

# WFM

## Big Box Retail “CCHP”



**CHP ASSOCIATION**  
COMBINED HEAT & POWER:  
RELIABLE ENERGY, DELIVERED EFFICIENTLY.

**Integrating CHP with DG**

**“Big Box Store CCHP”**

**11/14/14 Washington DC**

**Douglas Davis**

**Director – Broad USA**

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**BROAD U.S.A. INC.**



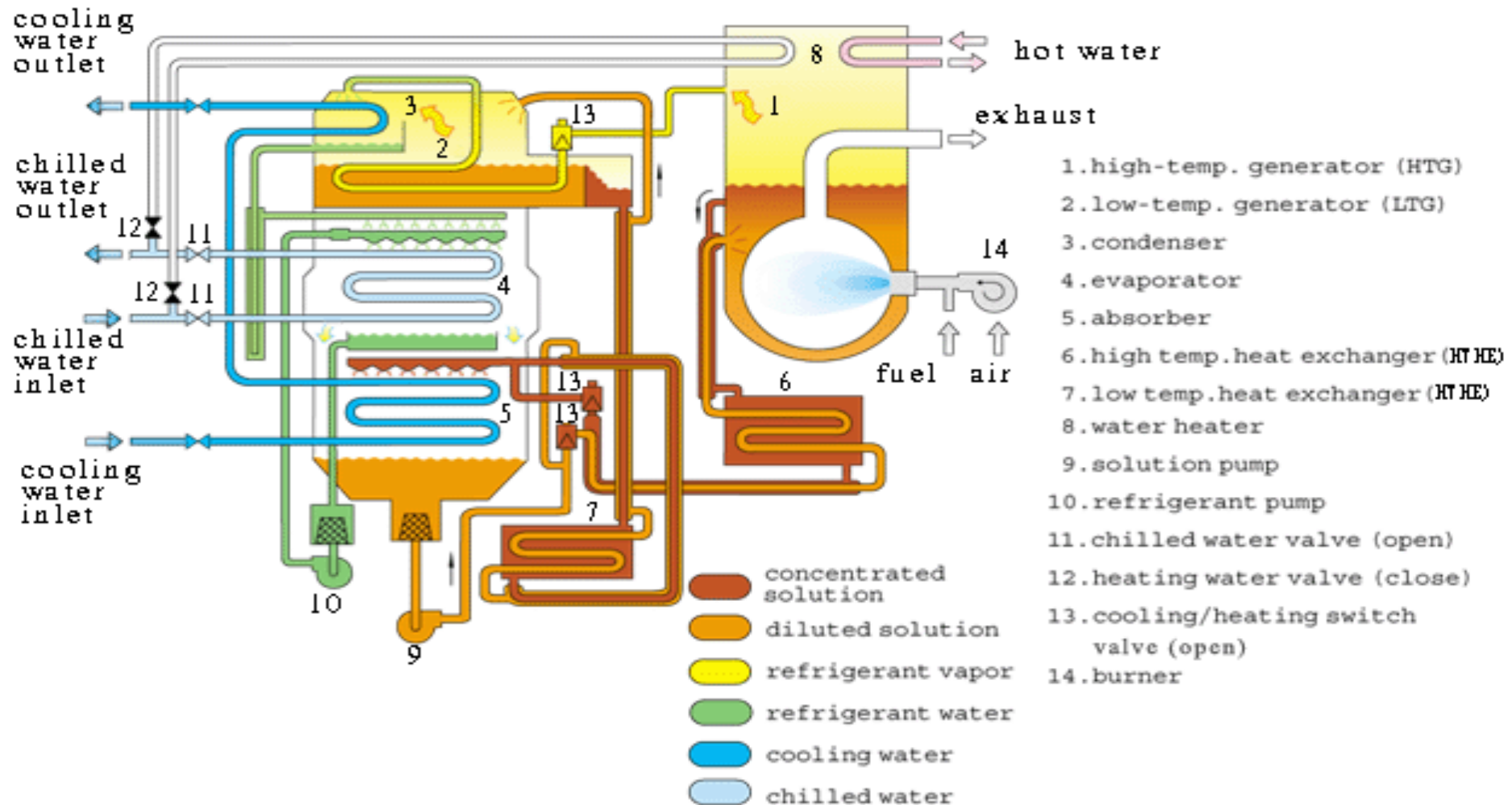
# AGENDA

- Modern Absorption/CCHP Technology
- Focus on a “Modern Grocery Store in Brooklyn NYC that combines HVAC and CCHP, Solar PV, Wind Power LEED .....”
- Sustainable Leadership by Design

