MARKET HOUSE HVAC ANALYSIS

Presentation by Public Works and Gannett Fleming
to City Council on April 7, 2011

Why do we need to upgrade the HVAC?

History of Market House Renovations

- ***Sept. 19, 2003***: Hurricane Isabel struck Annapolis

- ***Dec. 2003***: Contract awarded to provide professional A/E services to design & prepare construction documents for renovation of Market House

- ***April 2004***: Building assessment prepared with the following determination:

  "***The existing 15 ton split system does not have the ability to maintain an appropriate comfortable environment. Additional capacity with increased energy efficiency is needed. Replacement is recommended.***"

History of Market House Renovations (cont.)

- ***March 2005***: The roof and entire exterior of the building was replaced.
- ***Dec. 2005***: Master lease was signed with Market House Ventures. Per the lease, the City was required to complete new HVAC and ductwork installations sufficient to accommodate Tenant's anticipated load capacity.
- ***Jan. 2006***: A new 15 ton (nominal) A/C unit was installed.
- ***July 31, 2006***: Market House reopened for business. HVAC problems were immediate. In response, City installed **30 tons** of **additional** air conditioning on exterior of building.

History of Market House Renovations (cont.)

- ***May 2007***: The 30 ton A/C unit was replaced by a 25-ton and a 15-ton A/C unit (**40 tons total of additional air conditioning**). These units remained in place through December 2008.

History of Market House Renovations (cont.)

- ***Nov. 2007***: A new HVAC system (60 ton cooling tower) was designed, purchased and put out to bid. Installation was scheduled to begin in January 2008.

- ***Dec. 2007***: City is sued by Market House Ventures for breach of lease provisions. Installation of 60 ton cooling tower system was put on hold.

- ***Sept. 2008***: City sued architect and engineer for errors and omissions in HVAC design.

- ***Jan. 2009***: The City hired consultant for new HVAC analysis based on revised layout as a market with perimeter circulation and vendors in the middle - not a food court. Based on this analysis, a 40-ton water source heat pump was purchased. It was not installed because the contractor was unable to obtain the necessary Well Permits.

History of Market House Renovations (cont.)

- ***June 2009***: Suit against A/E was resolved in the City's favor and all parties signed mutual release.
- ***August 2009***: Atwater's moved in after all subtenants, except BankAnnapolis and Vaccarro's, moved out.
- ***April 2010***: Proposals for development of Market House were submitted. Gone to Market was selected as potential Master Tenant in December 2010.
- ***Dec. 2010***: Public Works is tasked with managing design and construction of required Landlord alterations. Gannett Fleming is selected by PW from a competitive bid to conduct HVAC load analysis and create construction documents for recommended renovations.

Landlord Alterations

- Objectives:

  1. To the maximum extent possible, use the previously purchased HVAC equipment (60-ton cooling tower and 40-ton water source heat pump) that are currently in storage

  2. Provide “warm lit shell” (that is, provide lighting, heating, air conditioning and ventilation to the tenants)

Market House Existing Conditions

- 5,500 square foot single-story building with glass windows comprising 50% of the walls on three sides of the building
- The roof is a significant historic feature with existing roof penetrations that constrain cooking operations to two vendors only.
- Existing HVAC is 15 ton (nominal) self-contained air-cooled unit in the attic
- Currently, there is minimal make-up air (ventilation) provided in the building

Challenges

- Air Conditioning challenges include:
  - There is no place to set traditional HVAC equipment outside on grade
  - HVAC equipment cannot go on the roof
  - HVAC equipment cannot go in the flood plain
  - The existing mechanical room in the attic is very small (13’ x 24’)
- Fundamental problem: It is difficult to reject the heat from this building due to the attic size and site limitations.

