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· Dallas Convention Center ·

Fort Detrick – Lessons Learned

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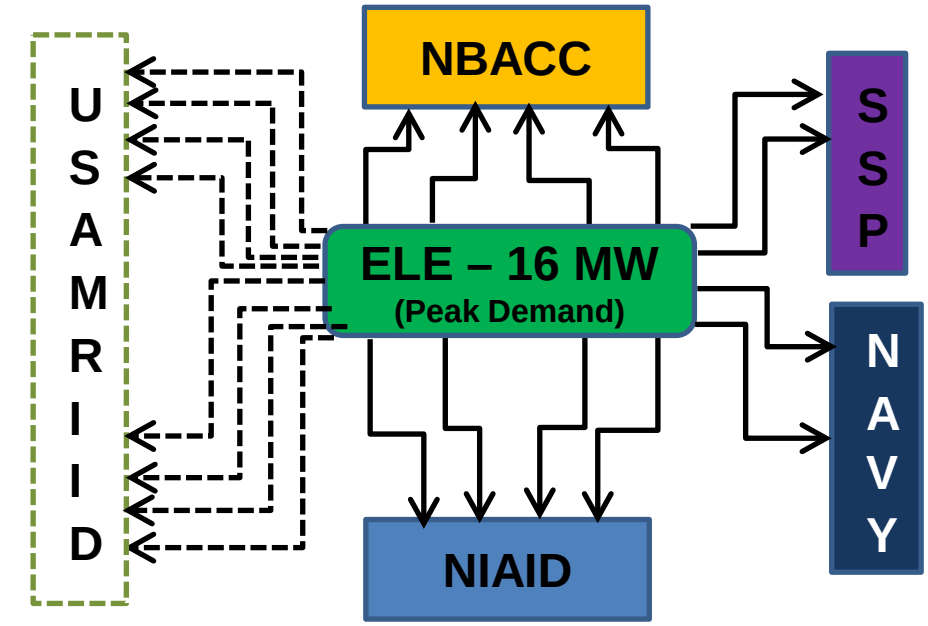
Agenda

- Fort Detrick NIBC Status
  - Background and CUP History
  - Contracted Supply & PQR Warranties
- Lessons Learned
  - Connected load intricacies – Model thru POU
  - Never underestimate Mother Nature
- Best Practices & Forward Planning
  - IsoParallel Microgrid
  - Series Counterflow w/ TES Decoupler Chiller Plant

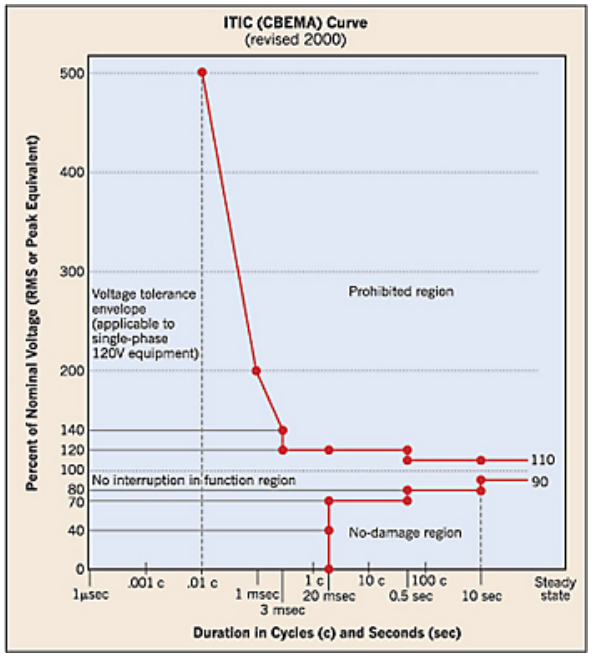
Contracted Supply & PQR Warranties

- Electrical Supply



In Construction Now

- Electrical Quality Warranty



- Electrical Reliability Warranty

99.999% or < 5 min 15 sec

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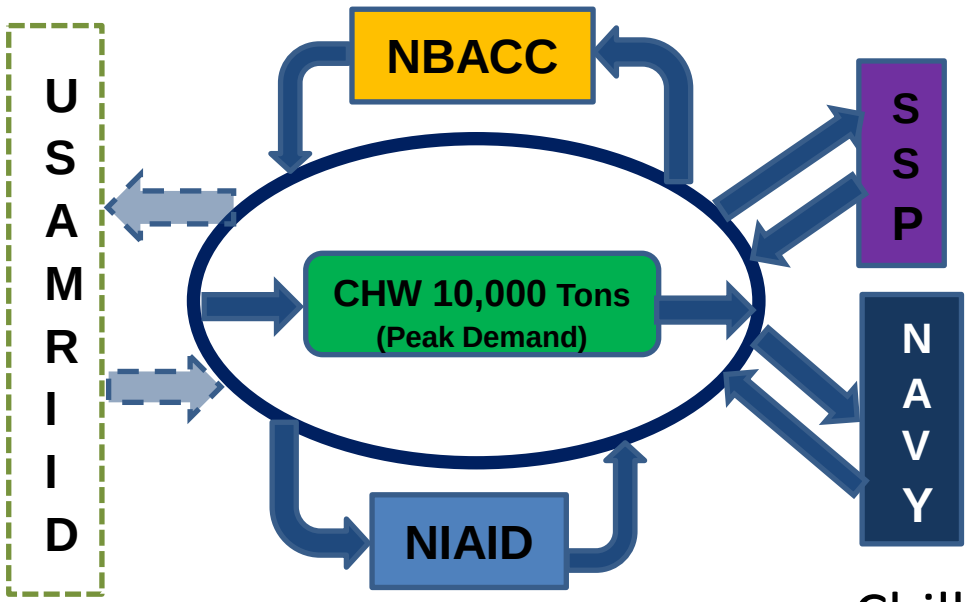
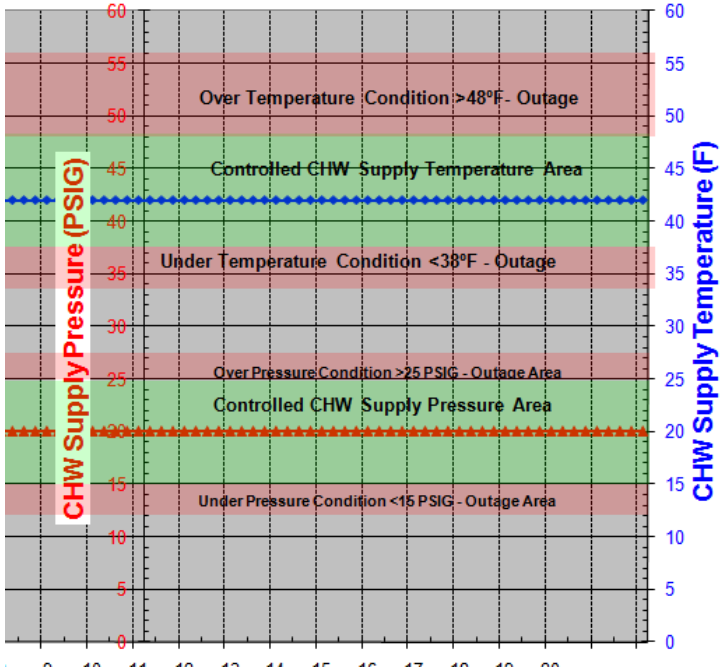
Contracted Supply & PQR Warranties



