

Spray Cooling for Performance Enhancement of Air-Cooled Condensers

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Alternative Solutions

- ⊕ Hybrid wet-dry systems
 - Commonly used for plume abatement
 - Several design options
- ⊕ Spray-enhanced dry cooling
 - Technology adaptation from gas turbine units



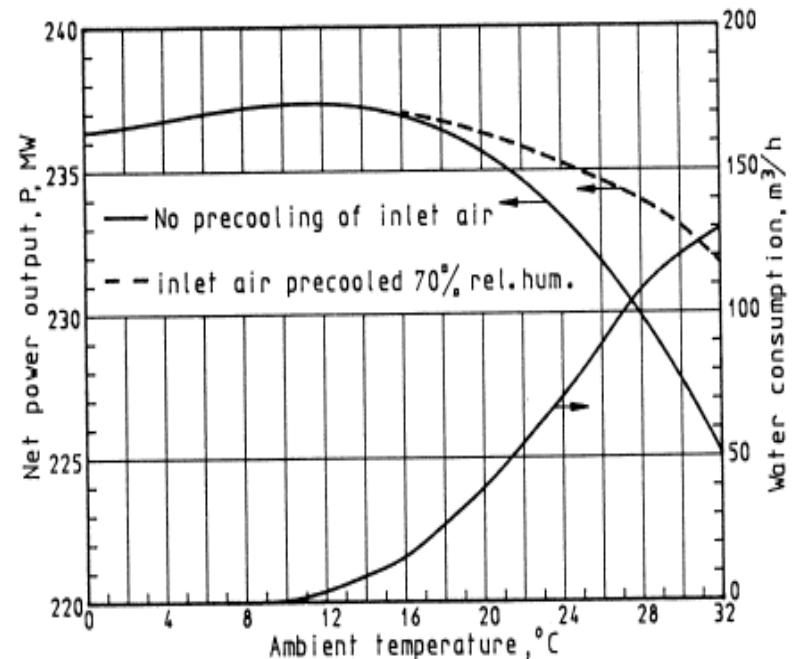
Spray-Enhanced Dry Cooling

- ✦ In gas turbines, inlet air cooling racks used to enhance efficiency
 - Pre-cooling spray nozzles introduce fine mist
- ✦ In dry cooling systems, approach could be applied to pre-cool inlet air
 - Reduce capacity loss
 - Water use intermittent; rate ~25% full wet cooling



Spray-Enhanced Dry Cooling

- Without pre-cooling, ambient T increase from $\sim 55^{\circ}$ to 90°F reduces capacity
 - For 235-MW unit, lose 10 to 12 MW ($\sim 5\%$)
- If air pre-cooled to 70% relative humidity, capacity loss reduced
 - For 235-MW unit, lose only 3 to 5 MW



Chinese Camp



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PLEASE USE THE PHONE ON YOUR LEFT FOR INSTRUCTIONS
SPEED LIMIT THROUGH THE GATE IS 5 MPH

ACC at Chinese Camp



Sprays in operation




Mist entering fan



Spray Enhancement



The logo consists of two curved, reddish-brown lines that sweep upwards from the center and then downwards, creating a shape reminiscent of a stylized eye or a pair of wings.