Components of HVAC Load Analysis

- Base load – *fixed*
  - Building Envelope (roof, walls, windows)
  - Lighting
- Usage Load – *variable*
  - People
    - Ventilation Requirements
    - Heat Generation (body heat)
  - Equipment
    - Heat Generation (refrigerators, freezers, display cases, coffee machines, cooking equipment, etc)
    - Ventilation Requirements (cooking equipment)

HVAC Load Analysis

- Base load – *fixed*
  - Building Envelope – 8 tons
  - Lighting – 2.7 tons
  - **Base Load Subtotal …… … …10.7 tons**
- Usage Load – *variable*
  - People
    - Ventilation – 10 tons
    - Heat Generation – 4.6 tons
    - **People Load Subtotal ……..…….14.6 tons**
  - Equipment
    - Heat Generation – 11 tons
    - Ventilation – 10 tons
    - **Equipment Load Subtotal ……..……..21 tons**
- **Total Load …….. 46.3 tons**
- **Existing HVAC Capacity …… ……...15 tons**

For both the interim use and the permanent use:

Do Nothing is not recommended!

The existing 15-ton nominal A/C unit is not sufficient for any anticipated use.

Primary HVAC Options

1. Non – Geothermal: Install a revised version of the pre-purchased cooling tower system

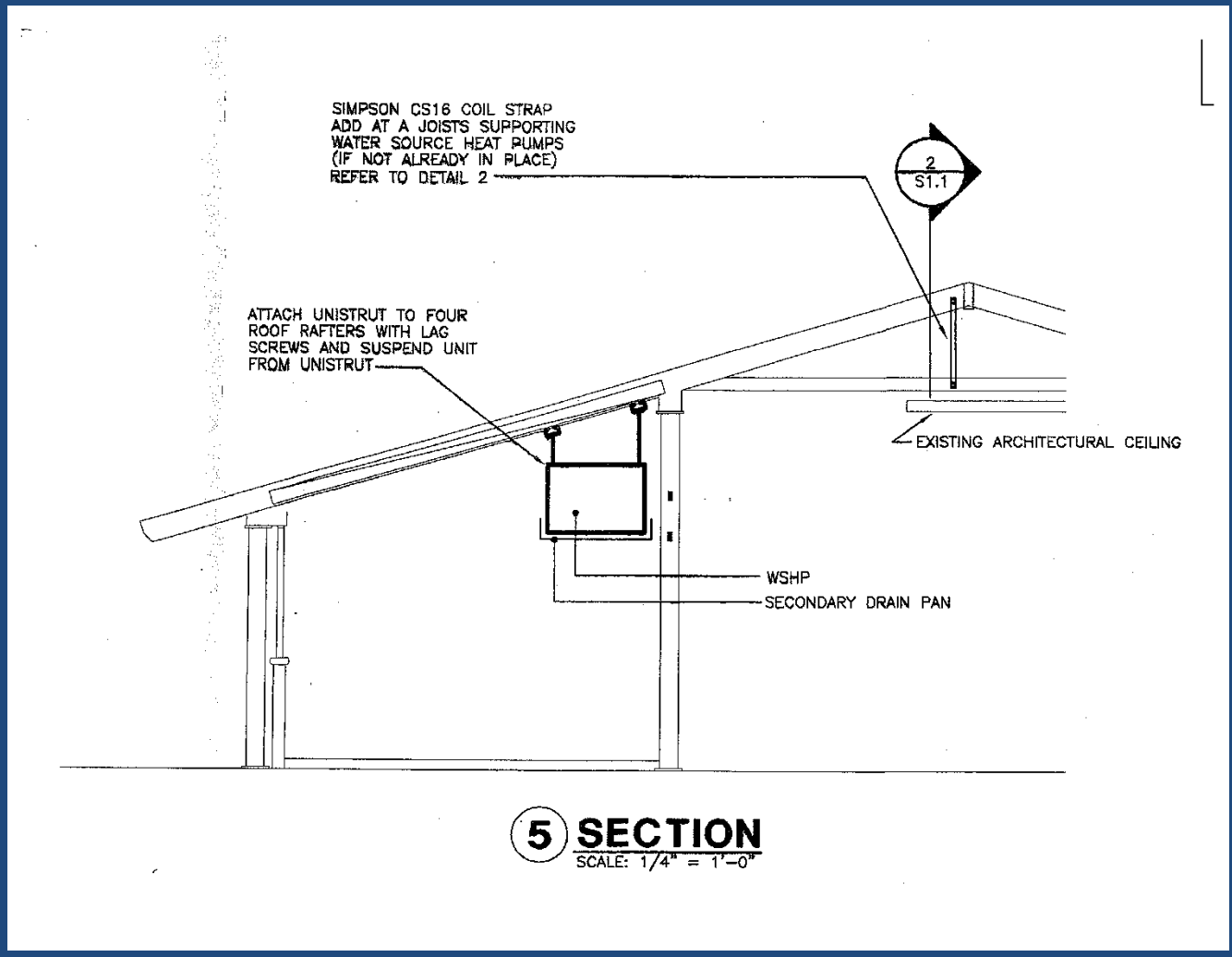
2. Geothermal ***(preferred):*** Install geothermal system utilizing the 5-ton heat pumps from the pre-purchased cooling tower system