Chilled Water Quality Warranty



Chilled Water Reliability Warranty

99.99% or < 52 min 30 sec

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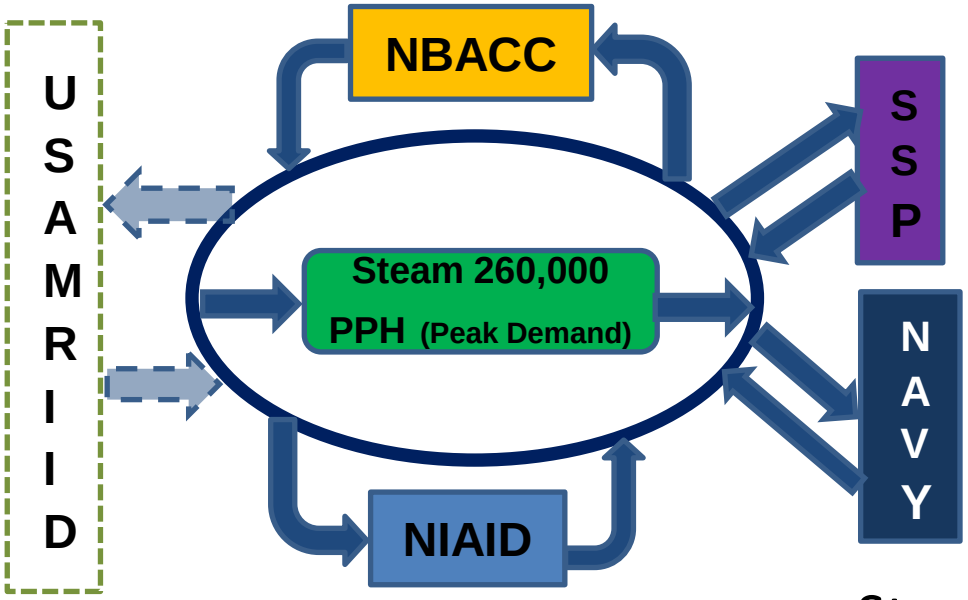
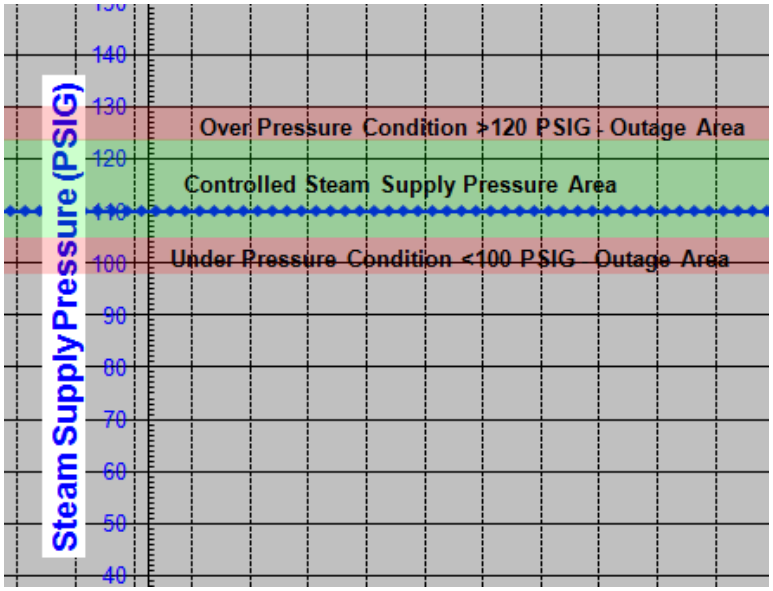
Contracted Supply & PQR Warranties

