Temporary School Cooling Options

Board of Education
May 21, 2019

Mr. Pete Dixit, Executive Director
Mr. Merril Plait, PE, Director
Ms. Leslie Lazzeri, PE, Manager of Design
Scope of Work

Schools and centers without central air conditioning (September 2019):

• Bedford Elementary School
• Berkshire Elementary School
• Dulaney High School
• Lansdowne High School
• Campfield Early Learning Center
• Catonsville Center for Alternative Studies
• Colgate ES (temporary located in the Rosedale Building)
Local, Board-approved, mechanical engineering firms:

- Alban Engineering, Inc.
- Burdette, Koehler, Murphy & Associates
- James Posey Associates
- Johnson, Mirmiran & Thompson, Inc.

BCPS staff:

- Manager of Design
- Senior Supervisor of Design
- Senior Project Engineer (Mechanical)
- Senior Project Engineer (Electrical)
Background Information

**Definitions**

- **Codes** - Rules that are adopted to specify the standards for buildings, in order to protect public health, safety, and general welfare.

- **Contaminants** - An unwanted airborne constituent that may reduce acceptability of air quality (*carbon dioxide, viruses, dander, body odor, pollen, cleaning components, furniture off-gassing, etc.*).

- **Indoor Air Quality Management** is defined by American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) as
  - Control of airborne pollutants,
  - Introduction and distribution of adequate outdoor air, and
  - Maintenance of acceptable temperature and relative humidity.

- **Thermal comfort** – Industry term that pertains to the condition of the mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation.

- **Ventilation air** - That portion of supply air that is fresh outdoor air that should be treated for indoor air quality.
**Background Information**

*Baltimore Co. Code Requirements and Design Guidelines*

**Mechanical Considerations:**

  - Code requires ventilation air for all occupied spaces through natural or mechanical means.
  - Indoor air quality necessitates humidity control and contaminate reduction through ventilation air.*
- **American National Standard Institute (ANSI)/ASHRAE Standard 62.1-2016:** Ventilation for Acceptable Indoor Air Quality
  - Recognized standard for ventilation system design and acceptable Indoor Air Quality (IAQ).

*Window units installed, without additional ventilation air will only cool the classroom, but do not replace stale air or provide adequate indoor air quality and, therefore, do not meet code.*
Electrical Considerations:

• Baltimore County building code adopted, with certain amendments, the 2017 National Electric Code.
  • Code requires a “building or other structure served shall be supplied by only one service.”
• Baltimore Gas and Electric (BGE) Retail Electrical Service Tariff
  • BGE specifies “It is the standard practice of the Company to provide...one service connection for all of the requirements of the Customer on a single property.”
  • BGE specifies “One meter installation for all requirements of each Customer.”
Temporary School Cooling Options

Operational Thermal Comfort

Chilled Water System with Chiller

Vertical Packaged Units (VPU)

Variable Refrigerant Flow Cassettes with Dedicated Outdoor Air System

Window units with Dedicated Outdoor Air System
Temporary School Cooling Options

Option 1 – Operational Thermal Comfort

What is it?

• Managing the factors of how a body feels comfortable.
  • Increasing air movement,
  • lowering the baseline temperature of the building each morning,
  • increasing hydration, and
  • managing solar load of a building.

Pros

• Lowest first cost
• Immediate impact

Cons

• Minimal thermal comfort relief
• Highest operational costs impact
• Limited temperature control
• No humidity control
Temporary School Cooling Options

**Option 1 – Operational Thermal Comfort (continued)**

How is it done?

- Operate mechanical ventilation system at full capacity from one hour after sunset to 3 a.m. to provide pre-cooling.
- Utilize existing windows, doors, and fans throughout building for cross-ventilation where and when practical.
- Provide enhanced supply of bottle water cooling stations to students and staff.
- Close window blinds on sunny side of school.
- Targeted monitoring of conditions by central building operations staff.
Temporary School Cooling Options

Option 2 – Chilled Water System with Chiller

What is it?