3. Geothermal ***(alternate)****:* Install geothermal system utilizing the pre-purchased water source heat pump

Option 1: Cooling Tower System

- Install:
  - Cooling tower and heat exchanger in attic (vent through roof)
  - Five 5-ton heat pumps above tenant spaces
  - Two outside air units in or above tenant spaces
  - Water piping from cooling tower to heat pumps
  - Circulating pumps in the attic
  - Power to all equipment
  - Ductwork and condensate drains
  - Controls

Cooling Tower System Detail



Option 1: Advantages & Disadvantages

- **Advantages:**
  - The equipment has been pre-purchased
  - System is expandable up to 60 tons
- **Disadvantages:**
  - There is a significant amount of construction work associated with installing the cooling tower, including large chimney discharge through the roof.
  - Building heat will be electric (it is currently natural gas).
  - Cooling towers require water make-up, chemical treatment, and maintenance.
  - Legionella concerns associated with cooling tower.
  - Moist tower air could recirculate into attic space.
  - Attic heating required to prevent cooling tower water from freezing.
  - While the tower will be sitting on a drain pan, overflows could occur.
  - The outside air units require wall louvers or roof opening for fresh air.

Option 1: Estimated Cost & Schedule

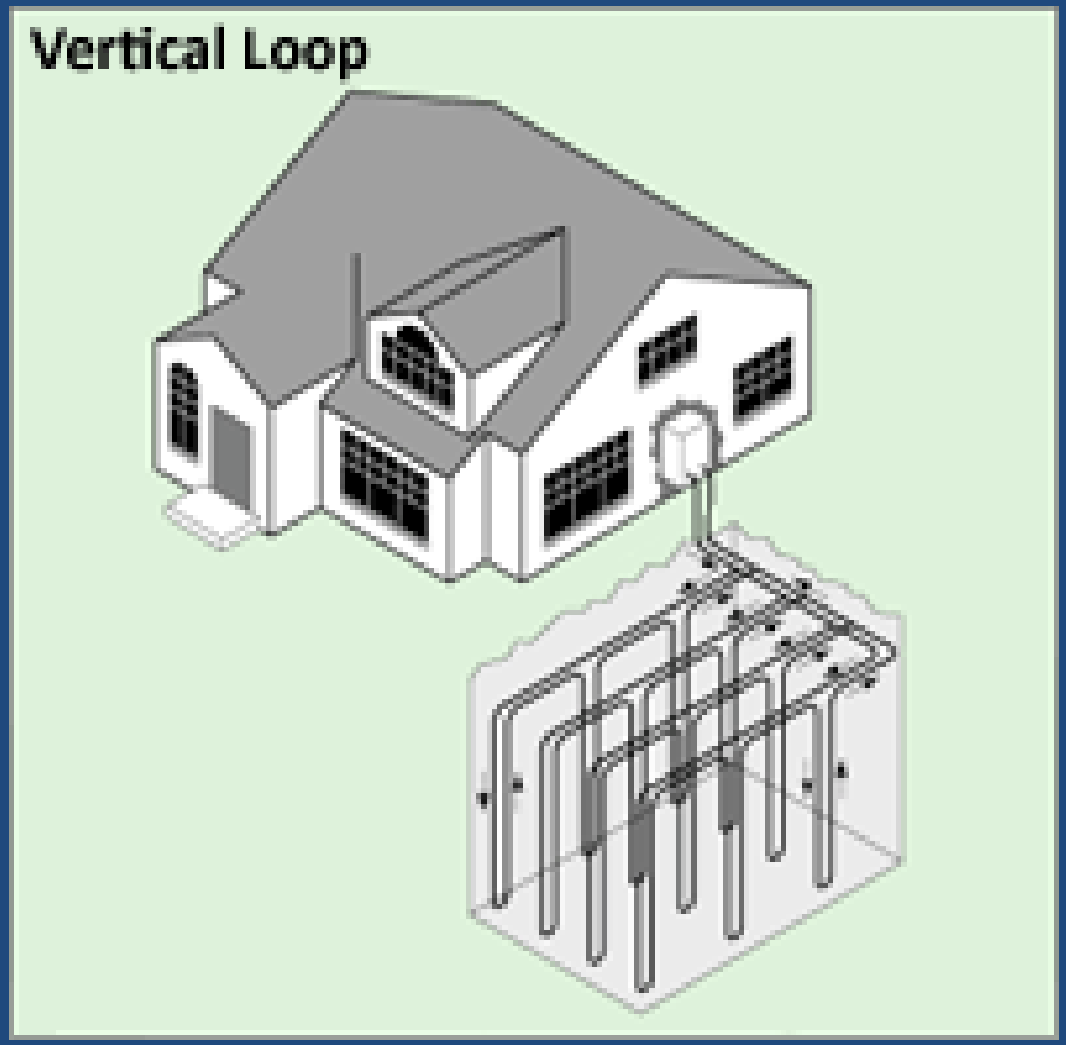
- Estimated Cost - $356,000

- Schedule
  - Design – 3 weeks
  - Bid – 4 weeks
  - Construction – 6 weeks
  - Total Time = 13 weeks from NTP

Option 2: Geothermal with 5-ton heat pumps

- Install:
  - Well field in Market Space
  - Five 5-ton heat pumps suspended from ceiling
  - Two outside air units in or above tenant spaces
  - Water piping from well field to heat pumps
  - Circulating pumps in the attic
  - Power to all equipment
  - Ductwork and condensate drains
  - Controls

Closed Loop Geothermal Layout



Option 2: Advantages & Disadvantages

- Advantages:
  - Very efficient heating and cooling = lower operating costs
  - No exterior noise or legionella concerns