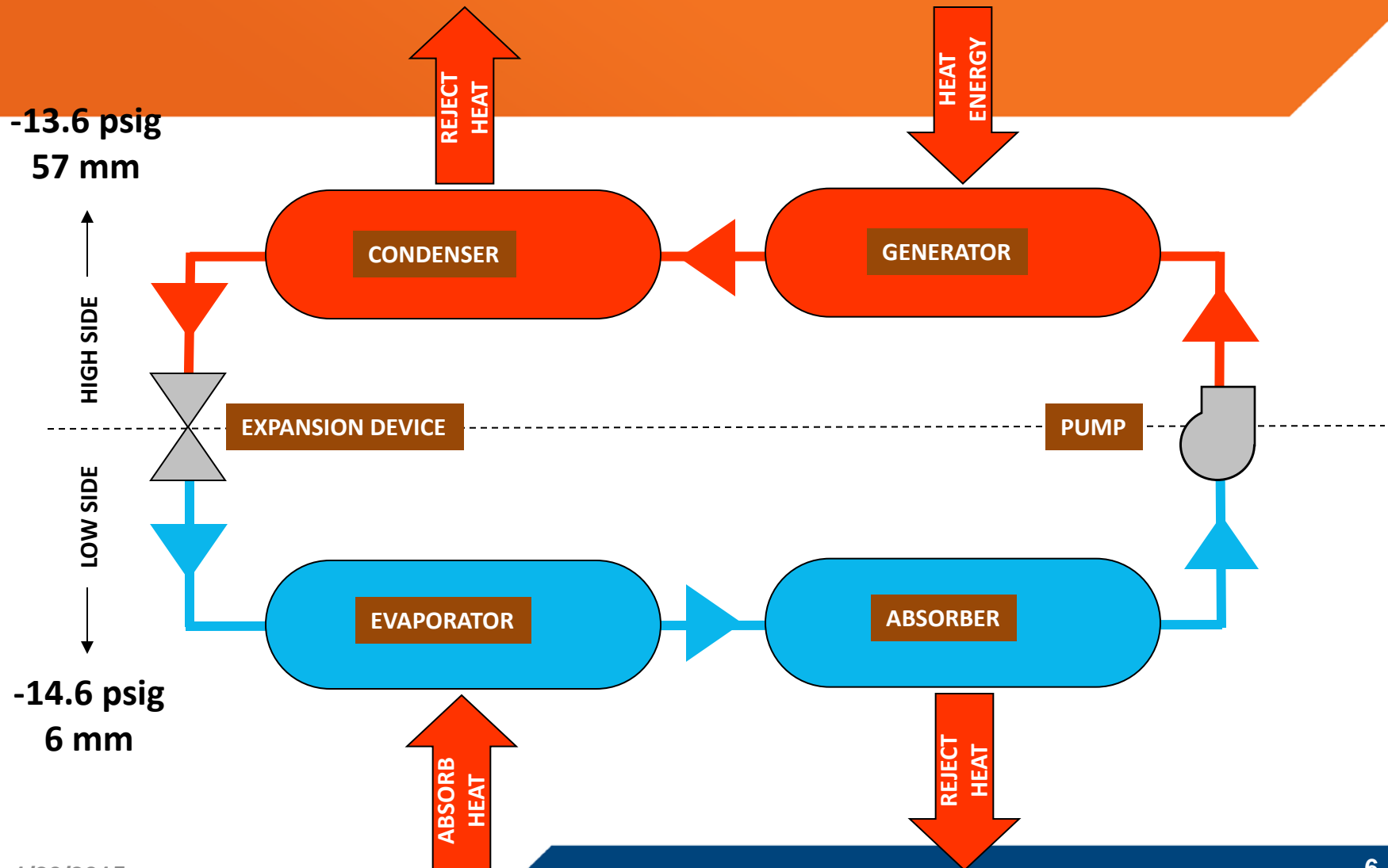
# ABSORPTION CHILLERS

- Thermally driven non-electric chillers
  - 30-3,300 ton indoor or outdoor packages
- Two primary markets
  - HVAC
    - “Typical” utility natural gas pressure
  - Waste heat recovery co-generation  **CCHP**
    - Exhaust, Jacket - hot water with Natural Gas

# THE ABSORPTION CYCLE



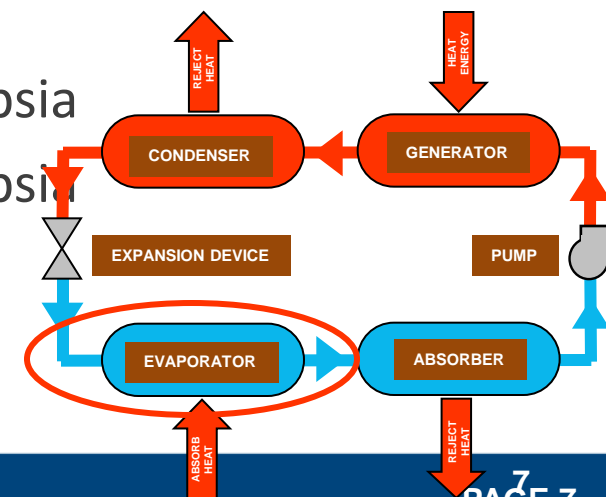
# ABSORPTION CYCLE



# ABSORPTION COOLING THEORY

- Evaporator with water as a refrigerant
  - Refrigerant water sprays on copper tubes of chilled water system
  - Changes state (boils) and absorbs large amounts of energy
    - Water evaporates at **212°F** at 14.7 psia
    - Water evaporates at **40°F** at 0.118 psia

CFC refrigerant changes state and absorbs large amounts of energy for ex. R134 evaporates at 40° at 35 psig