- Steam Supply



Steam Quality Warranty



Steam Reliability Warranty

99.99% or < 52 min 30 sec

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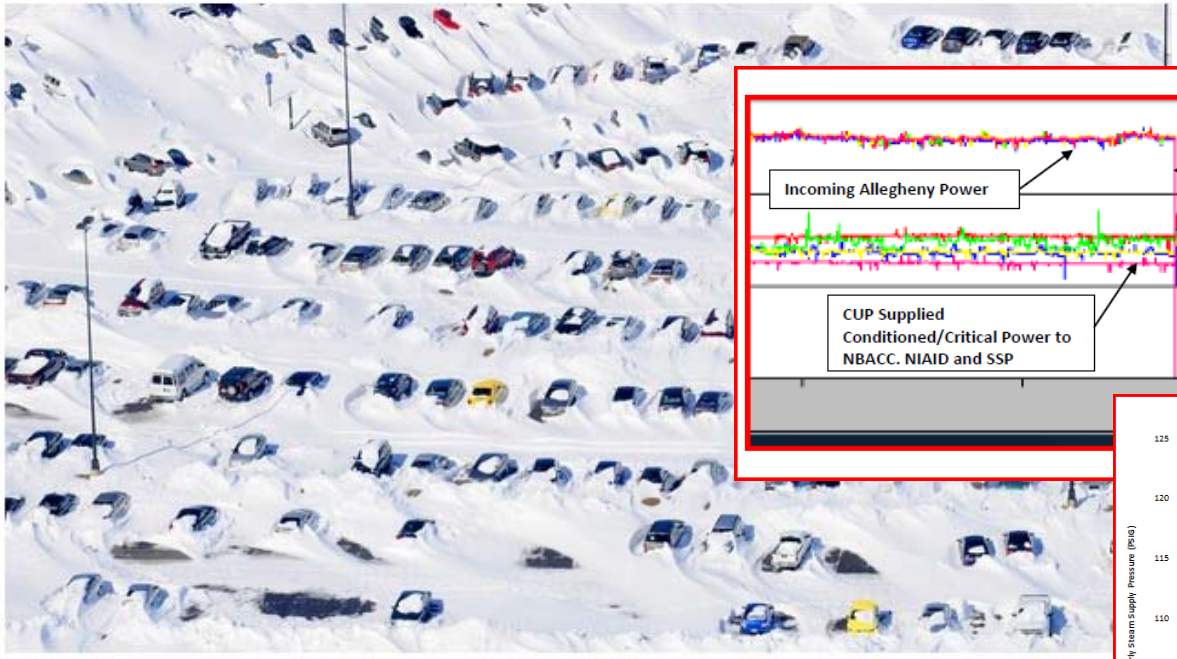
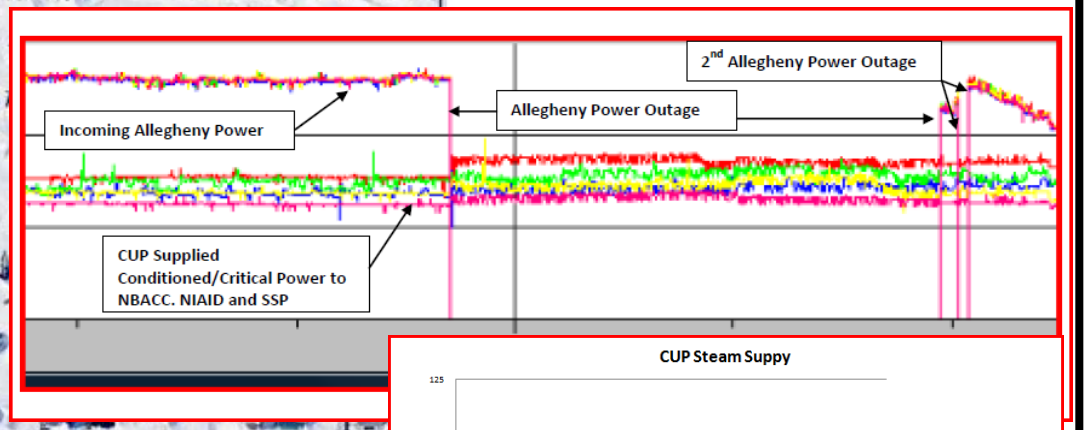
Lessons Learned #1

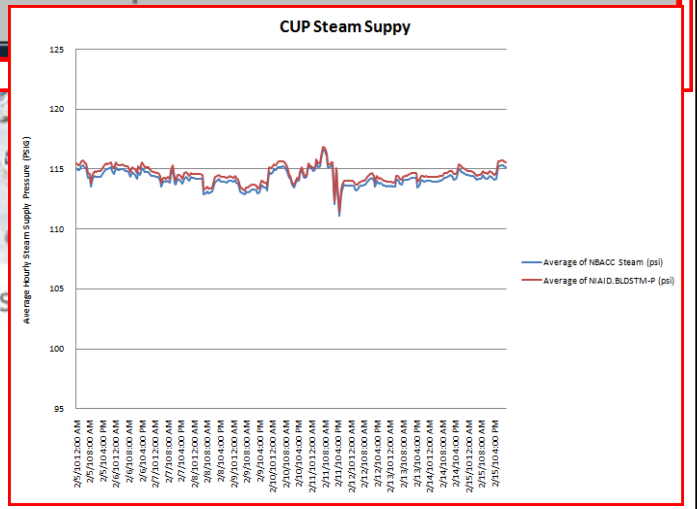
- Never underestimate Mother Nature
  - Presidents Day Weekend 2010



O'Malley says Frederick one of worst-hit areas

Photo by Bill Green
Hundreds of cars are buried Thursday in a parking lot at Mount St. Mary's University. Frederick County is recovering from a disabling snowstorm that dropped more than 20 inches of snow Wednesday.





