

Turbine Air Systems

Turbine Inlet Chilling & Generation Storage® Best Practices

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AGENDA



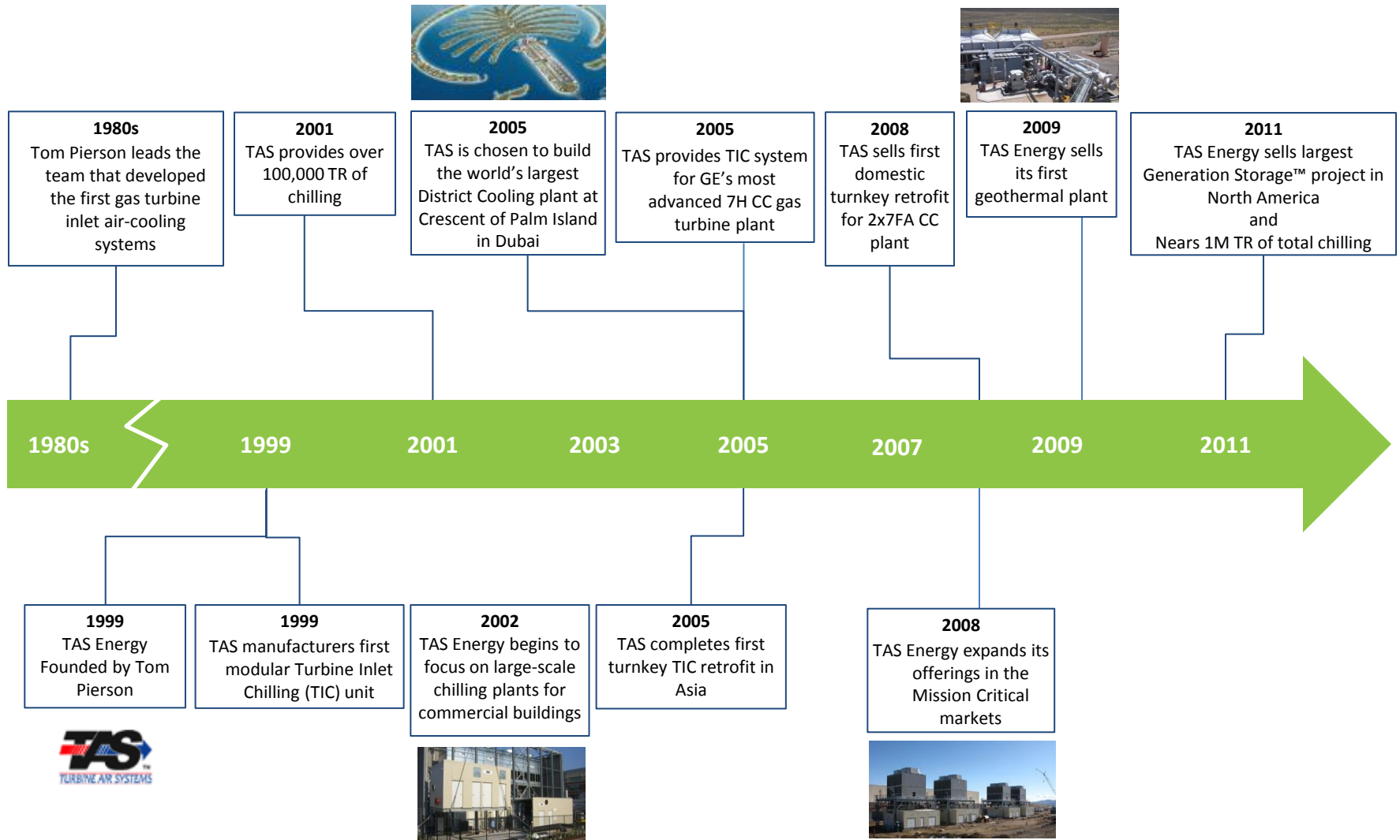
- TAS Introduction
- Technology Overview – Generation Storage & Inlet Chilling
- Project Examples
- Best Practices
- Questions

COMPANY INTRODUCTION



CORE COMPETENCIES

COMPANY HISTORY

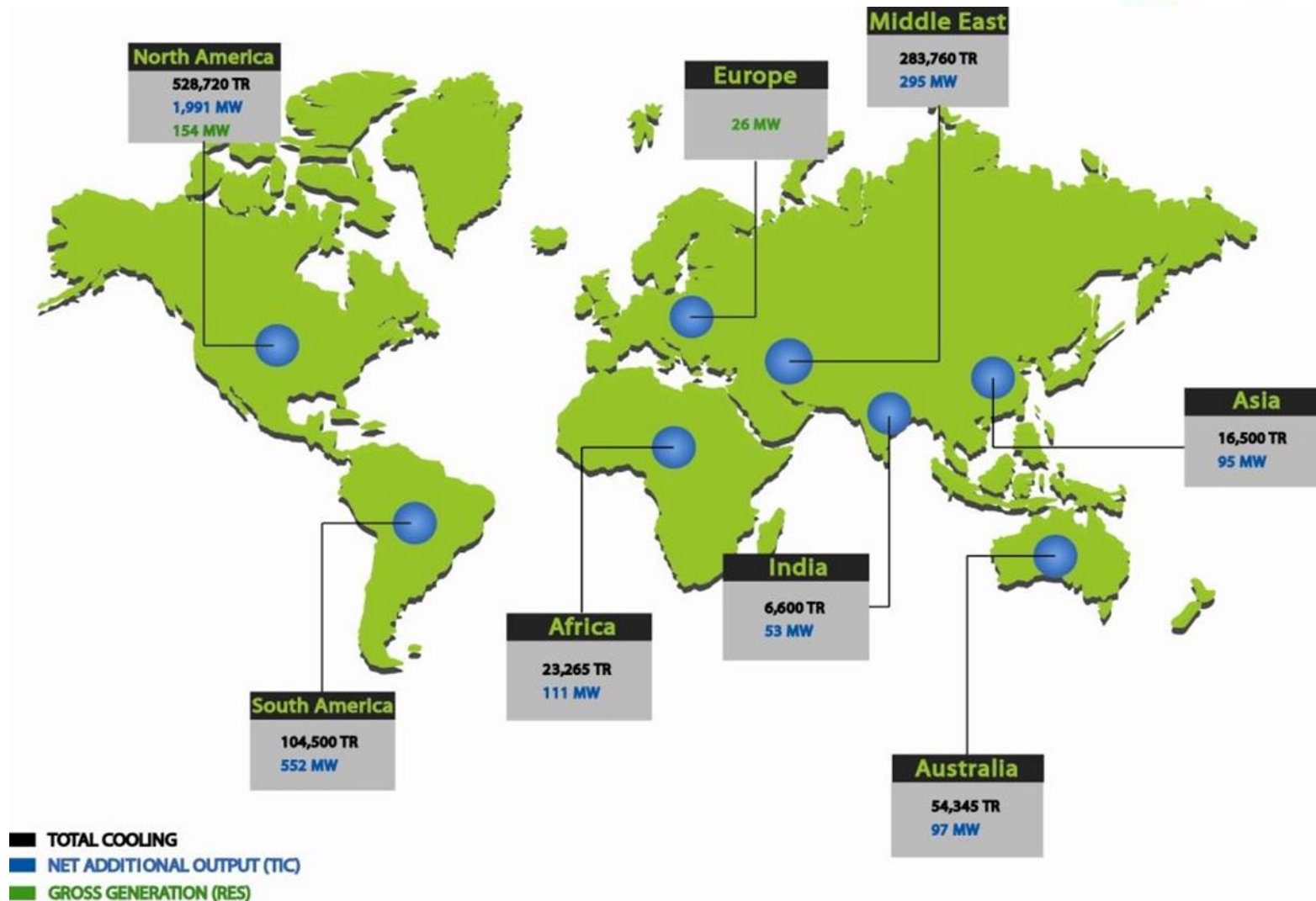


MANUFACTURING FACILITY

- Houston, TX HQ
- 275,000 sq ft
- 80 Ton Crane Capacity
- In-house pneumatic testing
 - Pressure & Leak Testing