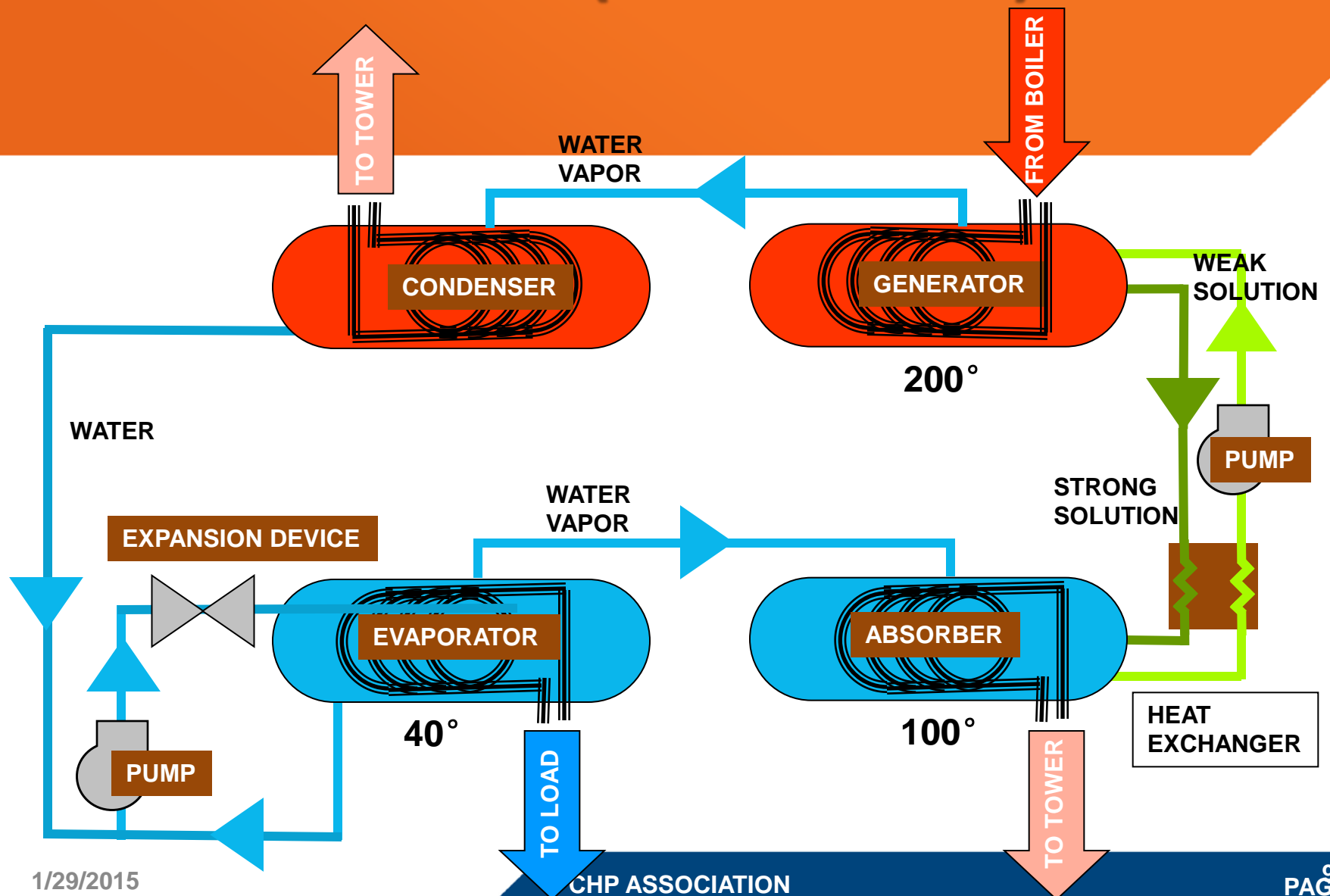
# REFRIGERANT H<sub>2</sub>O

## NO ODP/GWP - PHASE OUTDATE

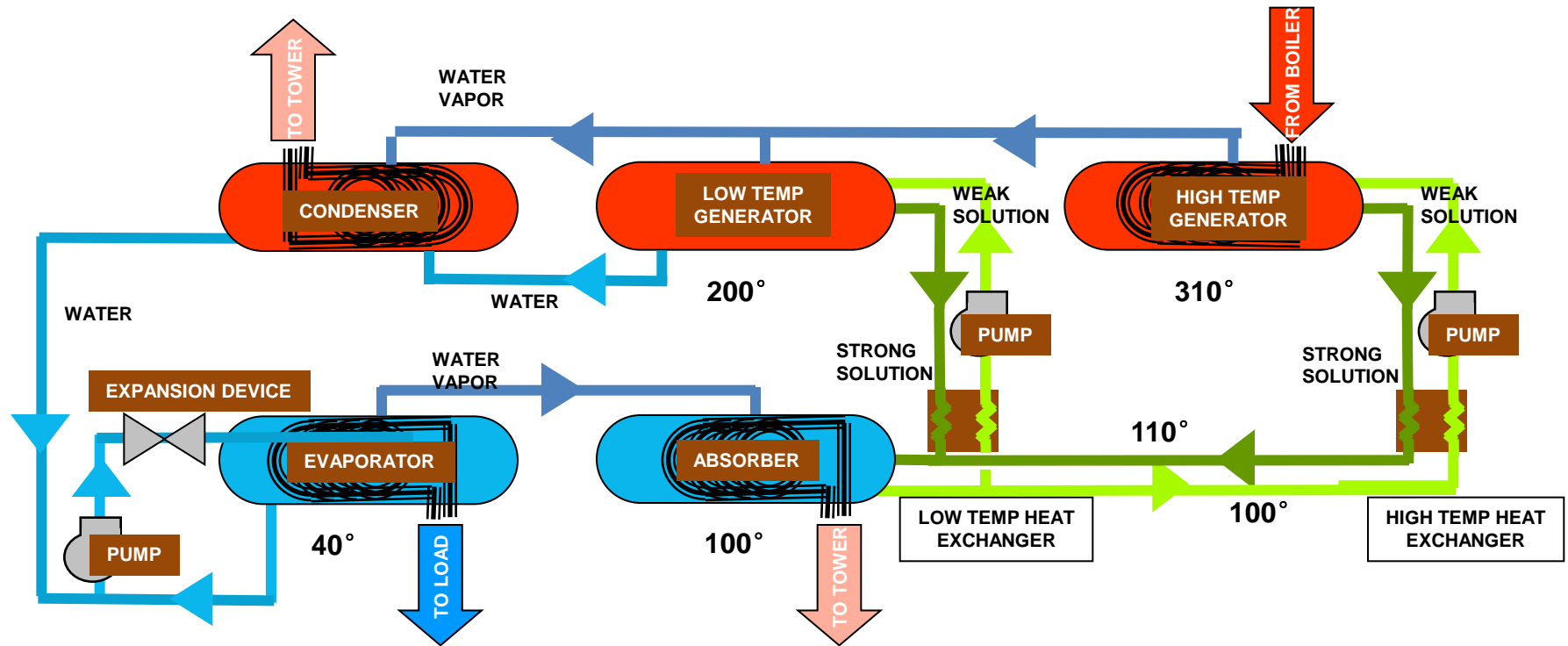
- Distilled water
  - Stable
  - Nontoxic
  - Low cost
  - Readily available