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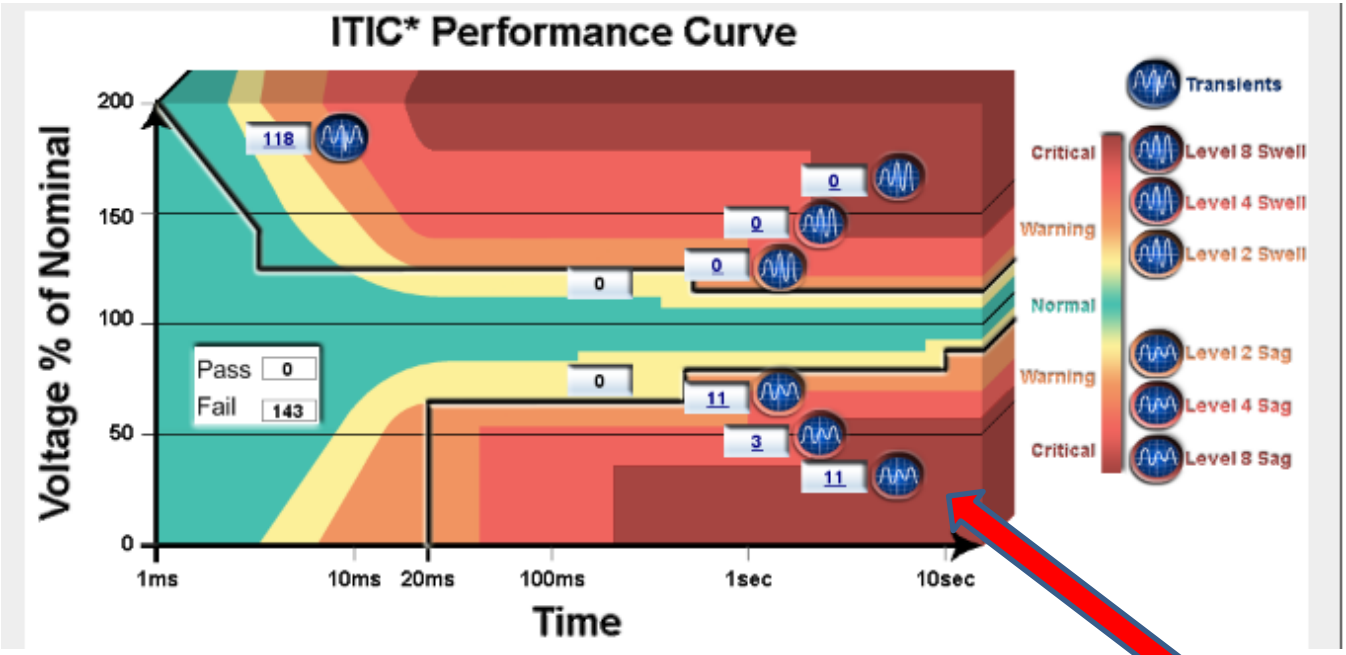
Best Practices & Forward Planning #1

- **Key Requirements drove basis of design**
- **NIBC Partner Buildings**
  - Isolated feeders
    - Each Building has 2 - 8 15kV service entrances
    - Each service entrance must be isolated from each other
      - A fault on one feeder shall not cause a disturbance on the other feeders
      - 99.999% available ITIC (CBEMA) quality maintained on EACH feeder at all times (even during construction)

Best Practices & Forward Planning #1

- **Key Requirements drove basis of design**
  - **Isolate from Utility Transmission Events**
  - **Allegheny feeder events (July 2009 – July 2010) as measured at Fort Detrick Substation**



CRITICAL

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Best Practices & Forward Planning #1

- **Key Requirements drove basis of design**
  - Building Electrical Topology
    - Double Ended Substations
      - Main-Tie-Main Breaker Automatic Transfers
        - » Out of Chevron control
        - » Load swings will occur (Up to 1pu per feeder)

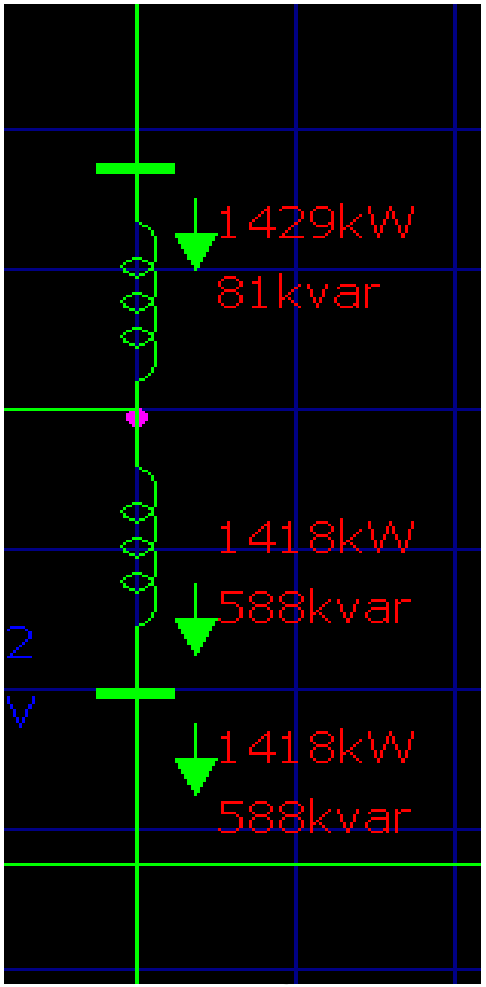
Provide Isolated but Paralleled Generation Sources?