GLOBAL PRESENCE



1,017,690 Tons and 220 Project Sites Worldwide

Turbine Air Systems

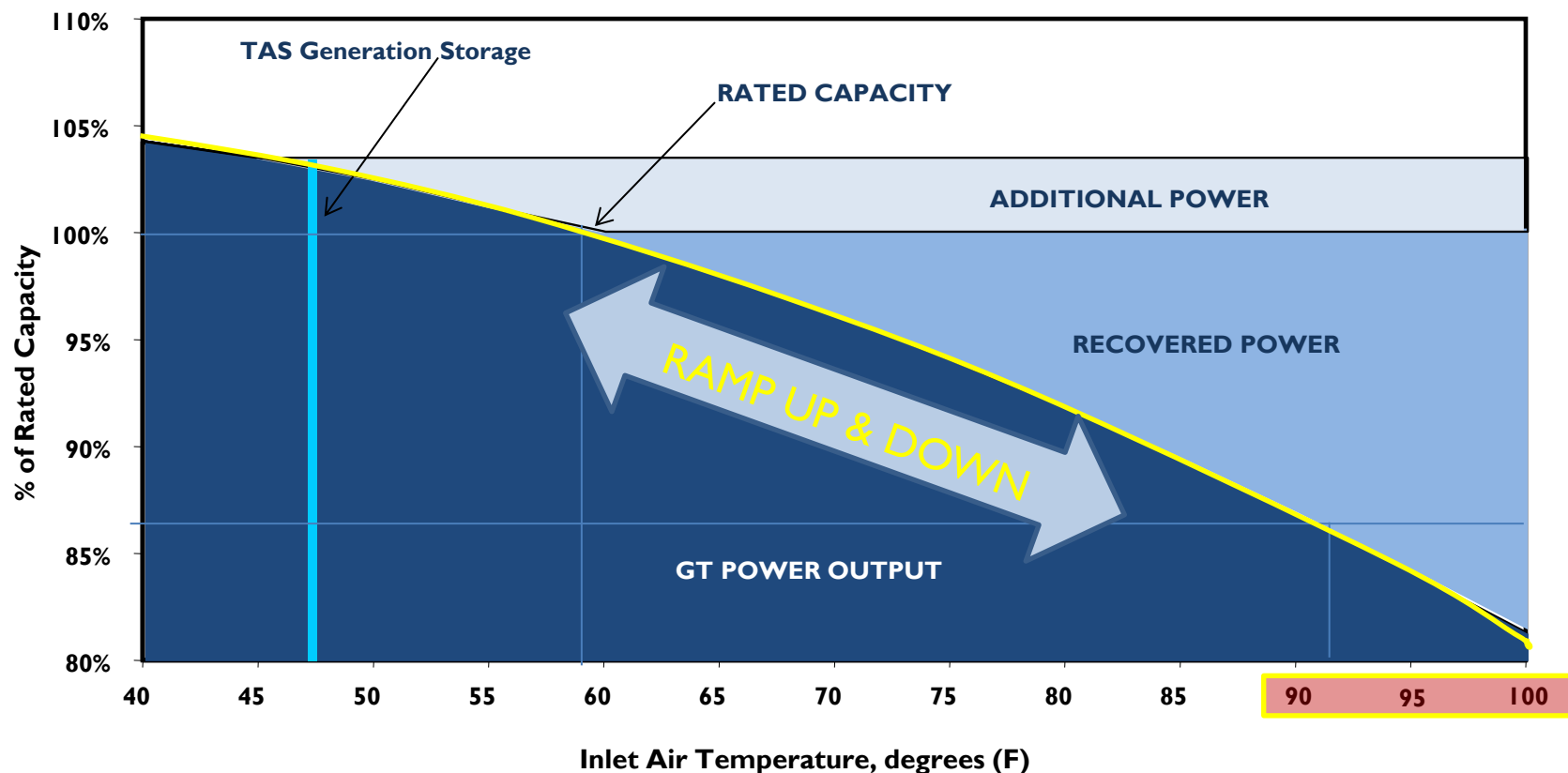
Technology Overview



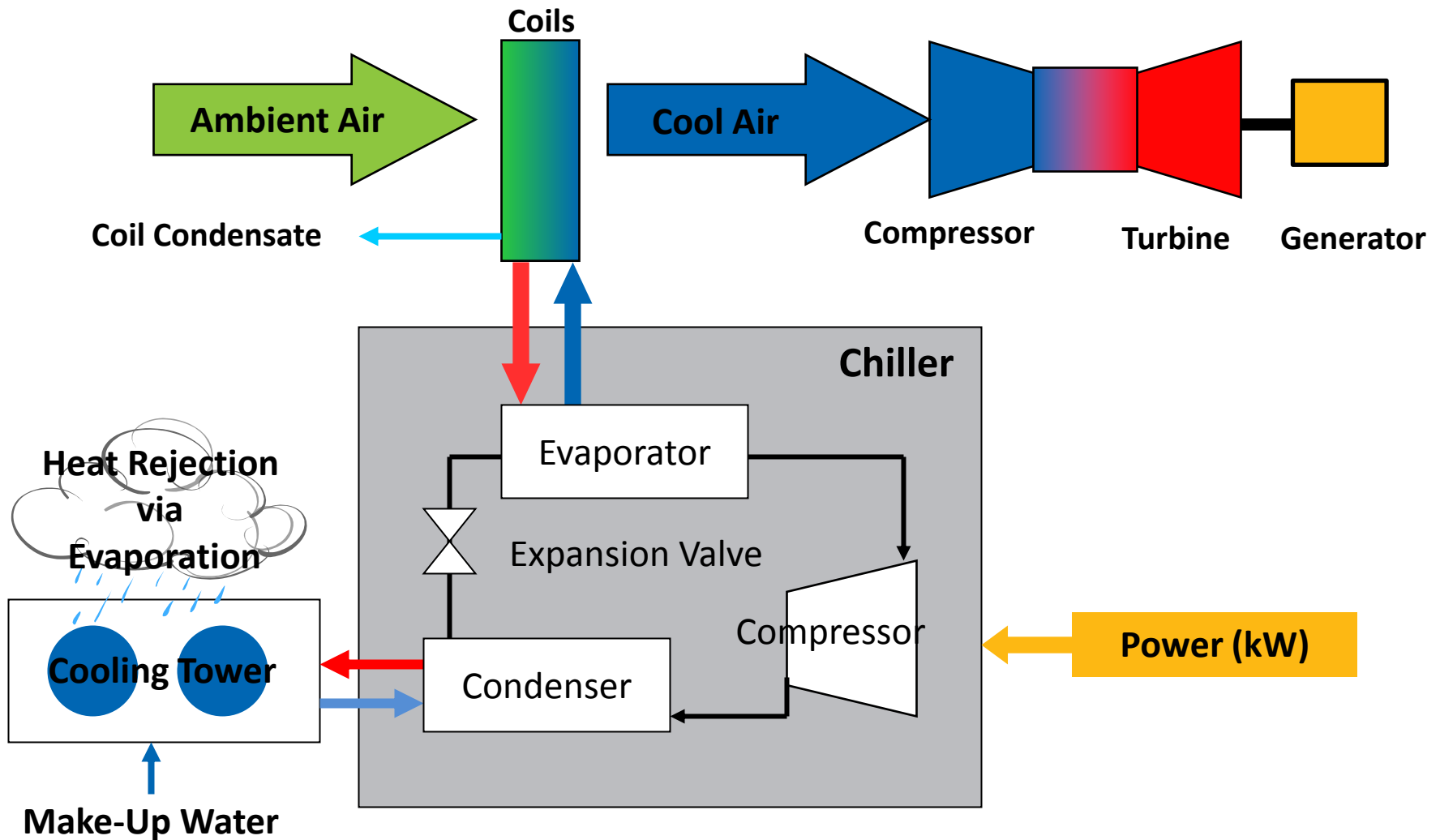
Turbine Inlet Chilling (TIC) & Generation Storage (GS)



