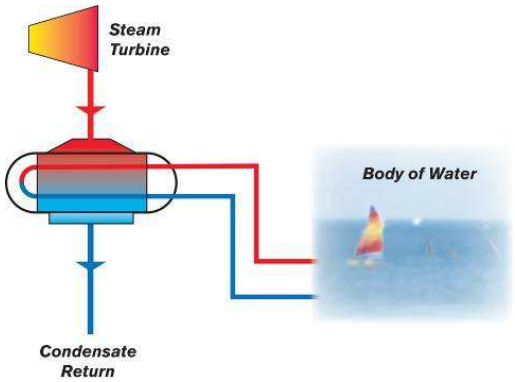
SPX COOLING TECHNOLOGIES

Cooling Options for Power Plants

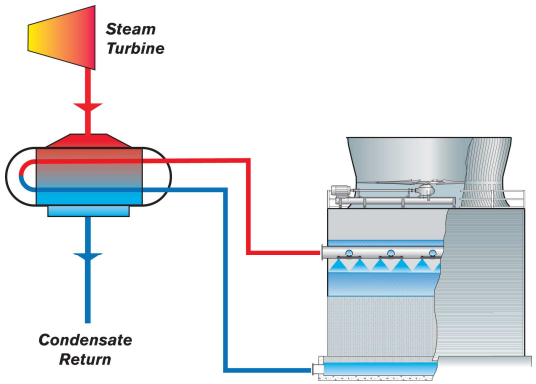
Cooling Options for Power Plants

SPX COOLING TECHNOLOGIES

Wet Cooling

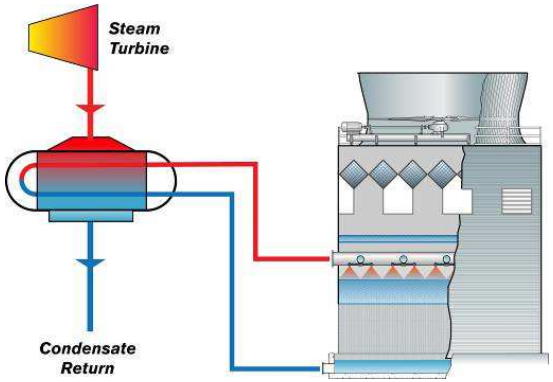


Once Through

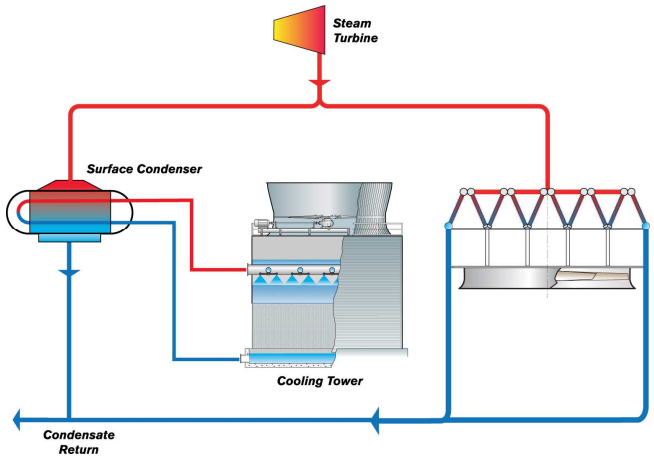


Evaporative Cooling Tower

Water Conservation

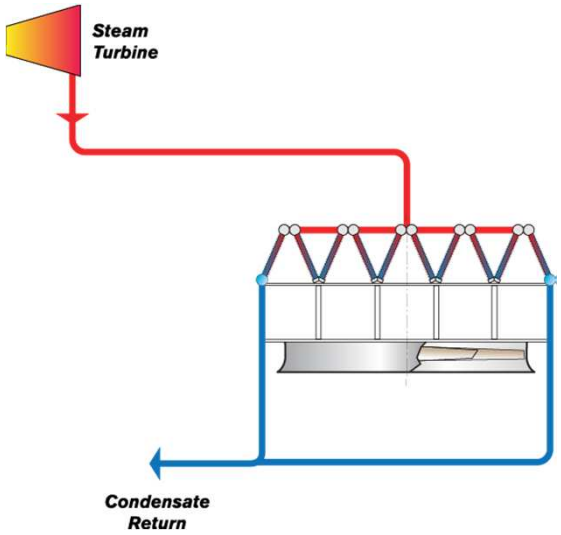


Wet-Dry Cooling Tower



Parallel Condensing

Dry Cooling



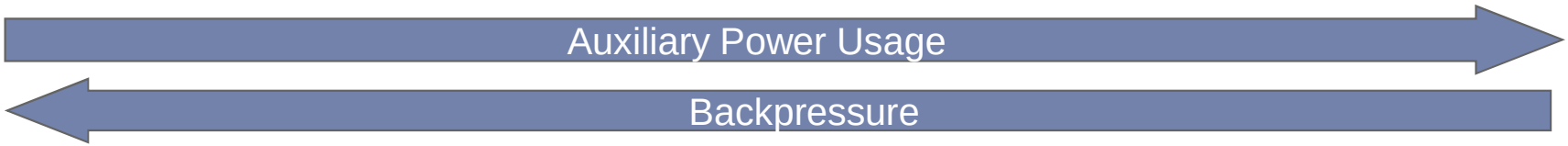
Air Cooled Condenser

Depending on site needs, there are a wide range of cooling solutions

Water Savings Options – Alternatives to Wet Evaporative

SPX COOLING TECHNOLOGIES

	All wet with high cycles of conc.	Wet/Dry Options		Parallel Condensing	Air Cooled Condensing
		Coil Type	ClearSky		
Estimated Water Savings	0-10%	10-30%+	10-30%+	30-90%*	100%
Other Pros and Cons	+ Relatively low up front costs + Highest power cycle efficiency + Lowest parasitic power + Smallest footprint - Most water usage	+ Plume abatement - No back-to-back layout - Higher pump head and fan power - Coil, damper and valve maintenance	+ Plume abatement + Matches wet cooling cycle efficiency + Matches wet pump head + Smaller footprint than dry or parallel - Higher fan power	+ Flexible water savings + Lower cost, power use, footprint vs dry + Retrofit is possible - Highest complexity - May still plume - Cost, power, footprint	+ No water or treatment costs - Highest backpressure - Highest upfront cost - Largest footprint - Lowest cycle efficiency - Cannot be retrofit



Different options require different amounts of water

*** Parallel condensing theoretically can reach any water savings required between 0-100%**

Water Losses in a Evaporative Cooling Tower

SPX COOLING TECHNOLOGIES

- Evaporation – ~1% of the flow rate per 10˚ F range
- Blowdown - Portion of circulating water purged to control cycles of concentration
- Drift - Drops entrained in exhaust air, approx 0.001% of flow
- Makeup – Water required to replace system losses