  - Environmentally friendly
  - High latent heat of vaporization
  - R718 = H<sub>2</sub>O
  - <http://www.r718.com/>
  - LEED POINT = 1



# SINGLE EFFECT (0.7-0.8 COP)



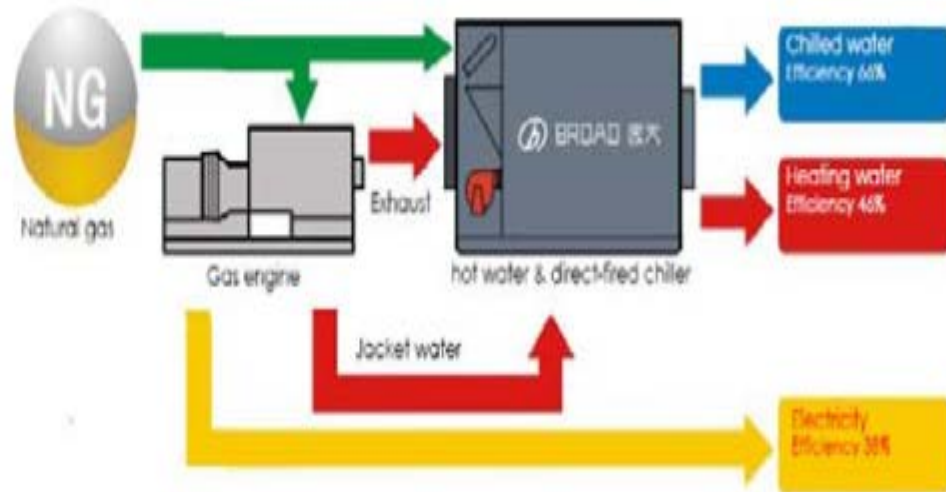
# DOUBLE EFFECT (1.3-1.4 COP)