Crockett Cogeneration

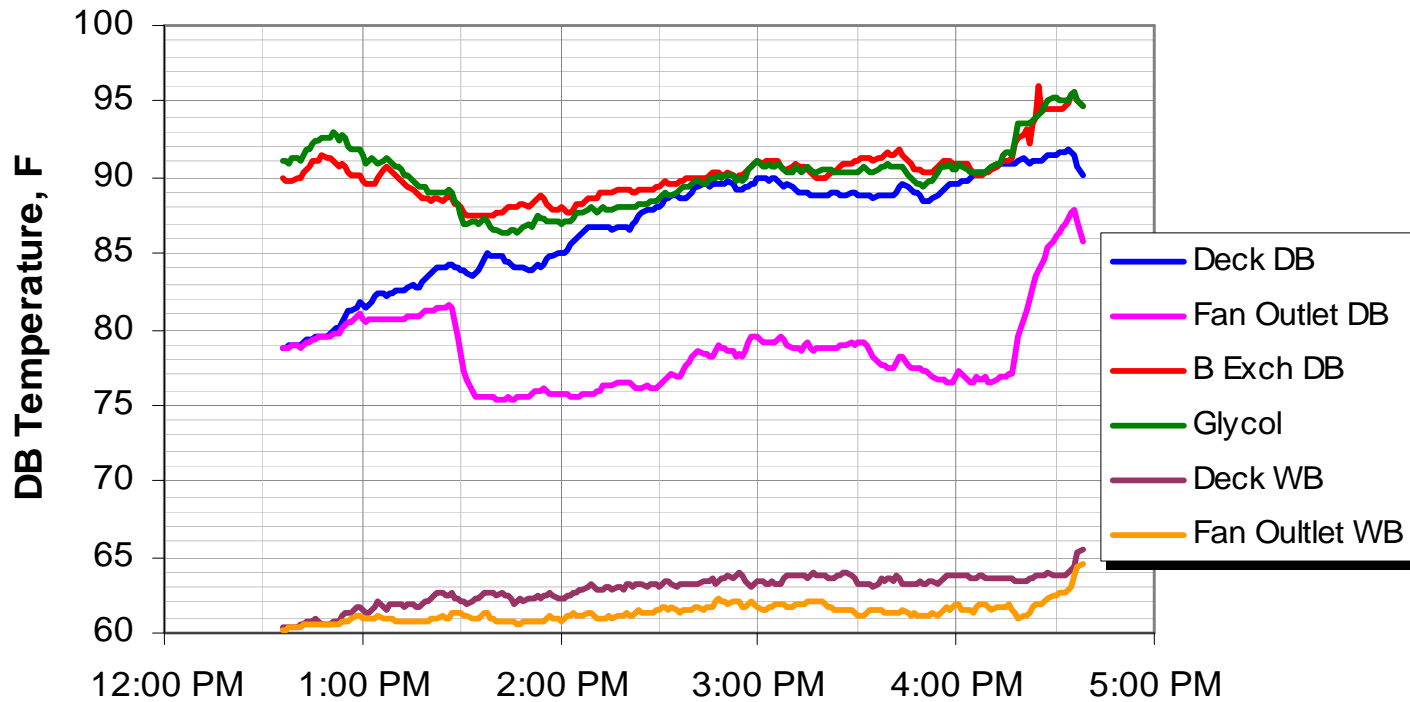
550 LORING AVENUE

Spray Enhancement Test Setup

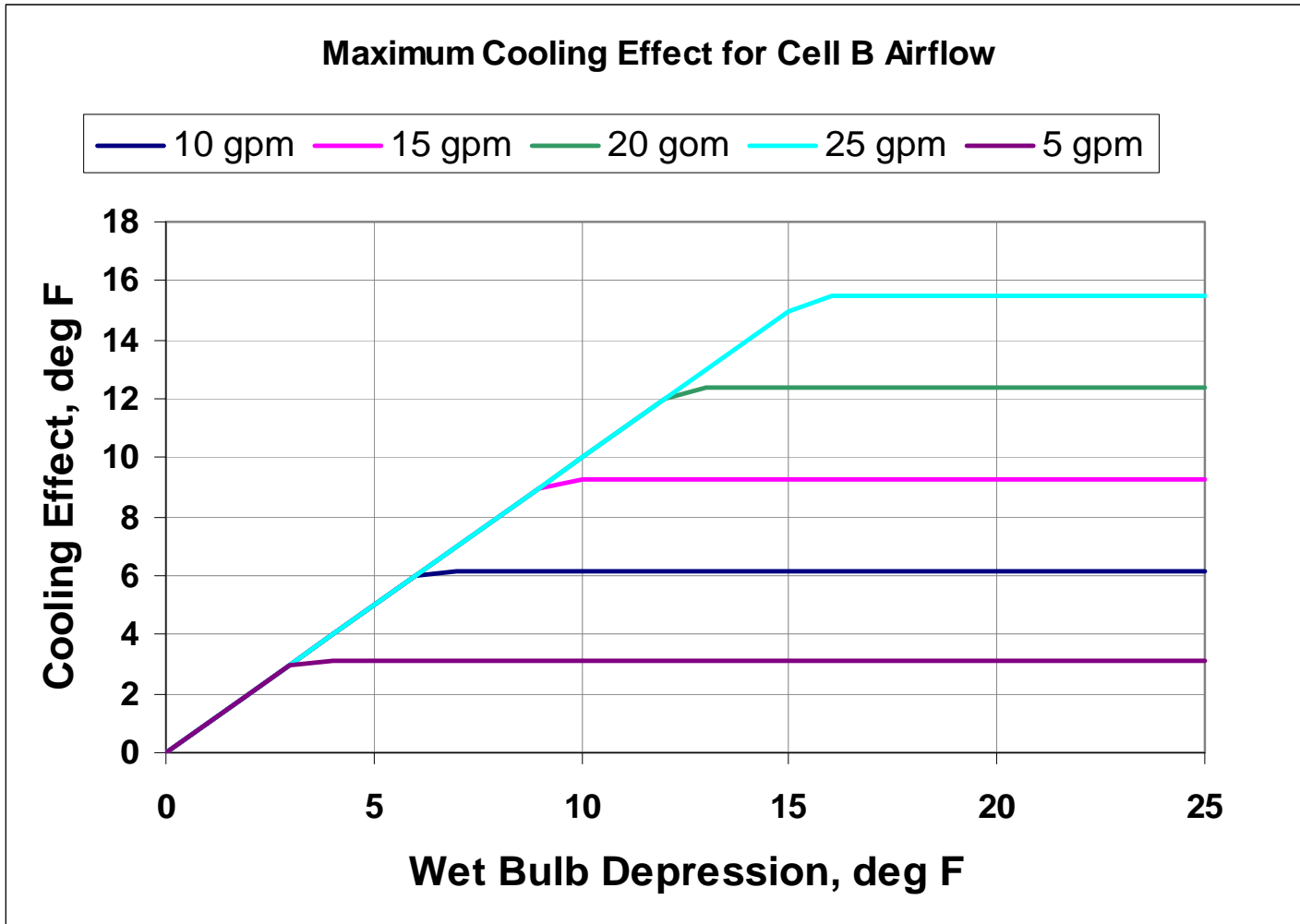