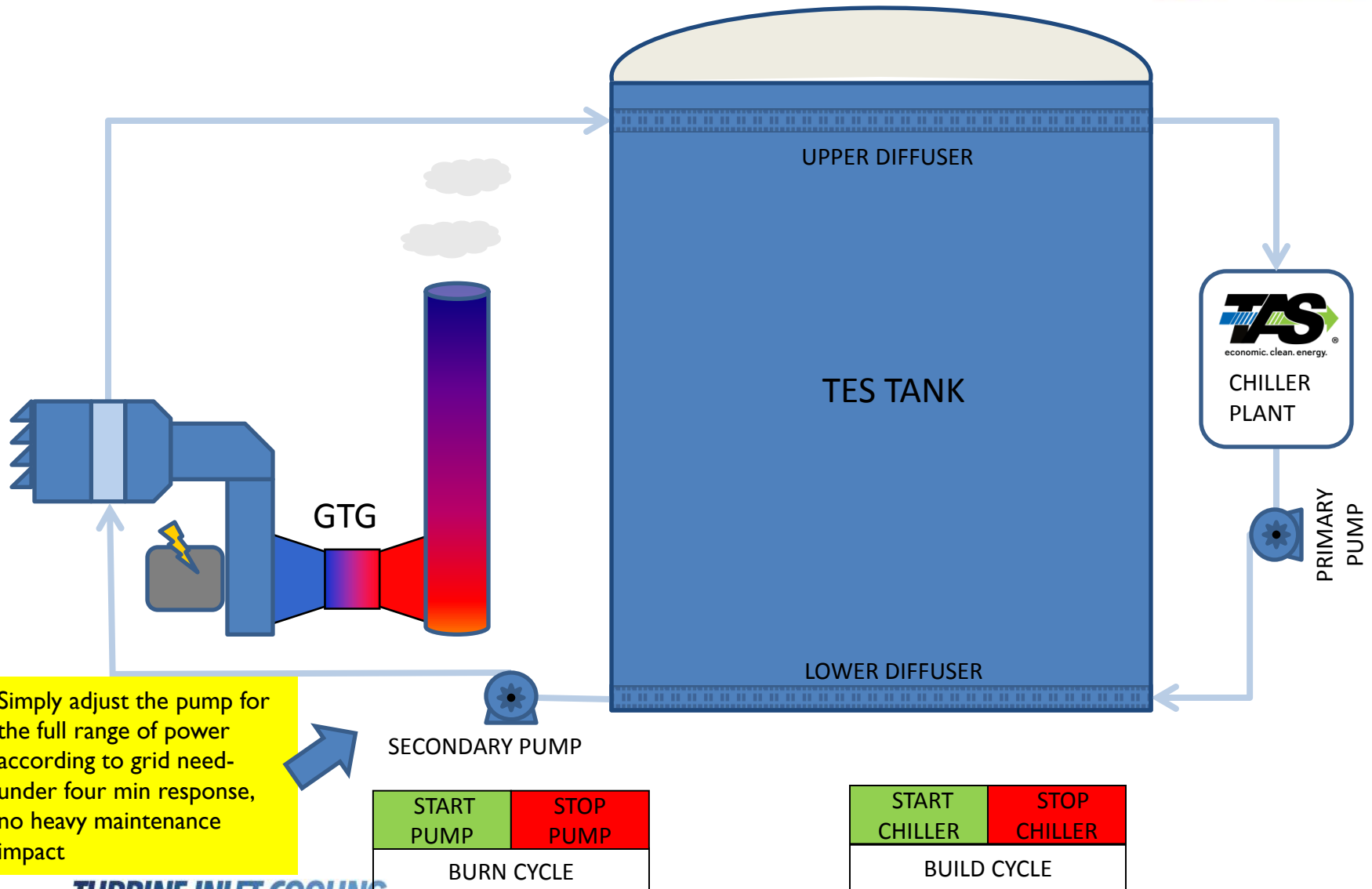
- Gas turbines only operate at 100% of their rated capacity when the temperature outside is 59°F.
- As temperatures climb into the 90's and beyond, greater than 10% of the capacity of the turbine disappears.
- By chilling below rated capacity and adding storage all lost power is recovered, and additional power is generated.
- Storage and ancillary services including ramping benefits are captured as well