- **IsoParallel Microgrid**

Best Practices & Forward Planning #1

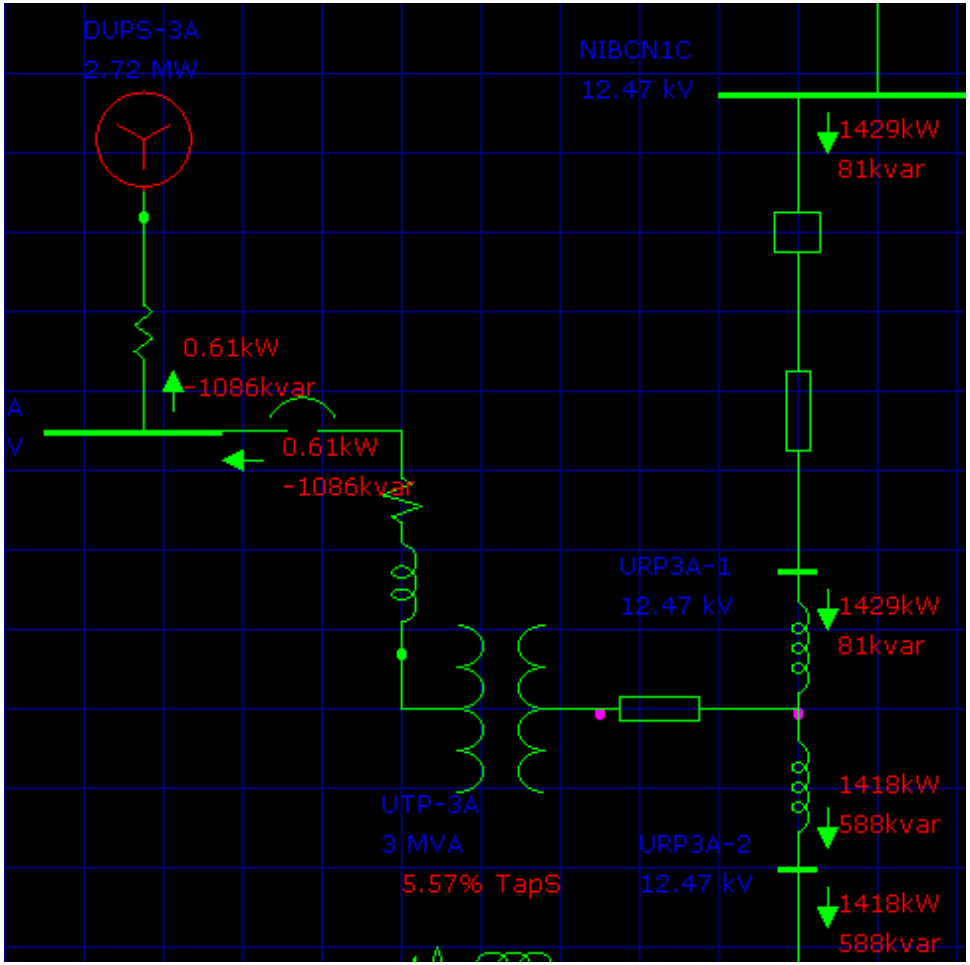
- IsoParallel Microgrid

  - The feeders must be isolated from the utility, the utility is 2 sources and must be divided up into 4.
    - An Isolating Choke is used for each Feeder bus
    - The choke has a high impedance thus filtering out transients.
    - Power flow through the Choke causes a significant voltage drop



Best Practices & Forward Planning #1

- IsoParallel Microgrid
  - Synchronous Condenser
    - Freewheeling generator connected to an energy storage device
      - Provides ride through
    - Supplies reactive power
      - Maintains output voltage at 100%



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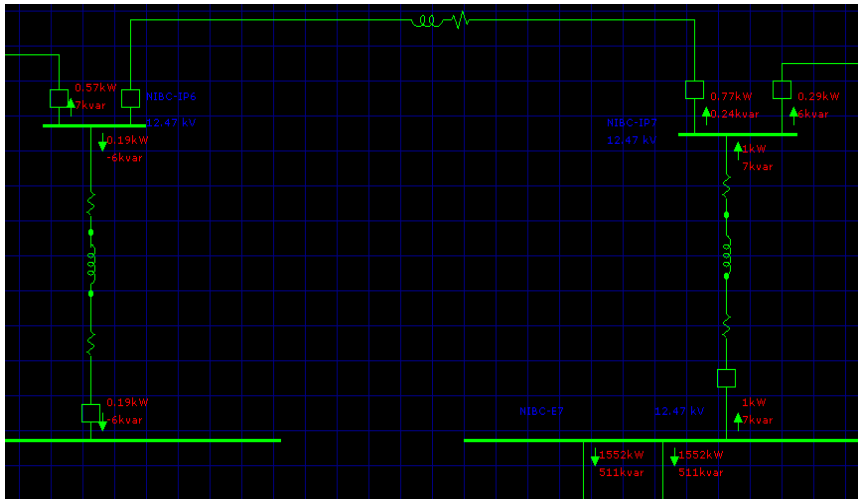
Best Practices & Forward Planning #1

- IsoParallel Microgrid
  - Isolating Chokes are also installed between feeder buses
    - Allows generating sources to share load current
    - Allows sharing of redundancy
    - Allows for seamless expansion



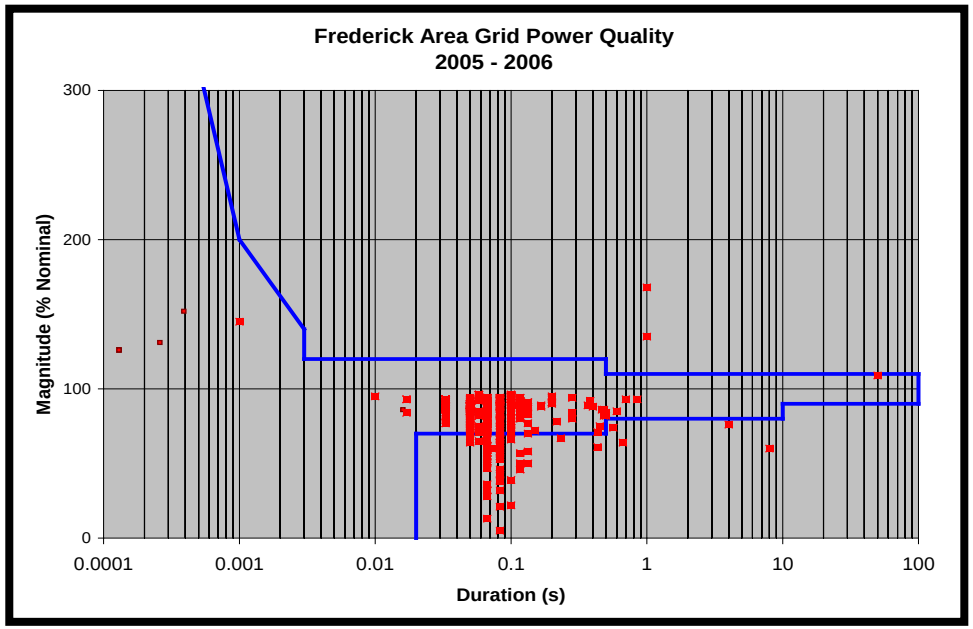
Best Practices & Forward Planning #1

- IsoParallel Microgrid
  - Results to date

  – Level 1 Events =

  – Level 2 Events =

  – Level 3 Events =



Best Practices & Forward Planning #2

- Series Counterflow w/ TES Decoupler Chiller Plant

CUP Phase Buildout Overview

Phase I Capacities

- 3,600 Ton Refrigeration Plant
- 200,000 Pound per Hour Steam Plant 120 PSI
- 8.8 MW Uninterruptible Power