Hot Day Performance

Average DB Temperature Profiles
Crockett Single-Cell Spray Testing



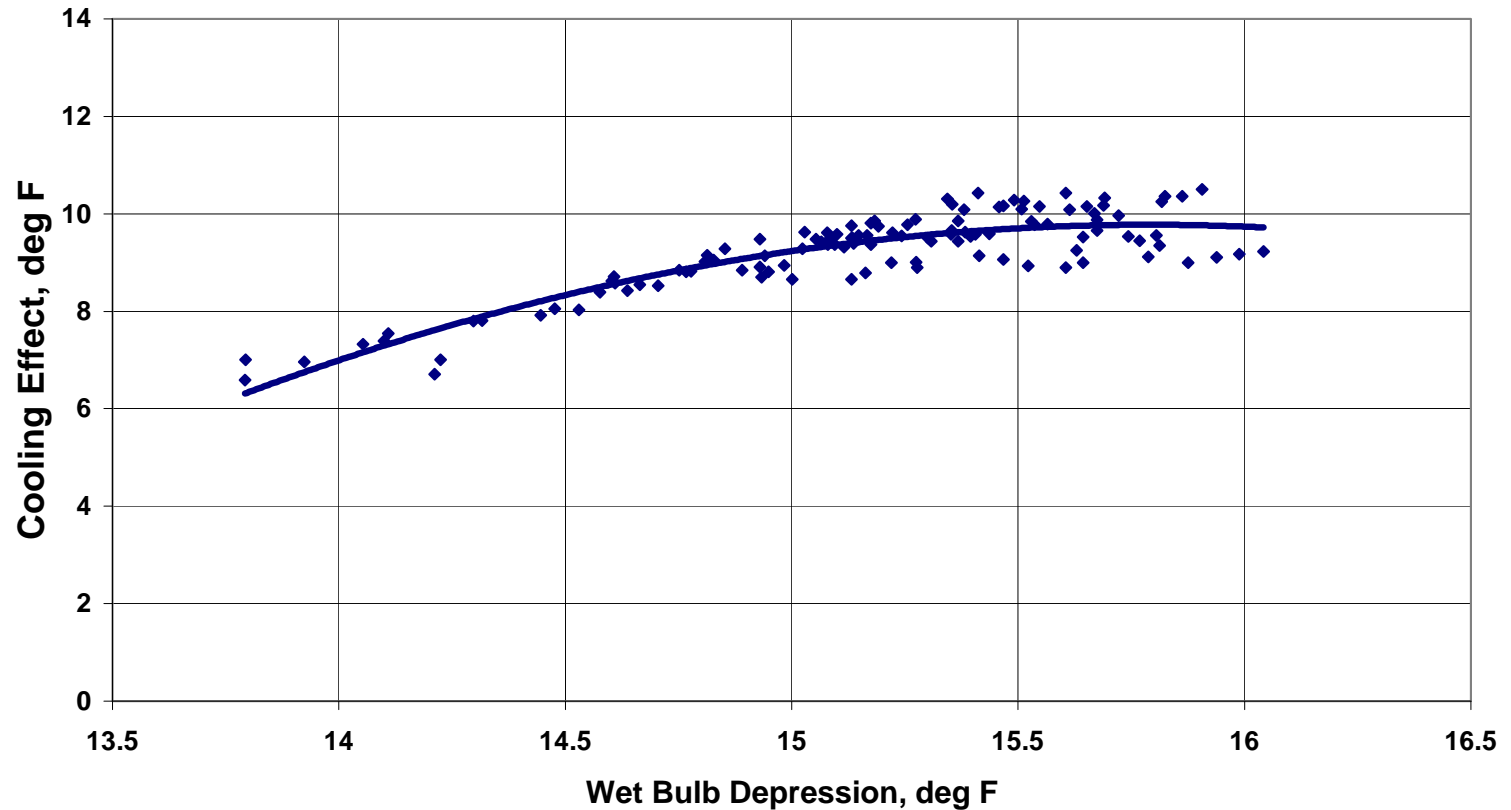
Maximum Cooling Effect