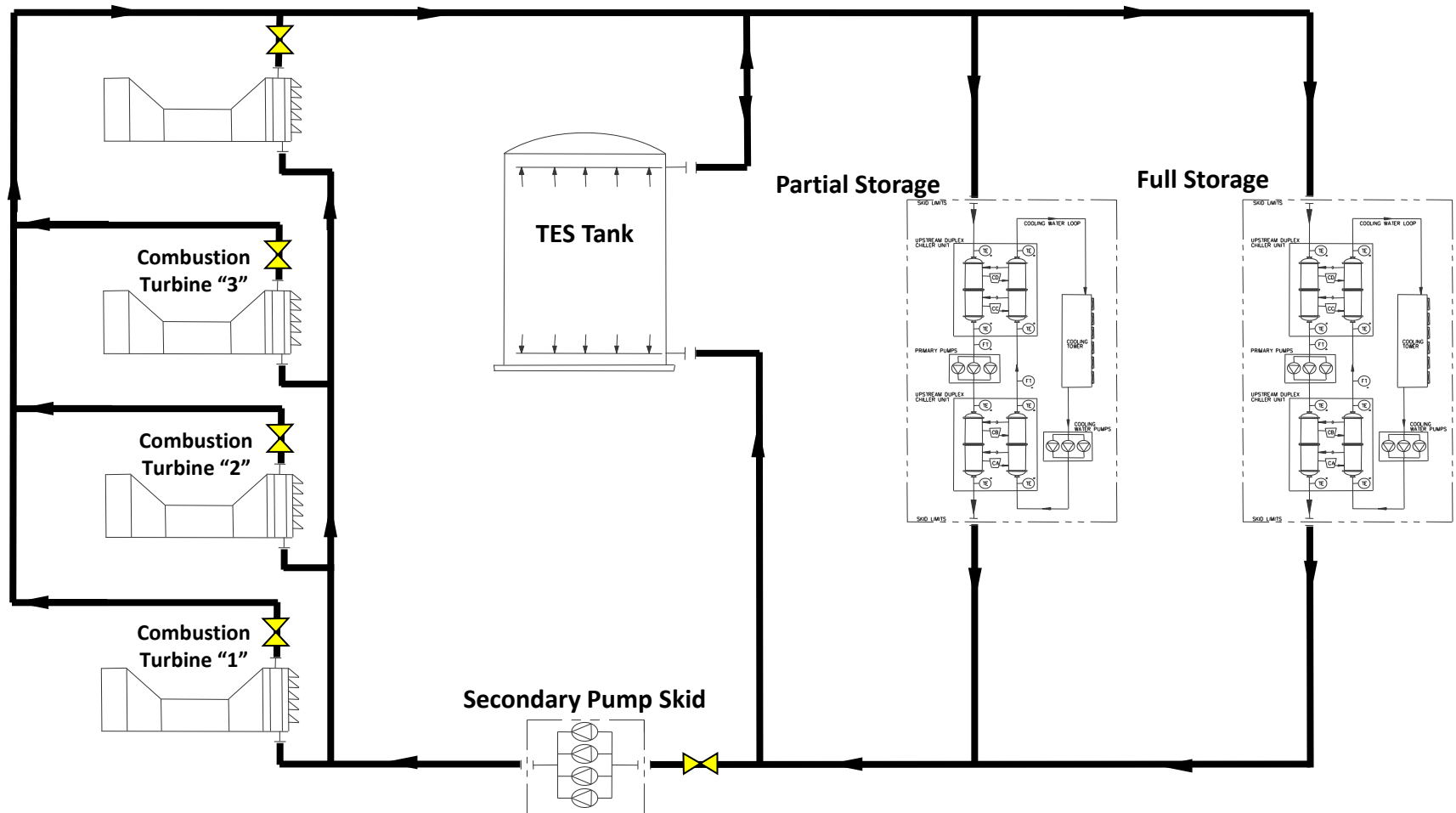
WATER-COOLED MECHANICAL



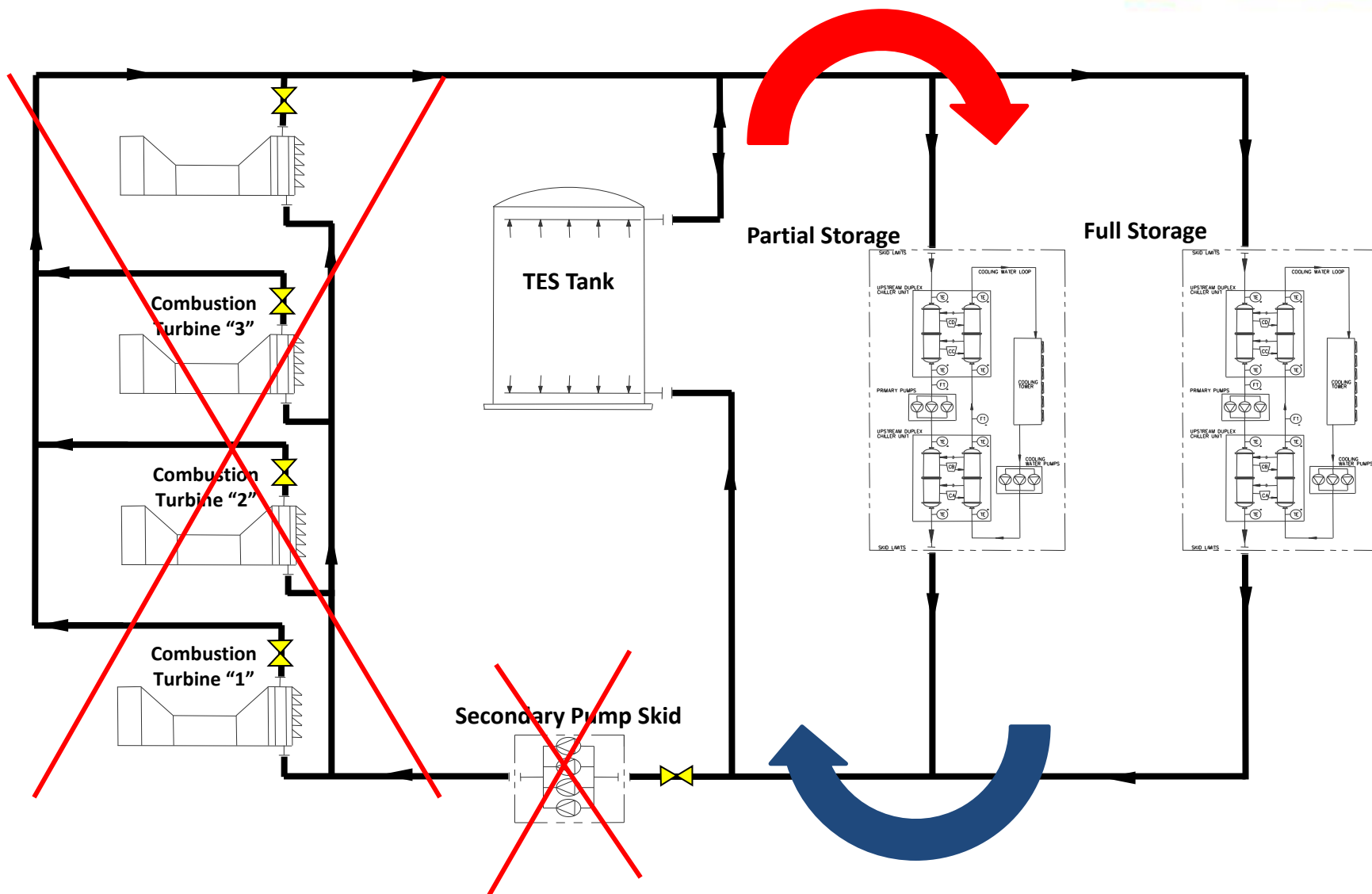
GS: More Than Just Capacity



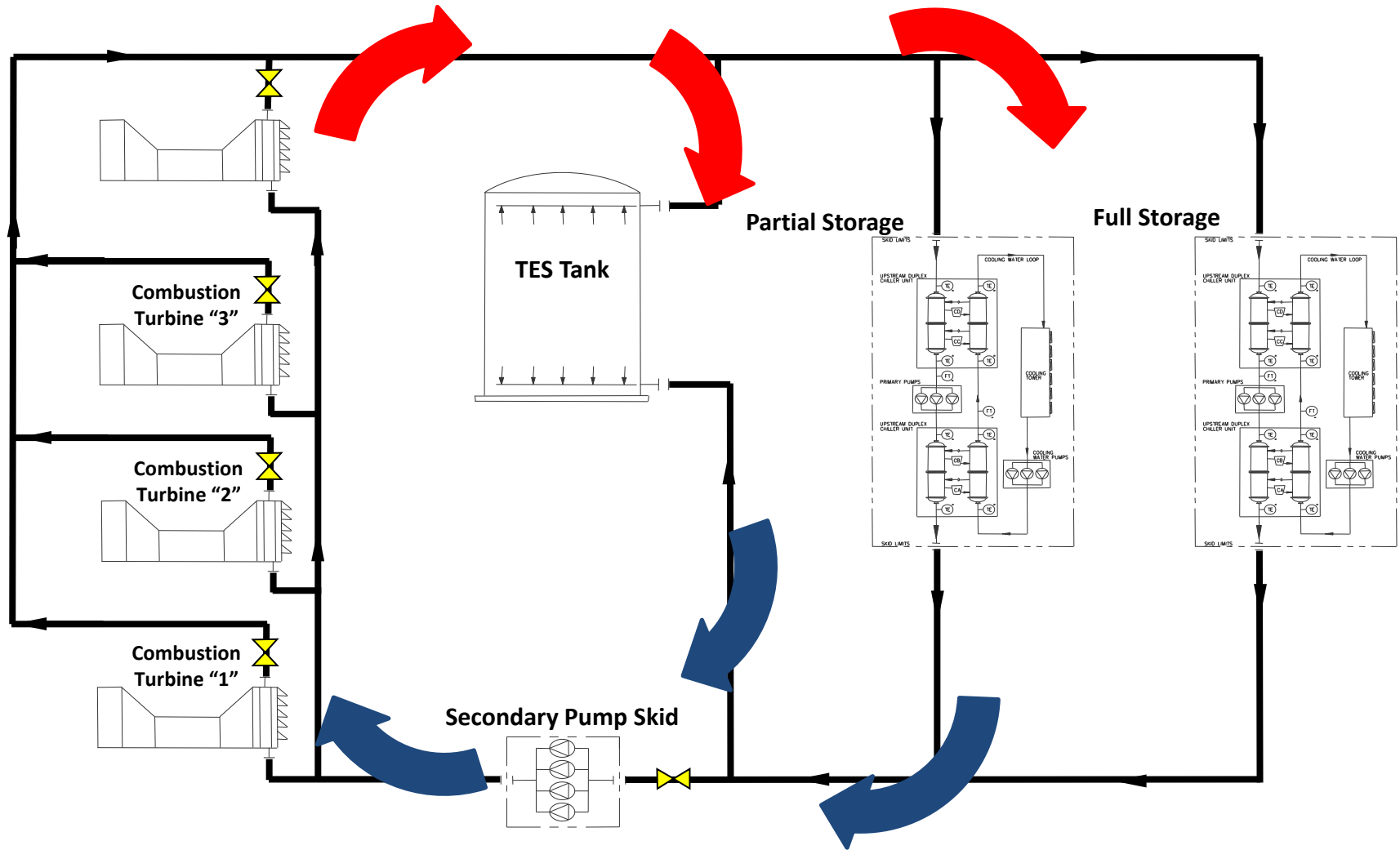
Generation Storage - PFD



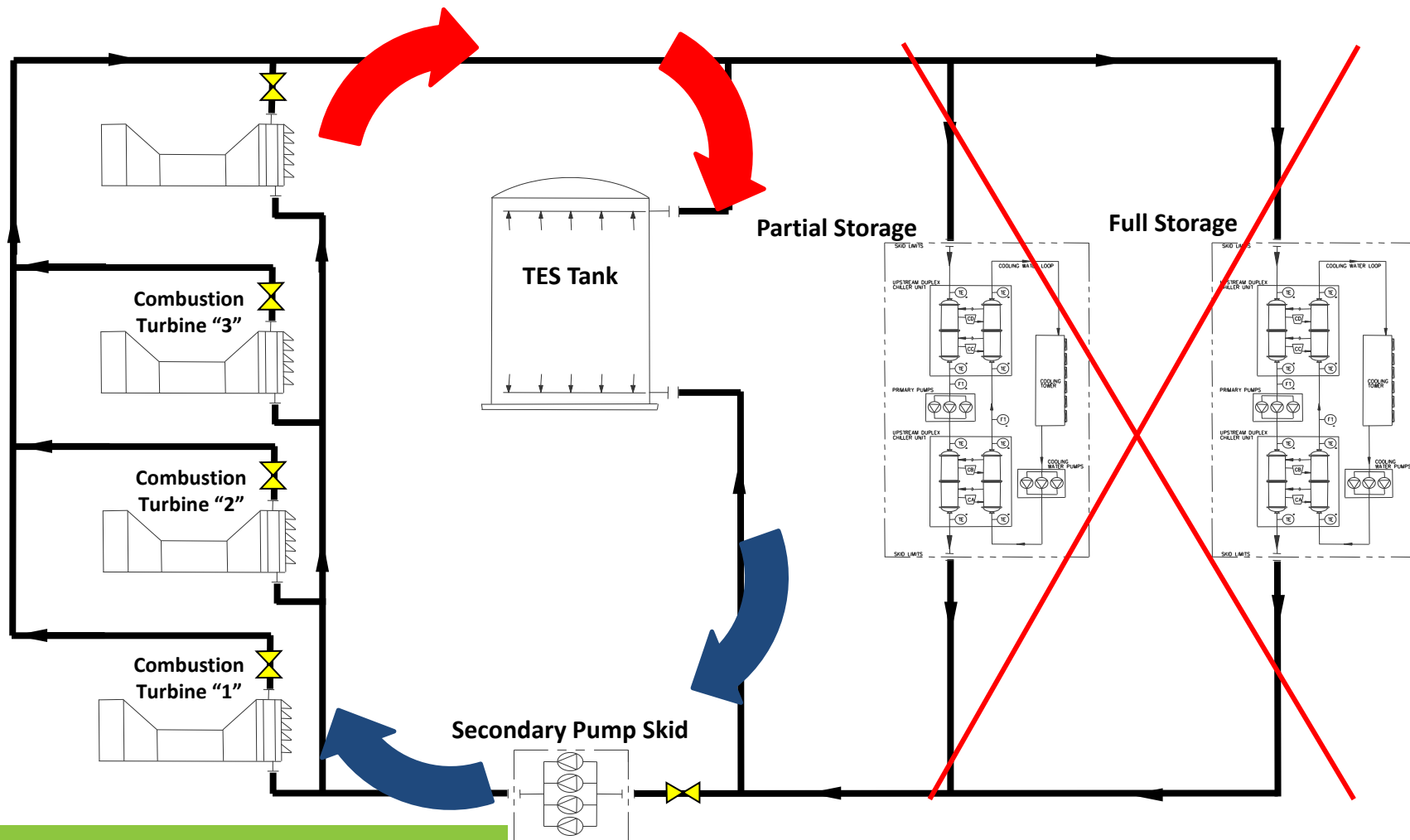
PFD – CHARGE 12/10/2



PFD – PARTIAL DISCHARGE 12/10/2

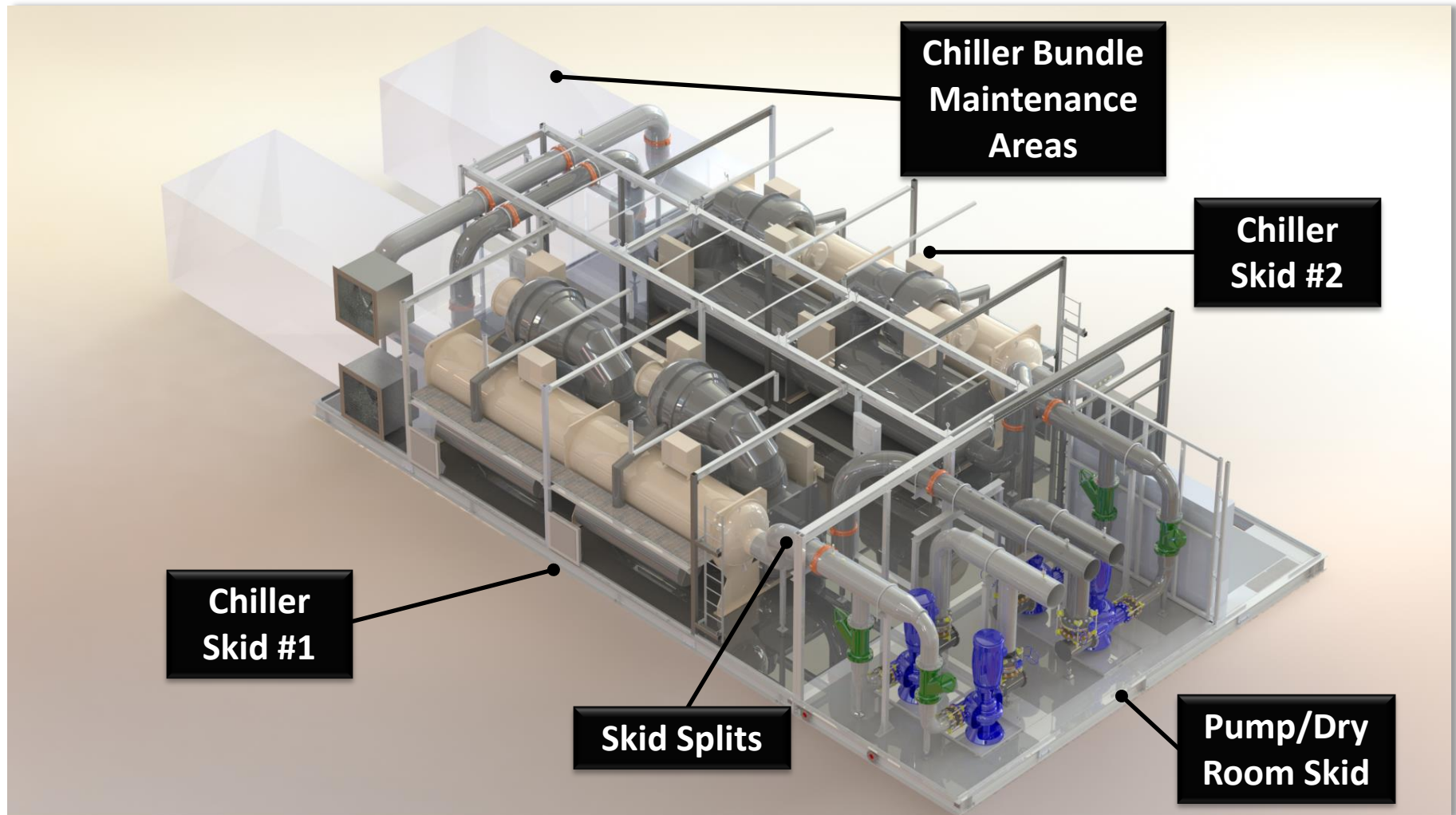


PFD – FULL DISCHARGE 12/10/2



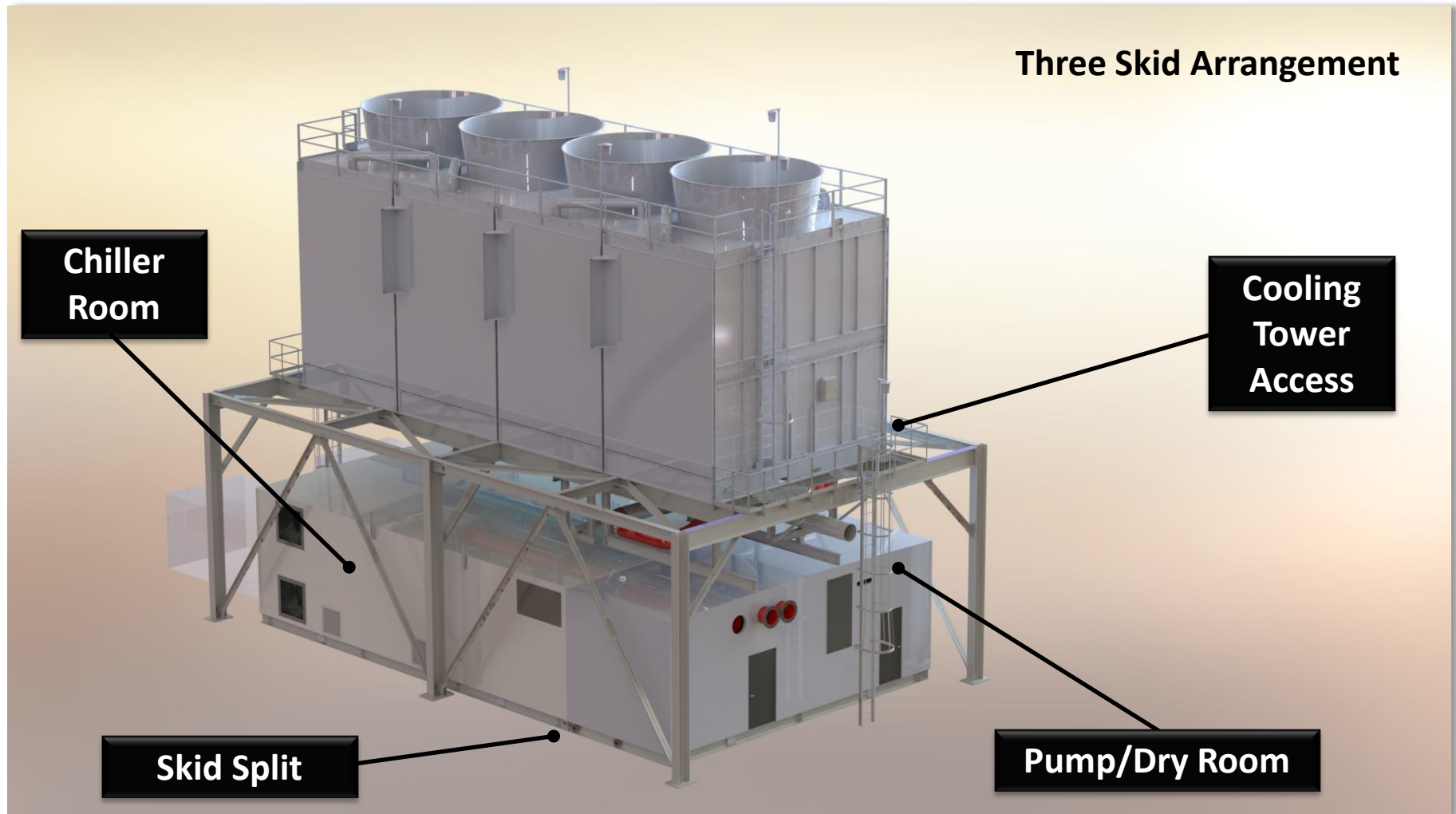
SuperPeak™

F-SKID FEATURES

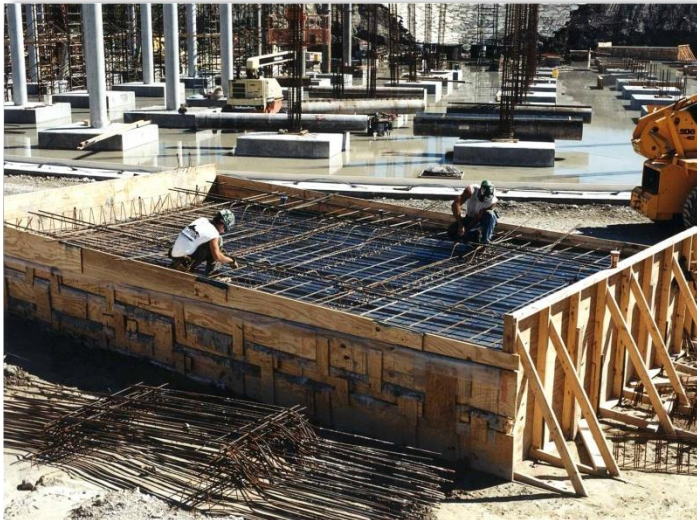


F-SKID FEATURES

Three Skid Arrangement



TES TANK CONSTRUCTION



TES TANK CONSTRUCTION



Pre-Stressing
Calibrated Wire Spacing

TES TANK INTERNALS