  - Once construction is finished, the wells and piping are hidden from view.
  - Allows room for dedicated outside air units in the attic.
  - Eliminates the need to heat the building with electric heat.
  - Provides most flexibility
- Disadvantages:
  - Installing well field will be disruptive to Market Space area.
  - May not be able to install well field until next winter.

Option 2: Estimated Cost & Schedule

- Estimated Cost - $501,000
  - $96,000 energy grant available for geothermal option
  - Net Cost = $405,000
- Schedule for interior portions of system
  - Design – 3 weeks
  - Bid – 4 weeks
  - Construction – 6 weeks
  - Total Time = 13 weeks from NTP
- Additional 16 weeks will be required when the geothermal well fields are installed

Option 3: Geothermal with water source system

- Install:
  - Well field in Market Space
  - 40 ton water source heat pump in attic space
  - One, possibly two, outside air units in or above tenant space.
  - Water piping from well field to heat pump
  - Circulating pumps in the attic
  - Power to all equipment
  - Duct system to tenant space and condensate drain
  - Controls

Option 3: Advantages & Disadvantages

- Advantages:
  - Most of equipment is in a central location (in attic)
  - Less noise in tenant spaces since heat pumps are not located overhead.
  - Fewer units to maintain and easier access - not suspended from ceiling
- Disadvantages:
  - Difficult to install in attic.
  - Need outside air unit in tenant space which requires wall louver or roof opening for fresh air.
  - 40-ton equipment designed for open loop geothermal. System must be reconfigured for a closed loop geothermal. Equipment may not produce 40 tons of cooling.

Option 3: Estimated Cost & Schedule

- Estimated Cost - $425,000
  - $96,000 energy grant available for geothermal option
  - Net Cost = $329,000
- Schedule
  - Design – 3 weeks
  - Bid – 4 weeks
  - Construction – 6 weeks
  - Total Time = 13 weeks from NTP
  - Additional 16 weeks will be required when the geothermal well fields are installed