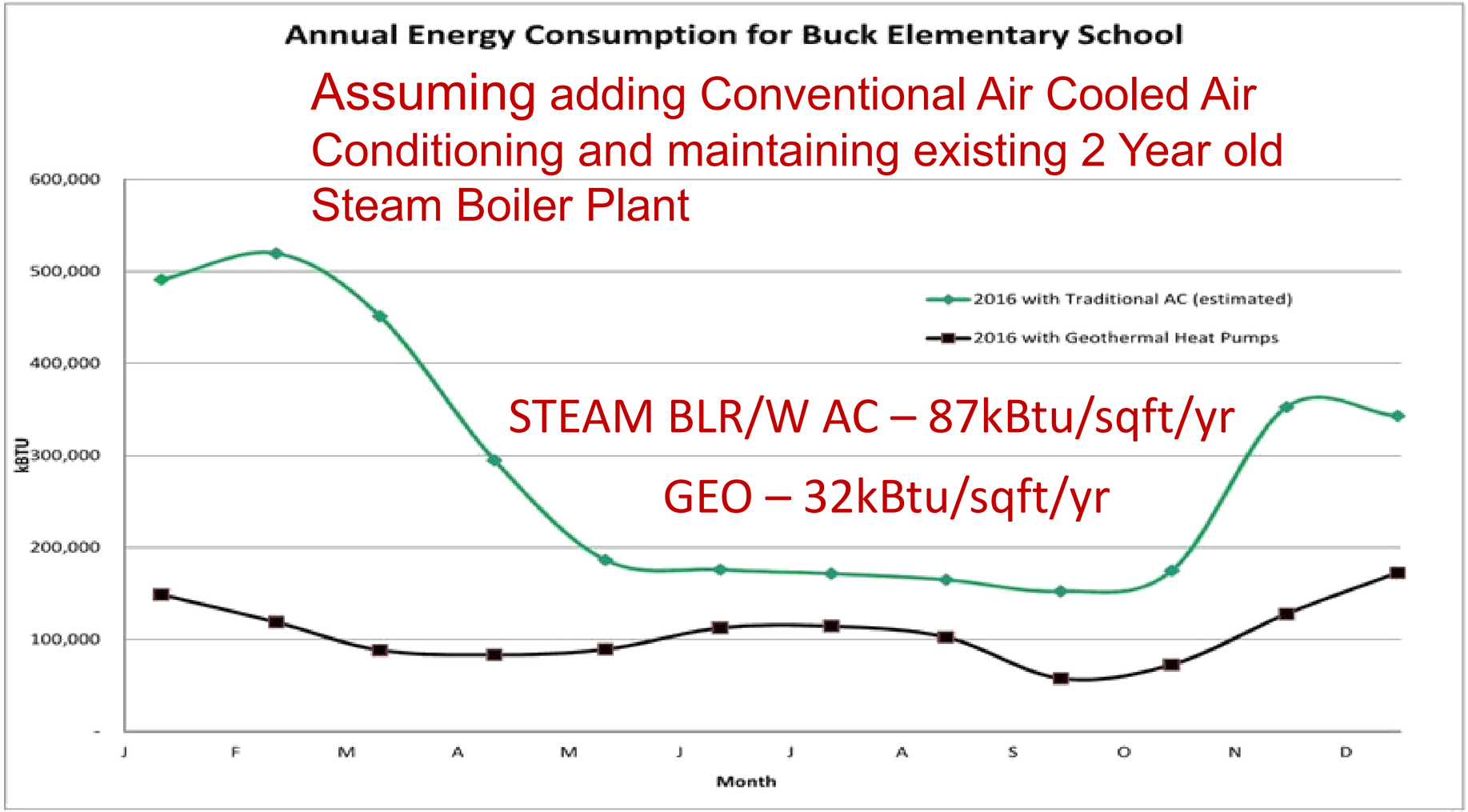


William L. Buck Elementary School

The Design Process: *From Concept to Commissioning*



The Design Process: *From Concept to Commissioning*



The Design Process: *From Concept to Commissioning*

1. Why is HVAC commissioning often ineffective when project completion and occupancy occur simultaneously?
A. Commissioning agents are not required by code
B. Systems are typically oversized
C. Equipment installation and startup are often incomplete
D. Controls programming is unaffected

Correct answer: C

2. What is the primary risk of declaring substantial completion before commissioning is complete?
A. Increased construction costs
B. Loss of design documents
C. Inability to properly verify system performance
D. Reduced contractor competition

Correct answer: C

The Design Process: *From Concept to Commissioning*

3. Post-occupancy commissioning within the first year is most justified when:
A. Energy rates increase
B. Commissioning was omitted due to schedule constraints
C. New equipment is added to the building
D. The owner changes tenants

Correct answer: B

4. Retro-commissioning is best described as:
A. Preventive maintenance of HVAC equipment
B. Commissioning performed before design completion
C. Assessment and optimization of existing building systems
D. Code-required testing of new equipment

Correct answer: C

The Design Process: *From Concept to Commissioning*

5. Why should an owner's maintenance capabilities be evaluated during pre-design?
A. To reduce first cost
B. To determine the building's energy code compliance
C. To align system complexity with long-term operability
D. To eliminate the need for commissioning

Correct answer: C

6. Which owner-provided information is most critical to HVAC and geothermal system design?
A. Utility rebate availability
B. Interior finish selections
C. Building operating schedule and usage patterns
D. Construction phasing plan

Correct answer: C

The Design Process: *From Concept to Commissioning*

7. Why should flushing and purging requirements be explicitly specified for geothermal systems?
A. To reduce glycol concentration
B. To improve heat pump efficiency ratings
C. To remove air and debris and ensure proper heat transfer
D. To comply with plumbing codes

Correct answer: C

8. Why is a minimum flushing velocity of approximately 6 ft/s commonly specified?
A. To reduce pump horsepower
B. To ensure laminar flow
C. To effectively remove entrained air and debris
D. To minimize pipe expansion

Correct answer: C

The Design Process: *From Concept to Commissioning*

9. Why should geothermal projects specify qualified contractors rather than relying solely on open bidding?
A. To reduce material costs
B. To improve commissioning documentation quality
C. To ensure proper installation and system performance
D. To eliminate construction administration

Correct answer: C

10. Why are balancing valves in borefields or vaults generally discouraged?
A. They increase glycol usage
B. They complicate flushing and purging operations
C. They reduce system efficiency at part load
D. They violate energy codes

Correct answer: B

The Design Process: *From Concept to Commissioning*

11. What is the primary purpose of performing an 8760-hour load analysis for geothermal design?
A. To calculate peak cooling load only
B. To size ductwork
C. To model annual thermal interaction with the borefield
D. To determine pump efficiency

Correct answer: C

12. Why is active construction administration essential for geothermal system success?
A. It reduces design fees
B. It limits contractor liability
C. It verifies installation quality and design intent
D. It replaces commissioning

Correct answer: C

THANK YOU

Don Penn, PE

Don Penn Consulting Engineer

817-832-3224

donpenn@donpenn.com