**Lower Diffuser
Manifold**

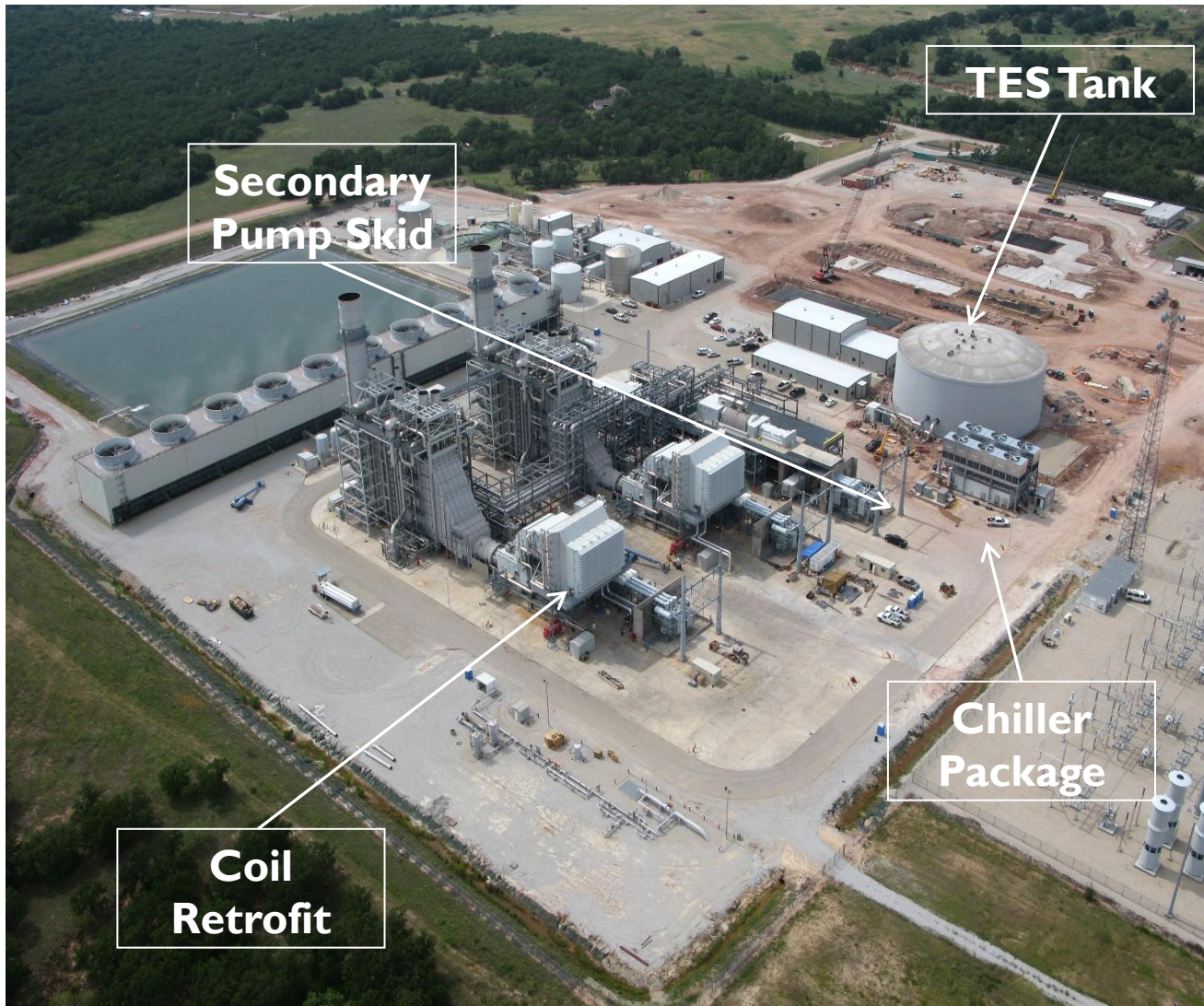


Diffuser Holes



**Upper Diffuser
Manifold**

TYPICAL LAYOUT



Texas Cooperative

- GE 7FA in CC (2 Blocks of 2x1)
- Two (2) F Packaged Chiller Systems
- One Thermal Energy Storage Tank
- Start-Up in 2010 (retrofit) & 2012 (new plant)

Retrofit
+
New EPC



Project Timing: 2008-2009 Outage Duration: ~15-30 Days Construction Man-Hours: ~50,000
Construction Duration: ~9 Months Project Timing: 2008-2009

Texas Cooperative

- Siemens 501FC in CC (1x1)
- One (1) Packaged Chiller Systems
- One Thermal Energy Storage Tank – 1.74 M gallons
- Start-Up in 2012

Retrofit



PROJECT PROFILE