• Central Air Conditioning – Uses pipe system to provide cooling and heating (dual temp), with an outside chiller to cool the air entering the building.

Pros

• Air conditions entire school
• Long term solution
• Controls humidity
• Controls Indoor Air Quality

Cons

• Typically the highest cost option
• Typically most invasive
• Longest construction time
Temporary School Cooling Options

Option 2 – Chilled Water System with Chiller (continued)

How is it done?

• Outside chiller cools water.
• Chilled water distributed through building to inside equipment (i.e. unit ventilator, air handler, etc.).
• Inside equipment cools outside air by running it over chilled water lines.
Temporary School Cooling Options

**Option 3** – Variable Refrigerant Flow cassettes with Dedicated Outdoor Air System

**What is it?**

- A system of internal cassettes and exterior heat pumps that are connected through refrigerant flow system.
- Another system is used to treat the ventilation air, which will provide dehumidification and cooled outdoor air.

**Pro**

- Long term solution
- Controls humidity
- Controls Indoor Air Quality

**Cons**

- Moderate cost option
- Moderately invasive
- Long construction time
- Cools only classrooms
Temporary School Cooling Options

**Option 3** – Variable Refrigerant Flow cassettes with Dedicated Outdoor Air System *(continued)*

**How is it done?**

- Rooftop units cool the refrigerant which is then piped to ceiling mounted units in the classroom.
- Classroom units cool the recirculated air with the cooled refrigerant.
- Rooftop units also dehumidify outdoor air and cool it.
- Cooled fresh air is mixed with recirculated air and ducted back into the classroom.
Temporary School Cooling Options

**Option 4 – Vertical Package Units**

**What is it?**

- Similar to a horizontal unit ventilator, but is a vertical unit with a large outdoor air louver.
- The unit provides cooling without requiring chilled water.
- Cooled air is distributed directly into the space, without ducts.

**Pros**

- Long term solution
- Controls humidity
- Controls Indoor Air Quality

**Cons**

- Moderate cost option
- Moderately invasive
- Moderate noise impact to classroom
- Cools only classrooms
Temporary School Cooling Options

*Option 4 – Vertical Package Units*

How is it done?

- Inside Vertical Package Unit (VPU) cools the refrigerant.
- VPU also mixes fresh air and recirculated air, then cools and dehumidifies it.
- An internal fan then pushes this air into the classroom.
Temporary School Cooling Options

**Option 5 – Window Units with Dedicated Outdoor Air System**

**What is it?**
- Window air conditioning units (2 per classroom) are installed to provide cooling of recirculated air.
- Another system is used to treat the ventilation air, which will provide dehumidification and cooled outdoor air.

**Pros**
- Controls humidity
- Controls Indoor Air Quality

**Cons**
- Moderate cost option
- Moderately invasive
- Applicable to exterior classrooms only
Temporary School Cooling Options

**Option 5 – Window Units with Dedicated Outdoor Air System**

How is it done?

- Window unit cools recirculated air within the classroom.
- Rooftop units dehumidify outdoor air and cools it.
- Rooftop units then mix the fresh outdoor air with recirculated classroom air and ducts it back into the classroom.
Background Information
• Bedford ES is scheduled for replacement. The estimated completion date has not been determined.

Option for Consideration
• Vertical Packaged Unit
• Installation of dedicated electrical panels are required.

Estimated Cost
• $1,675,000

Estimated Completion Date
• September 2020

Immediate Relief Strategy
• Operational Thermal Comfort
Temporary Options for Berkshire Elementary School

Background Information
• Berkshire ES is scheduled for replacement. The estimated completion date is September 2020

Option for Consideration
• Vertical Packaged Unit
• Upgraded BGE service (new transformer and external duct banks) is required.