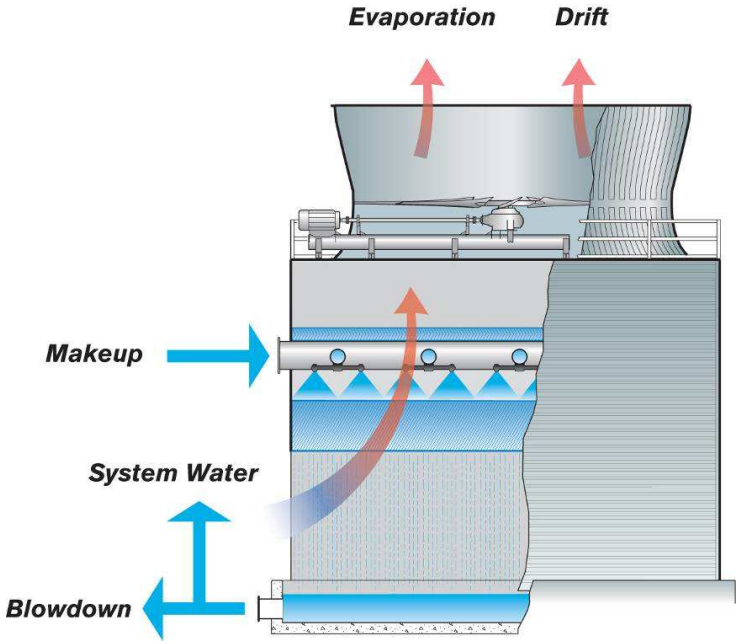
Example, 800 mW CC Plant*

3,520 gpm

1,170 gpm

2 gpm

4,692 gpm

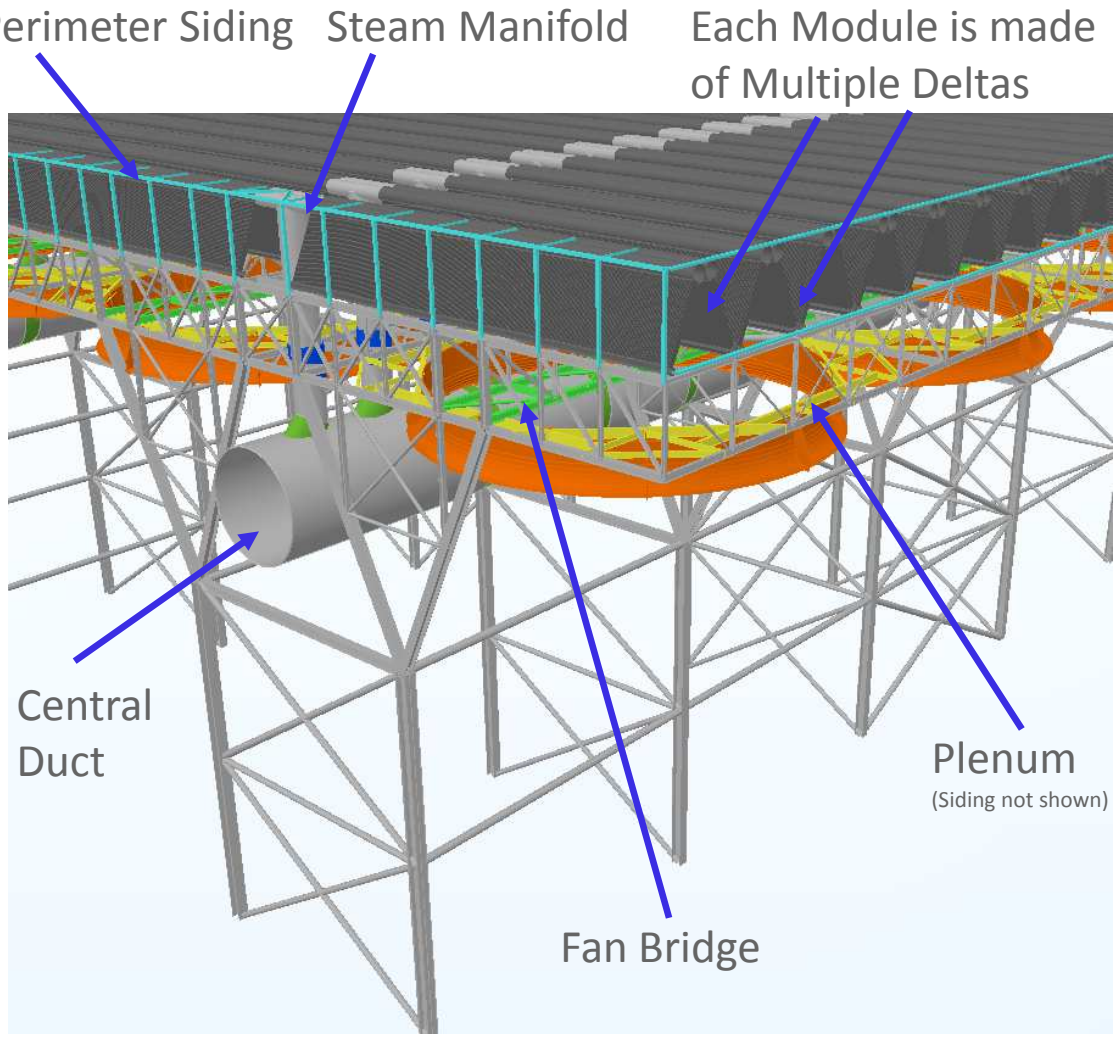


Making up ~ 6.7 MGD ~ 2.7% of circulating rate of 253 MGD

* 1/3 steam condensing: 176,000 gpm circulating with 20ºF range, 4 cycles of concentration

Makeup water = Evaporation + Drift + Blowdown

ModuleAir™ ACC



- Modularization of Components
- Shop assembled bundles including steam manifold and condensate headers
- Site welding reduced
- Integrated Structures
  Fan bridge/plenum/bundle
- Shop assembled steel trusses
  Sized for container transport
- Reduced field-assembly hours

Modular concept featuring SRC® fin tube technology

EPA 316(b) Final Ruling – Key Provisions

SPX COOLING TECHNOLOGIES

- An estimated 1,065 facilities are impacted by impingement standards (> 2 MGD water usage)
- Best Technology Available (BTA) required as determined by EPA Director on a case-by-case basis.
- Facilities with >125 MGD withdrawal must conduct Entrainment Characterization Study
- New units at existing facilities must either:
  1. Reduce actual intake flow to that commensurate with closed cycle systems
  2. Design intake screen systems to achieve > 90% of entrainment reduction of closed cycle systems
- Existing facilities must comply as NPDES permits are renewed:
  - If > NPDES renewal is >42 months from date of final ruling, full compliance is required.
  - If < 42 months to renewal date, interim BTA requirement to apply based on Director's Best Professional Judgement.

Information Source: EPA Fact Sheet 821-F-14-001 May 2014

Final Ruling Issued in May, 2014

Conclusion

SPX COOLING TECHNOLOGIES

Questions?

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Counterflow Cooling Tower

SPX COOLING TECHNOLOGIES

Evaporative, back-to-back configuration

Wet Dry Cooling Towers

SPX COOLING TECHNOLOGIES

Counterflow Wet Dry Cooling Tower

Air Cooled Condensers

SPX COOLING TECHNOLOGIES

ACC design minimizes water usage