Duke Power – Buck CC Plant

- GE 7FA in CC (2x1)
- Two (2) F Packaged Chiller Systems
- COD in 2011
- 48 MW increase



Duke Power – Dan River CC Plant

- GE 7FA in CC (2x1)
- Two (2) F Packaged Chiller Systems
- COD in 2012
- 53.4 MW increase



PROJECT PROFILE

Dominion – Fairless Energy

- GE 7FA in CC (2 blocks of 2x1)
- 2 TAS Packaged Chiller Systems
- 1 Thermal Energy Storage Tank
- Completed in 2008
- Filter House Retrofit for Inlet Coils

*Retrofit
(installation by others)*



TANK SIZE: 7.6 MG POWER INCREASE: 115 MW

Near Trenton, NJ

Dominion – Bear Garden

- GE 7FA Combined Cycle Plant (2x1)
- 1 TAS Packaged Chiller Systems
- 1 Thermal Energy Storage Tank
- Completed in 2011



TANK SIZE: 3.9 MG POWER INCREASE: 60 MW

Dominion – Warren County

- MHI 501G Combined Cycle Plant (3x1)
- 3 TAS Packaged Chiller Systems
- 1 Thermal Energy Storage Tank
- Start-Up in 2014



TANK SIZE: 8.9 MG POWER INCREASE: 107 MW EPC: Zachry/Burns & McDonnell

Dominion – Brunswick County

- MHI 501G Combined Cycle Plant (3x1)
- 4 TAS Packaged Chiller Systems
- 1 Thermal Energy Storage Tank
- Start-Up in 2016



TANK SIZE: 10.7 MG POWER INCREASE: 123 MW EPC: Fluor

Turbine Air Systems

Turbine Inlet Chilling (TIC) Generation Storage

Best Practices



WHAT IS THE DRIVER FOR ADDITIONAL CAPACITY?