Estimated Cost
• $1,250,000

Estimated Completion Date
• September 2020

Immediate Relief Strategy
• Operational Thermal Comfort
School by School Analysis

Temporary Options for Dulaney High School

Background Information
• Planning approval requested in Board approved FY2020 state submission for Dulaney HS.

Option for Consideration
• Vertical Packaged Unit
• Installation of dedicated electrical panels are required.

Estimated Cost
• $4,200,000

Estimated Completion Date
• Fall 2020

Immediate Relief Strategy
• Operational Thermal Comfort
Background Information
• Planning approval requested in Board approved FY2020 state submission for Lansdowne HS.

Option for Consideration
• Vertical Packaged Unit
• Full replacement of electrical service and main electrical switchboard, feeders, and transformers are required.

Estimated Cost
• $4,900,000

Estimated Completion Date
• Fall 2020

Immediate Relief Strategy
• Operational Thermal Comfort
School by School Analysis

Temporary Options for Campfield Early Learning Center

Background Information
• Future of program under review.

Option for Consideration
• Chilled Water System with Chiller (the required dual-temp piping is already existing).
• Full replacement of electrical service and main electrical switchboard, feeders, and transformers are required.

Estimated Cost
• $1,825,000

Estimated Completion Date
• September 2020

Immediate Relief Strategy
• Operational Thermal Comfort
School by School Analysis

Temporary Options for Catonsville Center for Alt. Studies

**Background Information**
- Future of program under review.

**Option for Consideration**
- Vertical Packaged Unit
- Full replacement of electrical service and main electrical switchboard, feeders, and transformers are required.

**Estimated Cost**
- $975,000

**Estimated Completion Date**
- September 2020

**Immediate Relief Strategy**
- Operational Thermal Comfort
School by School Analysis

Temporary Options for old Rosedale Center

**Background Information**
- Colgate ES is scheduled for replacement. The estimated completion date is September 2020.
- Colgate ES is temporarily housed in the old Rosedale Center.

**Option for Consideration**
- Vertical Packaged Unit
- Installation of dedicated electrical panels are required.

**Estimated Cost**
- $1,625,000

**Estimated Completion Date**
- September 2020

**Immediate Relief Strategy**
- Operational Thermal Comfort
School Closing Process

What?
- Heat Index predictions are reviewed each evening (prior to 6:30 p.m.).
- If heat index is predicted to reach or exceed 90 degrees by 11:00 a.m. the next day, then school closure is considered.
- Superintendent makes the final decision to close or not open at all.

Why?
- To protect the health of students and staff.
- The conditions are no longer conducive to the educational process.

How is it done?
- Built in curriculum support for pacing.
- Double routes possible for transportation with only 8 schools.
- If schools are dismissing early due to heat, whenever possible, the announcement will be made no later than 8:00 p.m. the evening prior to the closure.
# Temporary School Cooling Options

## Summary

<table>
<thead>
<tr>
<th>School</th>
<th>Electrical Impact</th>
<th>Completion Date of Option for Consideration</th>
<th>Electrical Cost (In thousands)</th>
<th>Mechanical Cost (In thousands)</th>
<th>Projected Cost (In thousands)</th>
<th>Scheduled Capital Project</th>
<th>Completion Date</th>
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<tr>
<td>Bedford ES</td>
<td>Minor</td>
<td>September 2020</td>
<td>$60</td>
<td>$1,615</td>
<td>$1,675</td>
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<td>$200</td>
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<td>$1,250</td>
<td>Replacement</td>
<td>2020</td>
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<td>Dulaney HS</td>
<td>Major</td>
<td>December 2020</td>
<td>$250</td>
<td>$3,950</td>
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<td>Campfield ELC</td>
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</table>

**Total Program Cost** $13,525,000 to $16,450,000

**Total Operational Thermal Comfort Cost** ≈ $200,000 (not included in above costs)
Funding Considerations

FY21 Capital Plan (State)
FY21 Capital Plan (County)
Questions?