# MODERN CCHP SYSTEMS



## • BROAD CHP Exhaust & Hot water type



# RAPID EVOLUTION OF TECHNOLOGY



Evolution of Absorption chillers 10 models improvements in 25 years

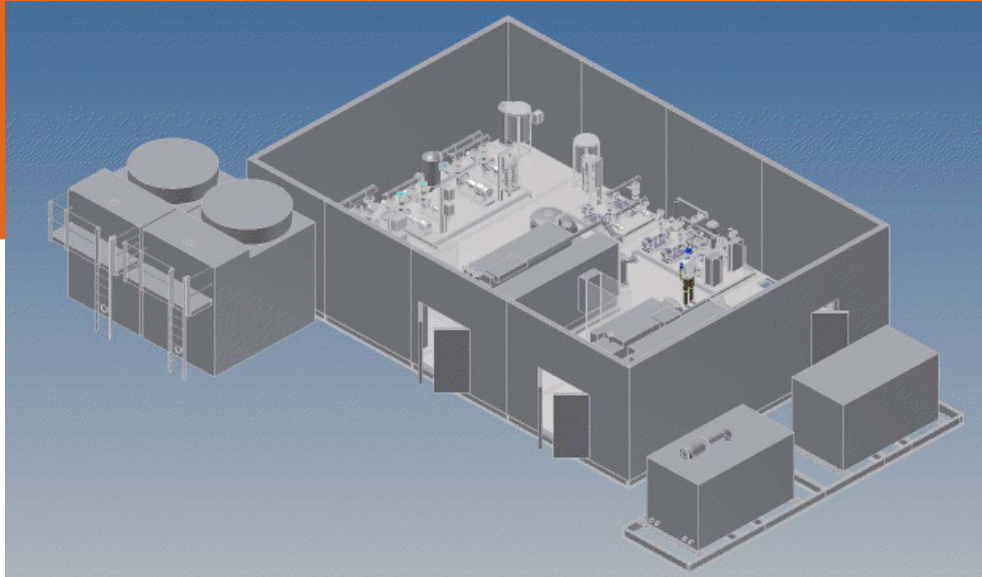
# CHILLER/HEATER OPERATING MODES

- Cooling only
- Heating only
- Simultaneous cooling/heating
- Domestic Hot Water
- Great for System COP!
- Great for reducing capital costs
- Eliminates or reduces the need for separate dedicated cw/hw/dhw systems
- Reduces MER size

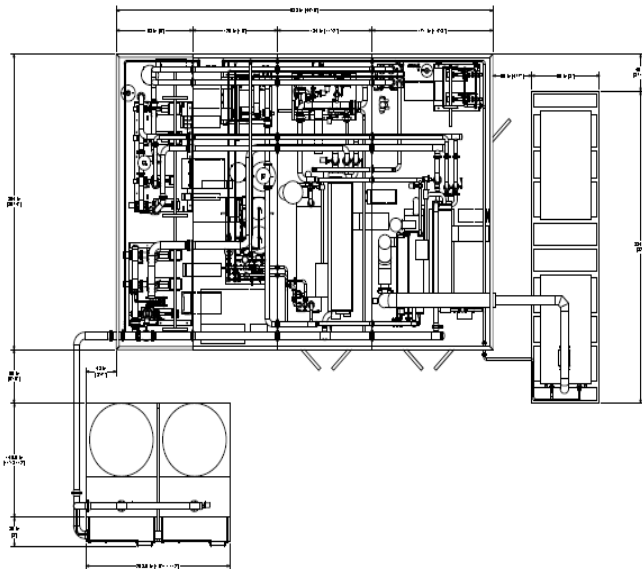
# BIG BOX RETAIL CCHP



# "GROCERY STORE CCHP PACKAGED PLANT"



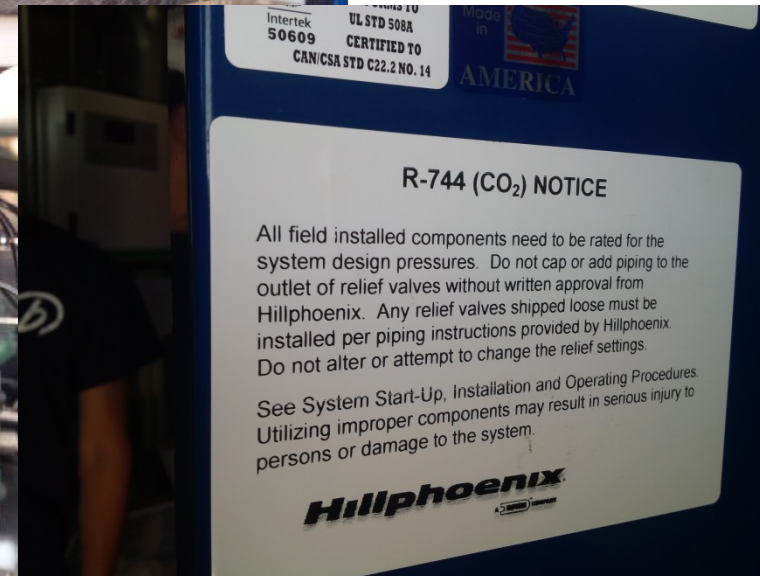
Model: BZHE and BZ  
Cooling Capacity: 260 RT  
Energy Source: Natural Gas & Waste  
Heat from recip  
150 KW CHP  
250 KW of demand response



# PRE-PACKAGED AND TESTED CCHP WAITING TO GO OVER THE GOVERNOR'S FAVORITE BRIDGE IN FORT LEE NJ



# CO2 LOW AND MEDIUM TEMP REFRIGERATION SUB COOLED BY CCHP ( ADDITIONAL HEAT SINK)



# GROCERY STORE SUMMARY

- Brooklyn NY (USA)
- Store can operate in a Black Out / “Black Start”
- 150 kw of CCHP / 250 kw of “Demand Response”
- 100 & 168 tons of Chiller /Heaters/DHW
- Solar PV with rain water capture 350 KW
- No man made chemical refrigerants
- CO2 low temperature refrigeration
- Sub cooling low temp via CCHP
- NYSERDA incentive participant (six figures)
- LEED - Platinum or Gold pending!