5X

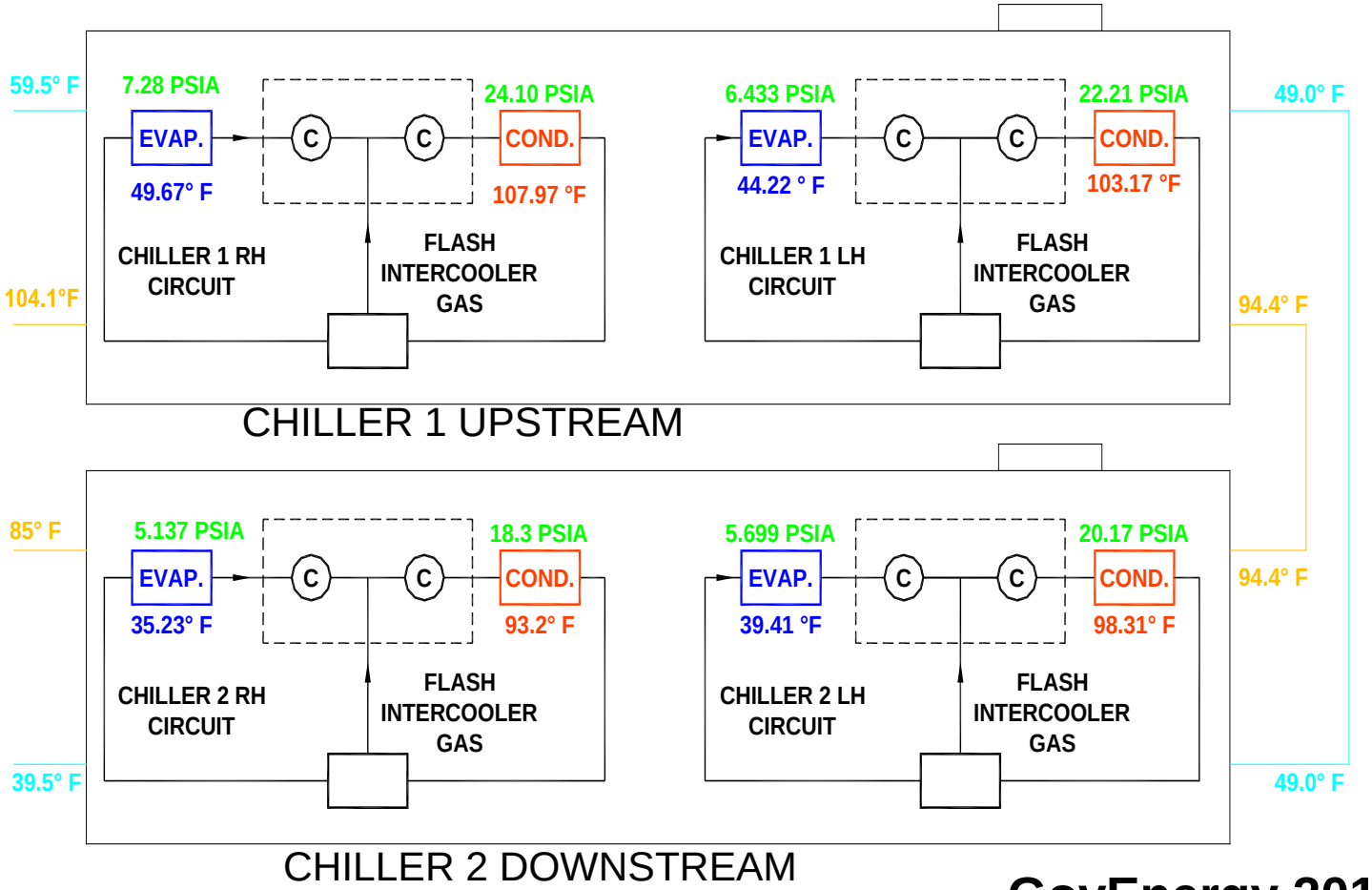
Ultimate Plant Capacities (potential)

- 18,000 Ton Refrigeration Plant
- 400,000 Pound per Hour Steam Plant 120 PSI
- 28.16 Uninterruptible Power

Best Practices & Forward Planning #2

2 STAGE CENTRIFUGAL – DUPLEX COMPRESSORSSERIES - COUNTERFLOW

- High Efficiency Configuration to meet efficiency warranty



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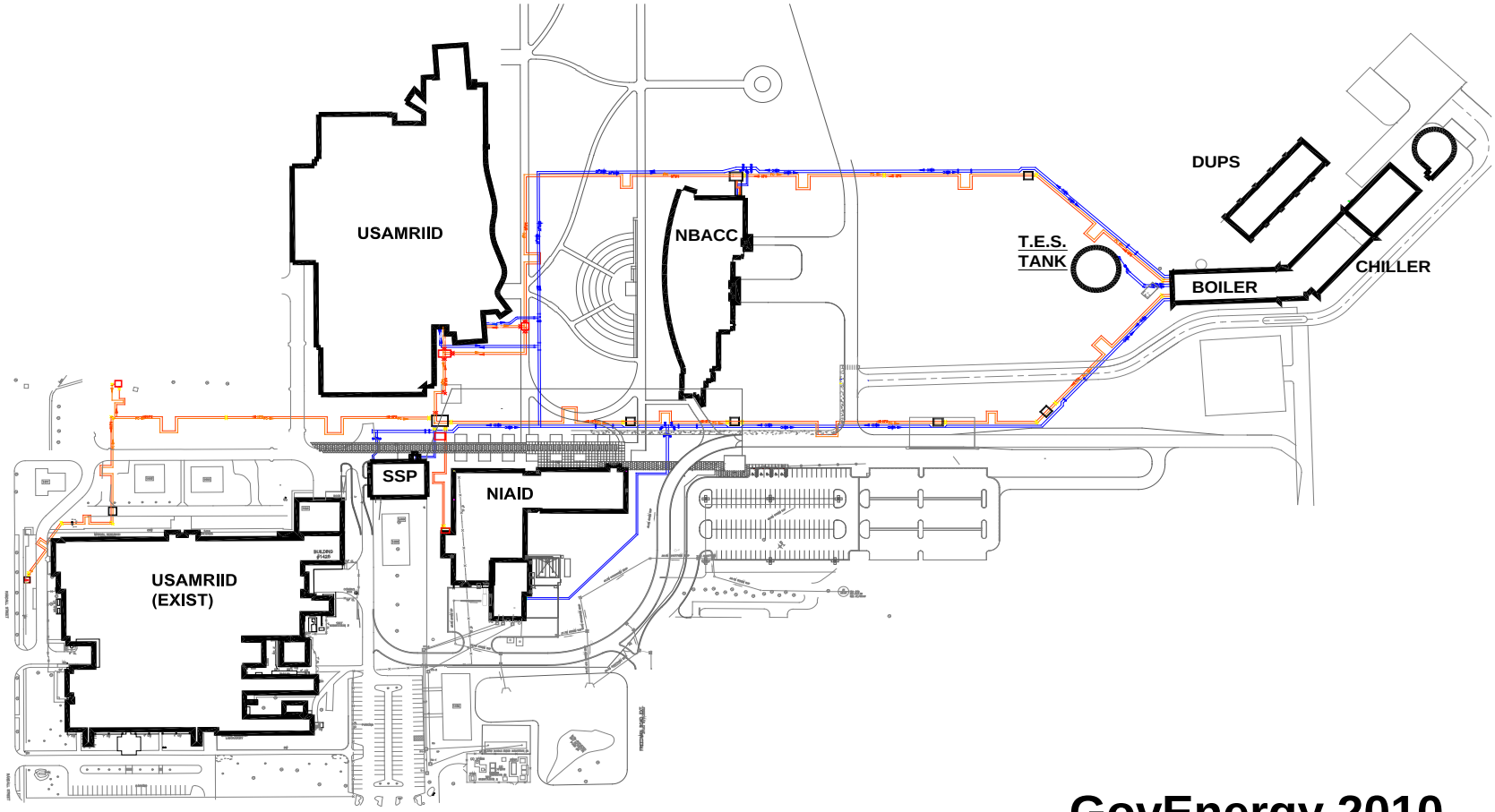
Best Practices & Forward Planning #2