- Do you need the added capacity 24 hours per day
- How many hours do you want highest output
- What are revenue considerations
 - How valuable is another 5-7 MW on top of system addition
- Will there be an expansion effort onsite in future
- Availability of water

AF COIL MODULE DESIGN



CONCENTRIC VS. ECCENTRIC

BEFORE



- Eccentric Inlet Duct
- Extended Inlet Duct for Fogging

AFTER

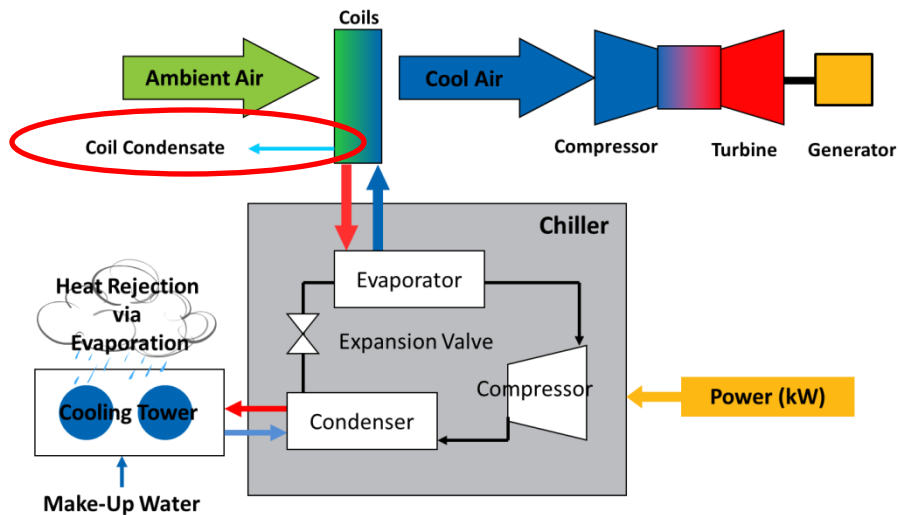


- Concentric Inlet Duct
- New Spacer Elevates Inlet Duct
- Existing Filter House Utilized

BEST PRACTICES

WINTERIZATION

- No Glycol
- Drainable coils
- Not required on the TES Tank



COIL CONDENSATE

- Good quality
- Water makeup flexibility

SERIES COUNTERFLOW: EFFICIENCY

- Ultra-low condenser water flow (1.5 gpm/ton)
- Ultra-low chill water flow (0.8 to 1.0 gpm/ton)

♦ Four compressors in series do more work than 4 compressors in parallel

♦ 8 Stages of Compression

Cooling Tower
Inlet Duct

101.6 °F
63.2 °F



2,500 tons + 2,500 tons = 5,820 tons!

Cooling Tower
Inlet Duct

83.0 °F
42.0 °F



Lower Parasitic Loads
Higher CHW delta T = smaller TES tank, Pumps

SUPER PEAK – 12/10/2 (charge, partial discharge, SuperPeak)

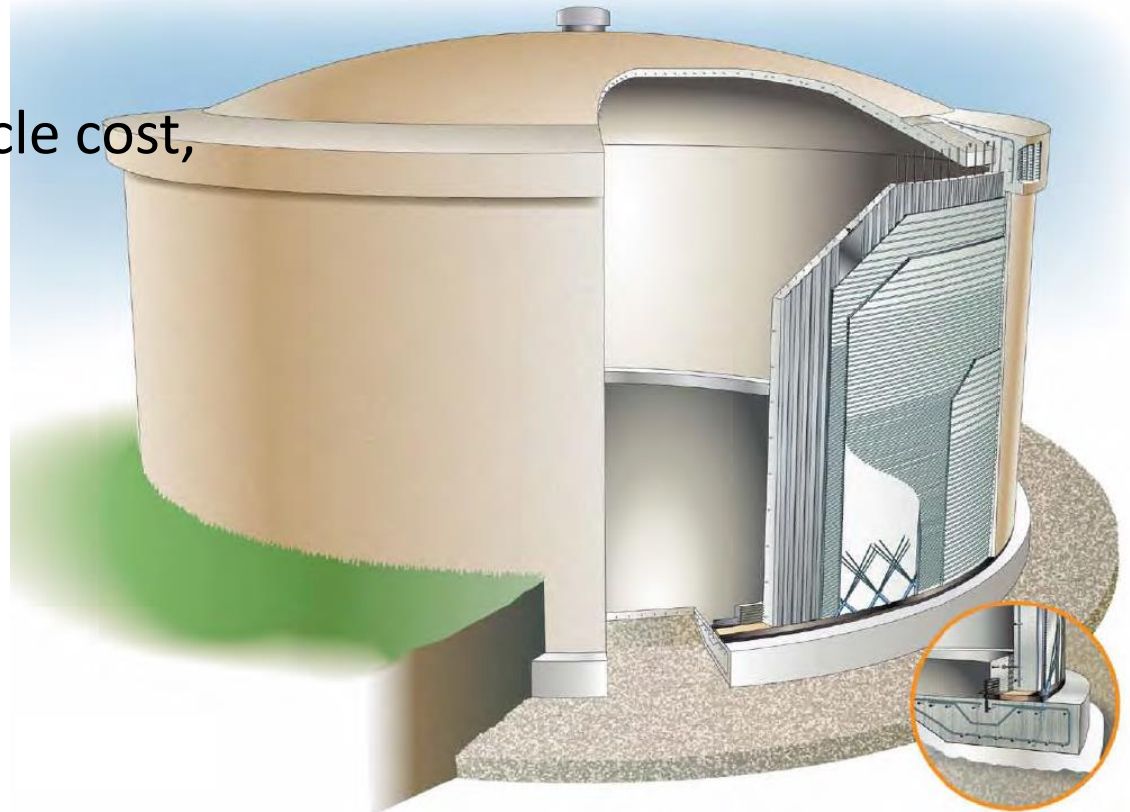
- Max benefit, lowest parasitics
- Larger Secondary Pump Skid, TES Tank flow rate

DESIGN CONDITION

- Design condition (95°F drybulb, 75°F wetbulb)
- 24 hour design DAY

TES TANK

- AWWA Standard D-110, Type III
- Water Tight
- Thermal performance
- Concrete – lower life cycle cost, no painting



Thank You!

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