# STORE DESIGN CONSIDERATIONS

- All Mechanical equipment on roof ( resiliency )
- Gowanus canal “water management”
- “Beckwith relay” does not allow exporting power
- Transfer switches allow store to shed non-critical loads during a “island mode operation”
- System was “pre-packaged and tested” FAT!
- FAT Made for a simple start up
- 24/7/365 monitoring via store BMS and CCHP suppliers PLCs and internet.
- **Grid independence - run business with or without grid – product loss mitigation – keep the register ringing – be an asset to the community they serve.**

BIRDS EYE VIEW OF THE NEW PLANT(S) THAT GREW IN BROOKLYN NYC ( YES THEY GROW ORGANIC VEGETABLE ON THE ROOF FOR SALE IN THEIR STORES IN NYC )GREENHOUSE PRODUCES THE EQUIVARIANT OF 40 ACRES.



# INSIDE ELECTRICAL ROOM PRE-PACKAGED MER BOX (BECKWITH RELAY)



# STORE OPENS ON SCHEDULE AND IT WORKS! DECEMBER 20<sup>TH</sup> 2013



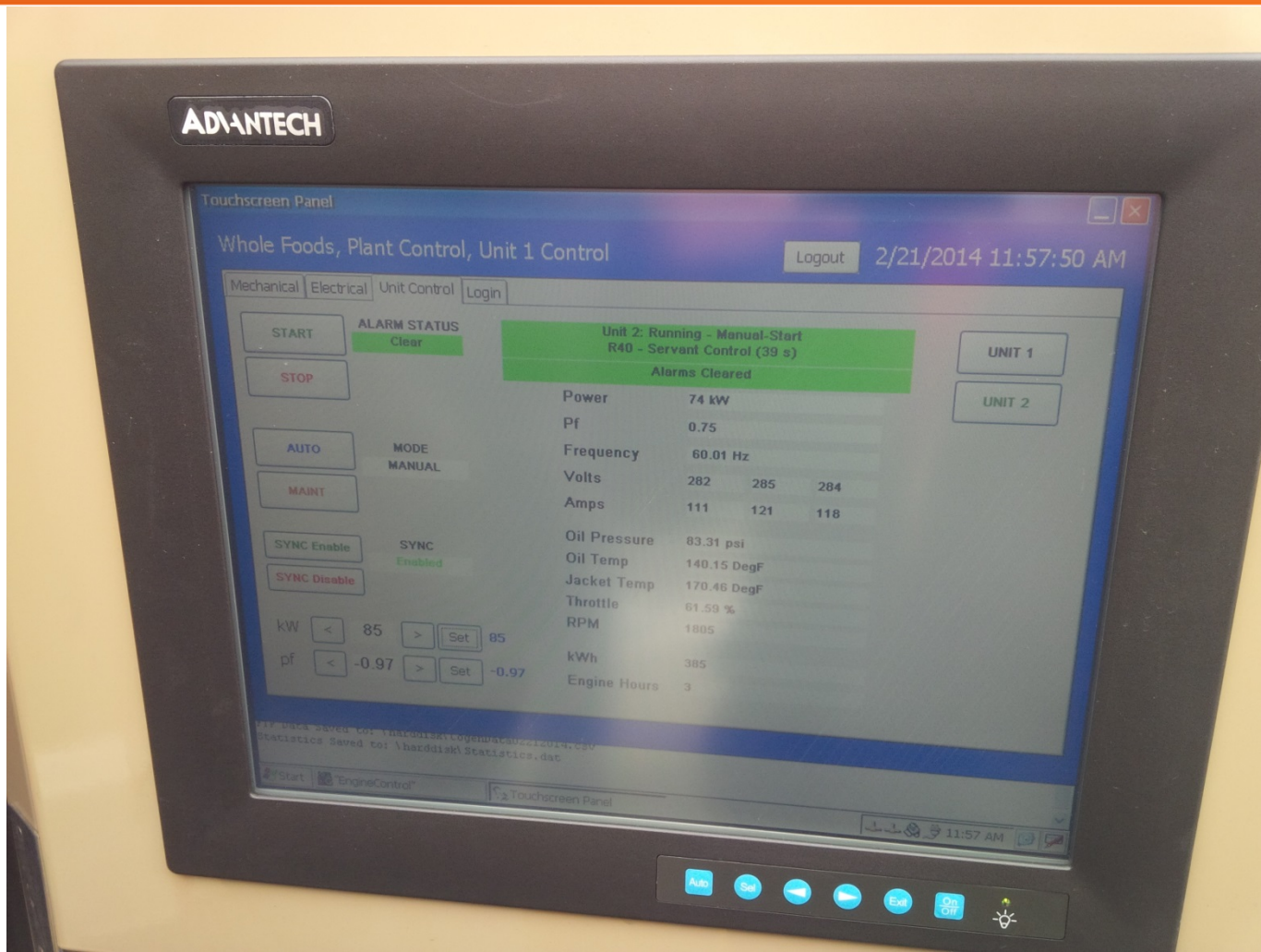
# CCHP TURNS ON 2/20/2014

- Hi folks,
  - Congratulations to everyone on 2 huge milestones today: we got National Grid's sign off and passed ConEdison's witness test! The generators started up successfully, and we will be working tomorrow to dial in synchronicity on all systems. I appreciate everyone's hard work to get to this point. Please let me know if you have any questions.
  - Thanks!
  - J'aime Mitchell, LEED Green Associate
  - Associate Coordinator of Construction | Green Mission Specialist
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- 56,000-square-foot structure is 60 percent more energy efficient than the building code requires. That's right: 60 percent more efficient, making it one of the most energy efficient supermarkets in the nation, Whole Foods says. (source greenbiz.com)