- Primary-Secondary pumping required for future growth
  - Distribution



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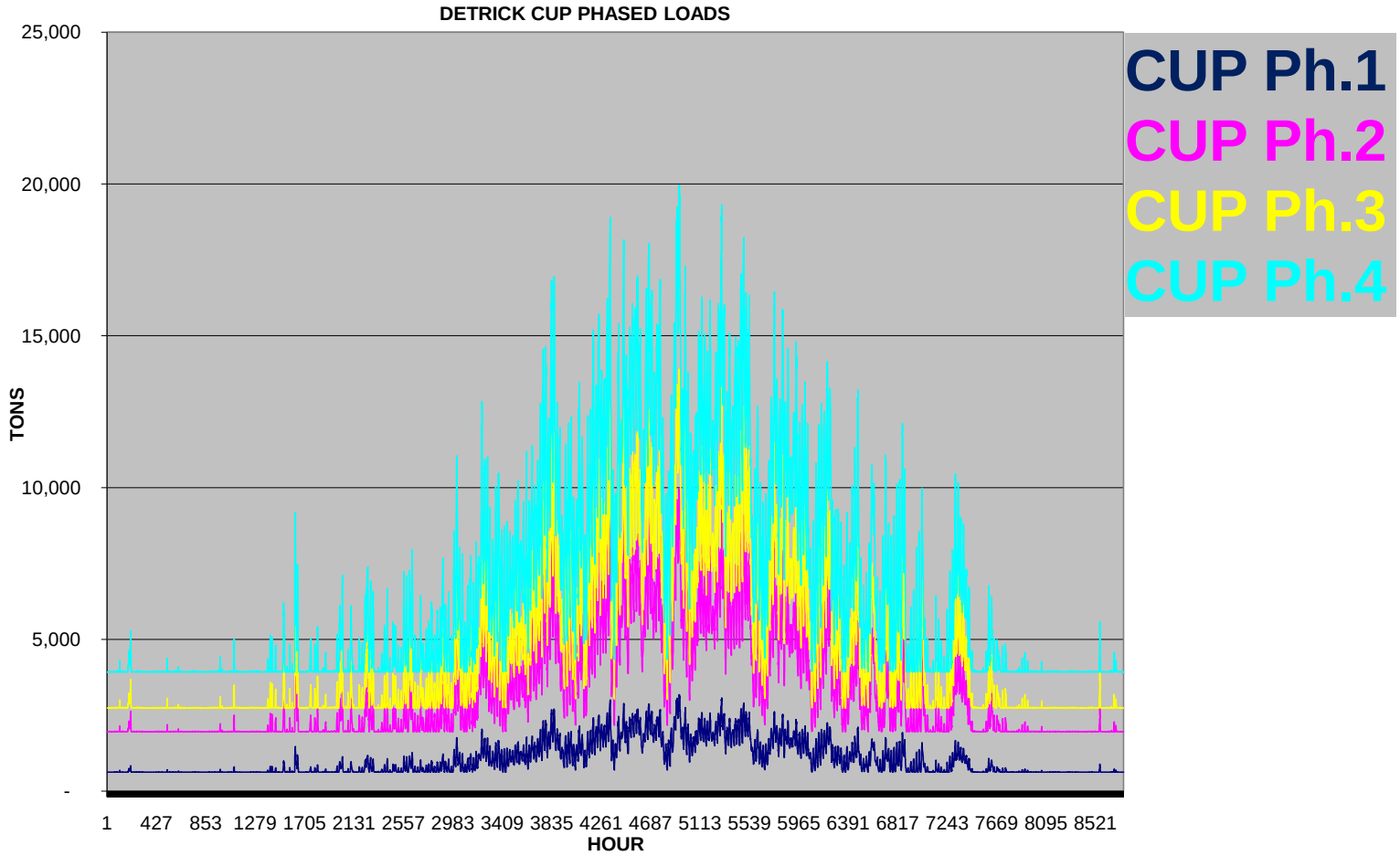
Best Practices & Forward Planning #2

- Primary-Secondary pumping required for future growth
  - Load Growth



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Best Practices & Forward Planning #2