Cooling Effect Results

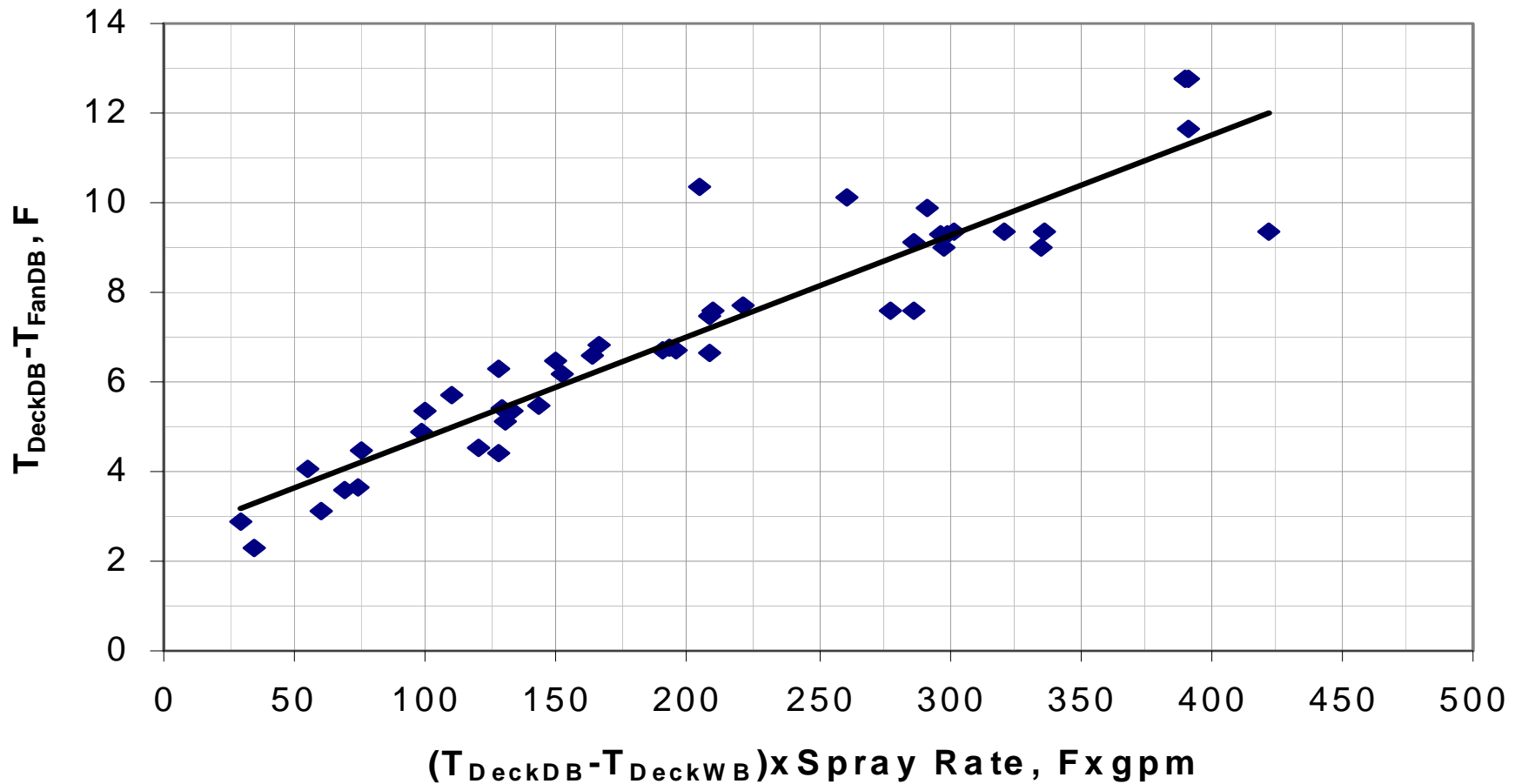
Cooling Effect vs. Wet Bulb Depression

◆ Spray rate = 19 gpm