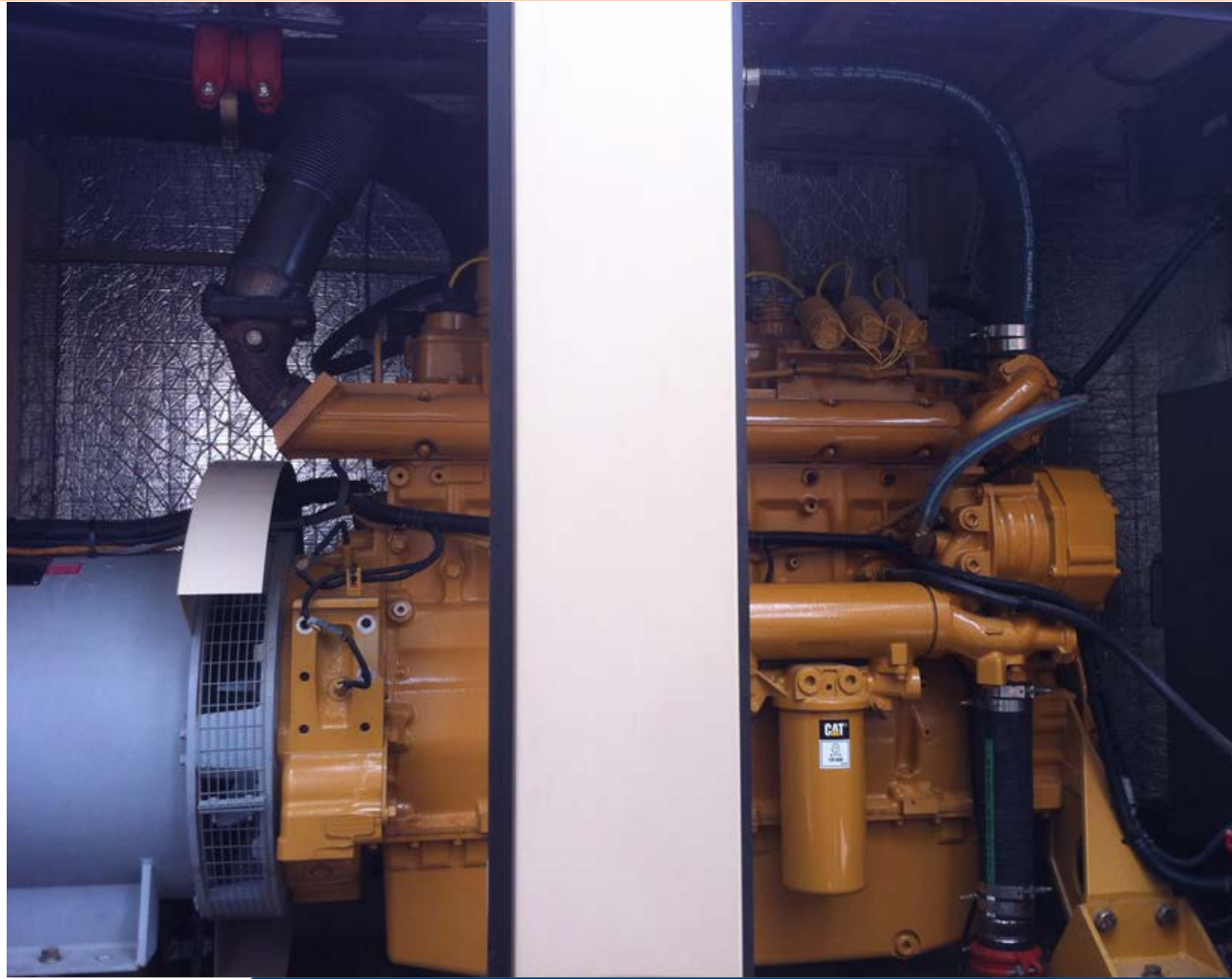
# SOLAR PV CANOPY FOR PARKING AND RAIN WATER CAPTURE SYSTEM



# PLC CONTROLS RECIPROCATING ENGINE



# THE CCHP “PRIME MOVER” 150 KW RECIPROCATING ENGINE / QUIET BY DESIGN OF PRE-PACKED BOX



# PLC CONTROLS ON CCHP PLANT

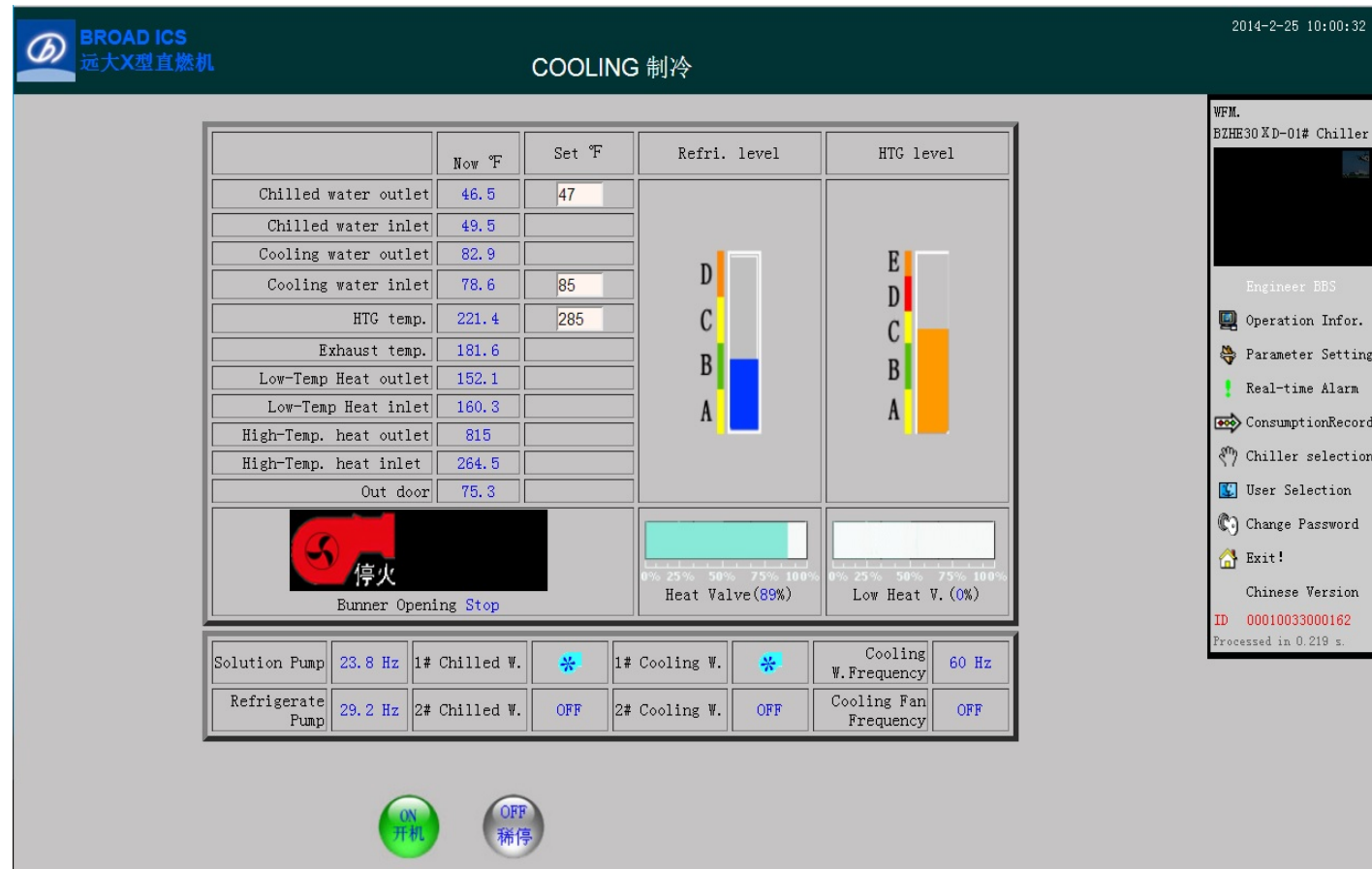


# PLC 27/7/365 MONITORING OF THE CHILLERS FROM ANY PC OR SMART PHONE IN THE WORLD VIA THE INTERNET

Exhaust temp. 820/266°F, maintain chilled water delta T 2.5~3 °F only by Exhaust.

Regards

Bill Huang  
Technical manager  
Broad USA Inc.



# EASY TO COMMISSION VIA FACTORY TESTING



# FEEL FREE TO EMAIL DENIS ?

- Jordan Melton
- **Physical Plant Coordinator**
- **WFM**
- 214 3rd St,
- Brooklyn, New York 11215
- (718) 907-3622
- or Denis Boyle Project Manager (NE NEO) (Denis.Boyle@wholefoods.com)

# TOUR LAST MONTH -ICF



WADE Annual Meeting & DistribuGen Conference  
and NYSERDA CHP Expo

October 14 - 17, 2014  
Westchester, New York



# TOUR LAST MONTH



# TOUR LAST MONTH



# SIMULTANEOUS CHW, HW & DHW

- Typically a lower capital cost system
- Offers Better “System Efficiency”
- Up to three energy inputs...great for simple CCHP integration with hvac



Rated COP: 1.34

IPLV COP: 1.529 calculation as

Load	COP	Factor	Result
A 100 %	1.340	0.01	0.013
B 75 %	1.546	0.42	0.649
C 50 %	1.595	0.45	0.718
D 25 %	1.241	0.12	0.149

# Questions?