PROBLEMS WITH PRIMARY SECONDARY PUMPING AND THE SOLUTION OF THE TES TANK LOCATED IN THE DECOUPLER BYPASS

PROBLEMS

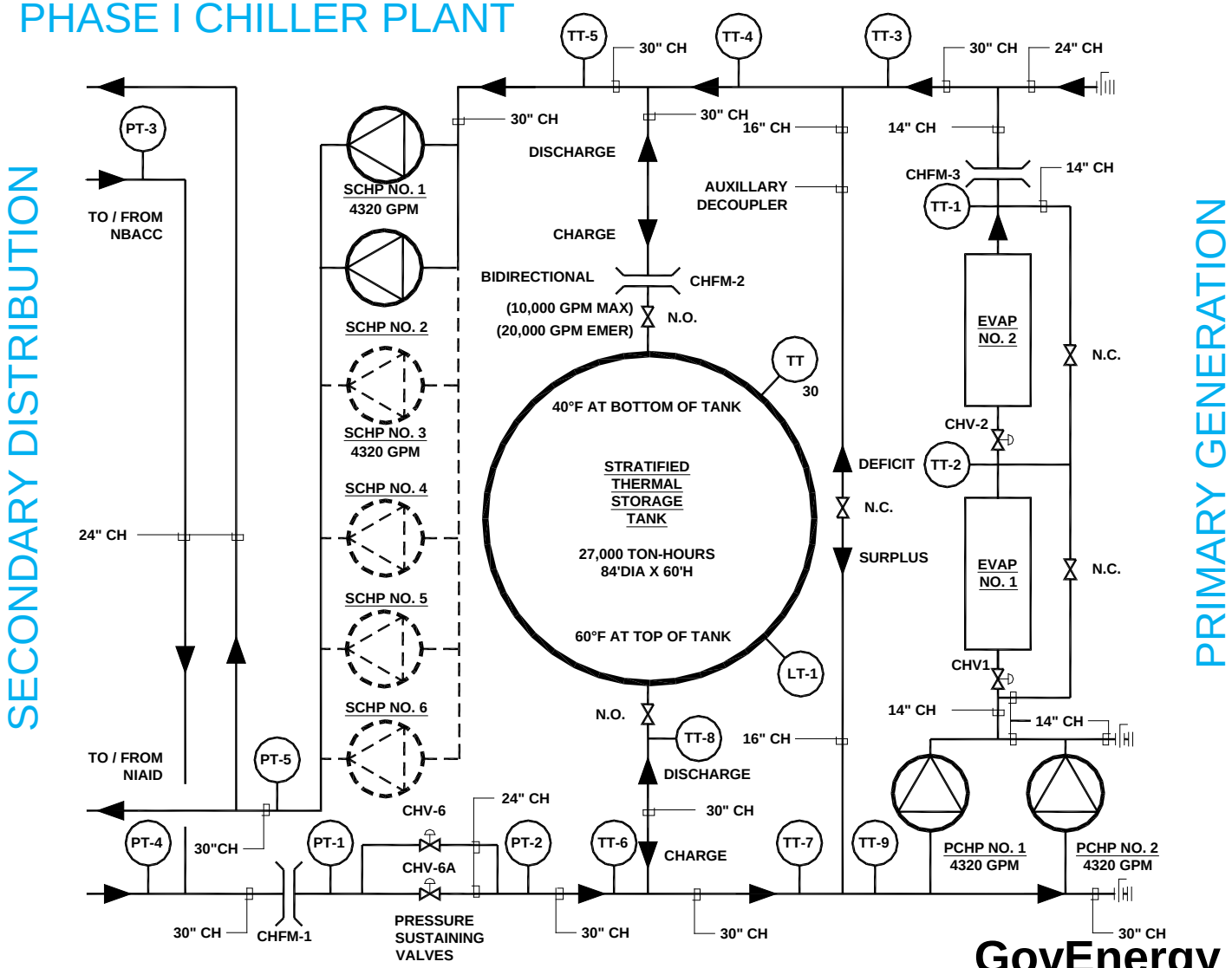
- **SURPLUS FLOW WITHOUT TES TANK IN DECOUPLER**
  - PRIMARY PUMPING THROUGH CHILLERS > SECONDARY PUMPING DISTRIBUTION
  - DECOUPLER RECIRCULATES COLD WATER BACK TO THE CHILLERS
  - REDUCES TEMPERATURE DIFFERENCE (DELTA T) ACROSS CHILLERS
  - CAUSES THE CHILLER TO UNLOAD
- **DEFICIT FLOW WITHOUT TES TANK IN DECOUPLER**
  - PRIMARY PUMPING THROUGH CHILLERS < SECONDARY PUMPING DISTRIBUTION
  - DECOUPLER RECIRCULATES WARM WATER BACK TO THE DISTRIBUTION
  - REDUCES TEMPERATURE DIFFERENCE (DELTA T) ACROSS DISTRIBUTION
  - EVENTUALLY CAUSES TEMPERATURES OUTSIDE OF PRESCRIBED RANGE

SOLUTIONS

- **SURPLUS FLOW WITH TES TANK IN DECOUPLER**
  - SURPLUS FLOW CIRCULATES TES TANK WITH EXCESS PRIMARY FLOW
  - DECOUPLER WITH TES ALLOWS TANK TO CHARGE WITH ANY EXCESS FLOW
  - TEMPERATURE DIFFERENCE IS MAINTAINED ACROSS CHILLERS AT 20°F
  - CHILLER REMAINS LOADED
- **DEFICIT FLOW WITH TES TANK IN DECOUPLER**
  - DEFICIT OF FLOW IS MADE UP FROM THE BOTTOM OF THE TES TANK AT 40°F
  - MAINTAINS TEMPERATURE DIFFERENCE (DELTA T) ACROSS DISTRIBUTION AT 20°F
  - MAINTAINS TEMPERATURES WITHIN PRESCRIBED RANGE OF 38 TO 48°F

Best Practices & Forward Planning #2

PHASE I CHILLER PLANT



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Best Practices & Forward Planning #2

- Utilizing TES as decoupler in a primary/secondary chilled water pumping configuration plus utilizing a series-counterflow refrigeration plant provides operational flexibility, reliability and efficiency.