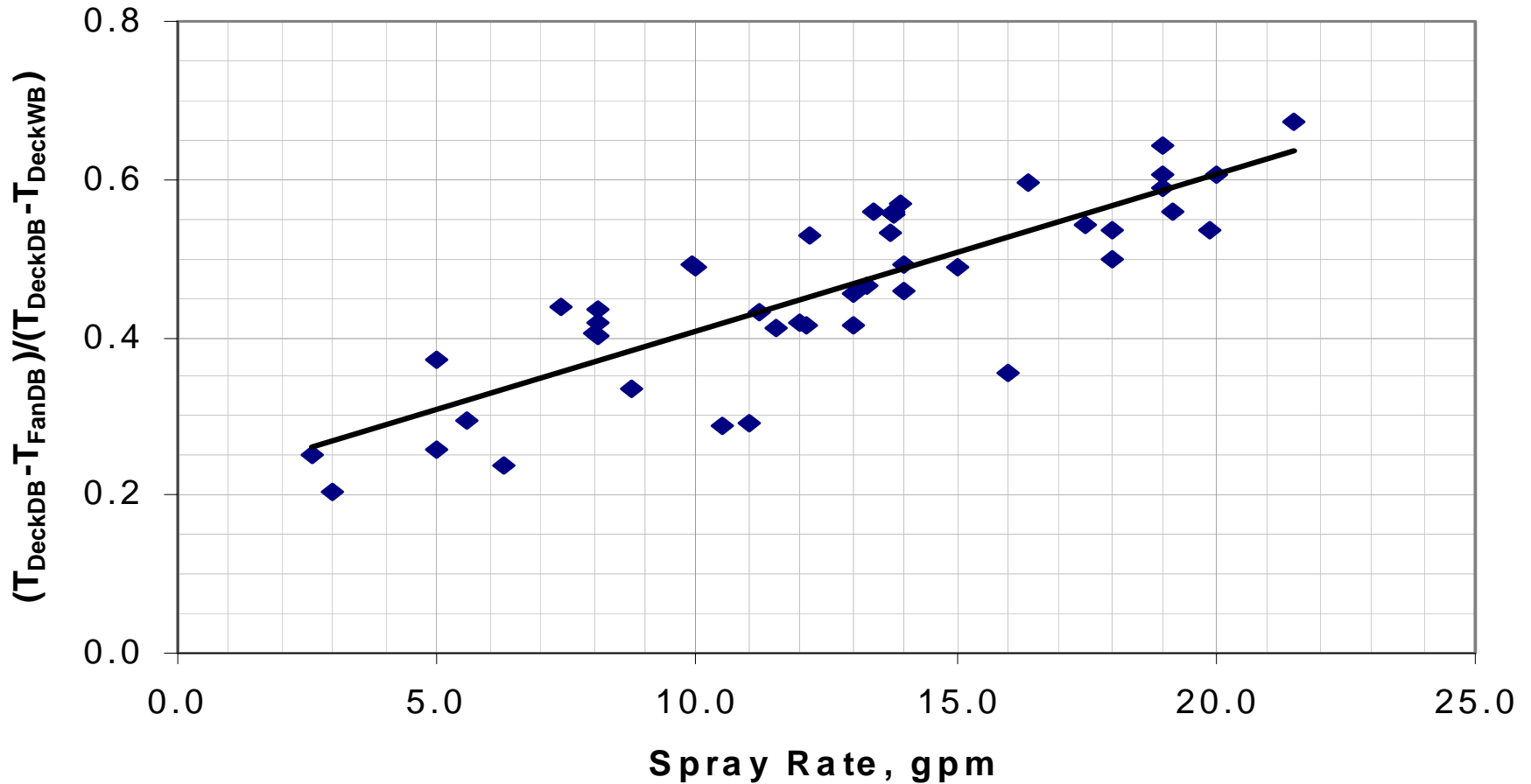
Data Correlation

$T_{DeckDB} - T_{FanDB}$ VS $(T_{DeckDB} - T_{DeckWB}) \times \text{Spray Rate}$
Single-Cell Testing, Crockett



Correlation vs. Spray Rate

$(T_{\text{DeckDB}} - T_{\text{FanDB}}) / (T_{\text{DeckDB}} - T_{\text{DeckWB}})$ vs Spray Rate
Single-Cell Testing, Crockett



El Dorado Energy Center



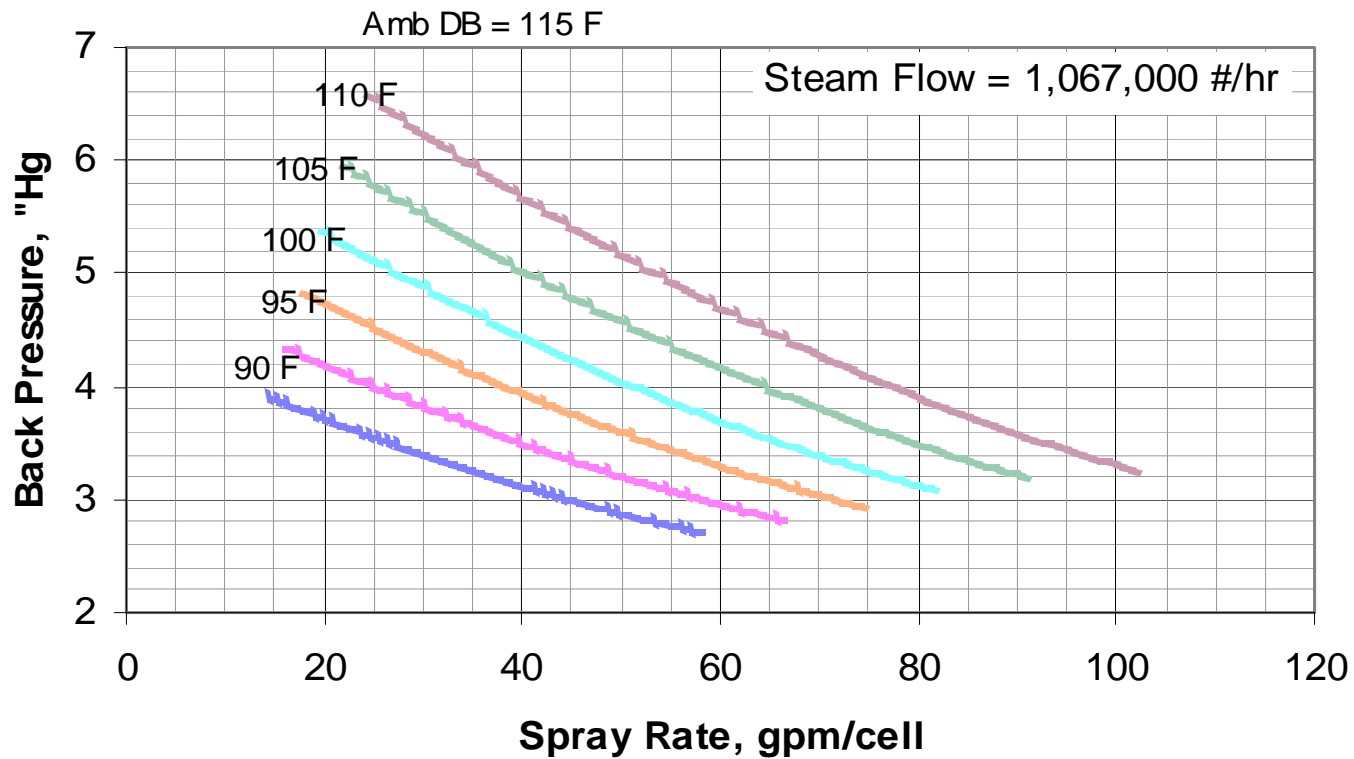
El Dorado ACC



Effect on Backpressure

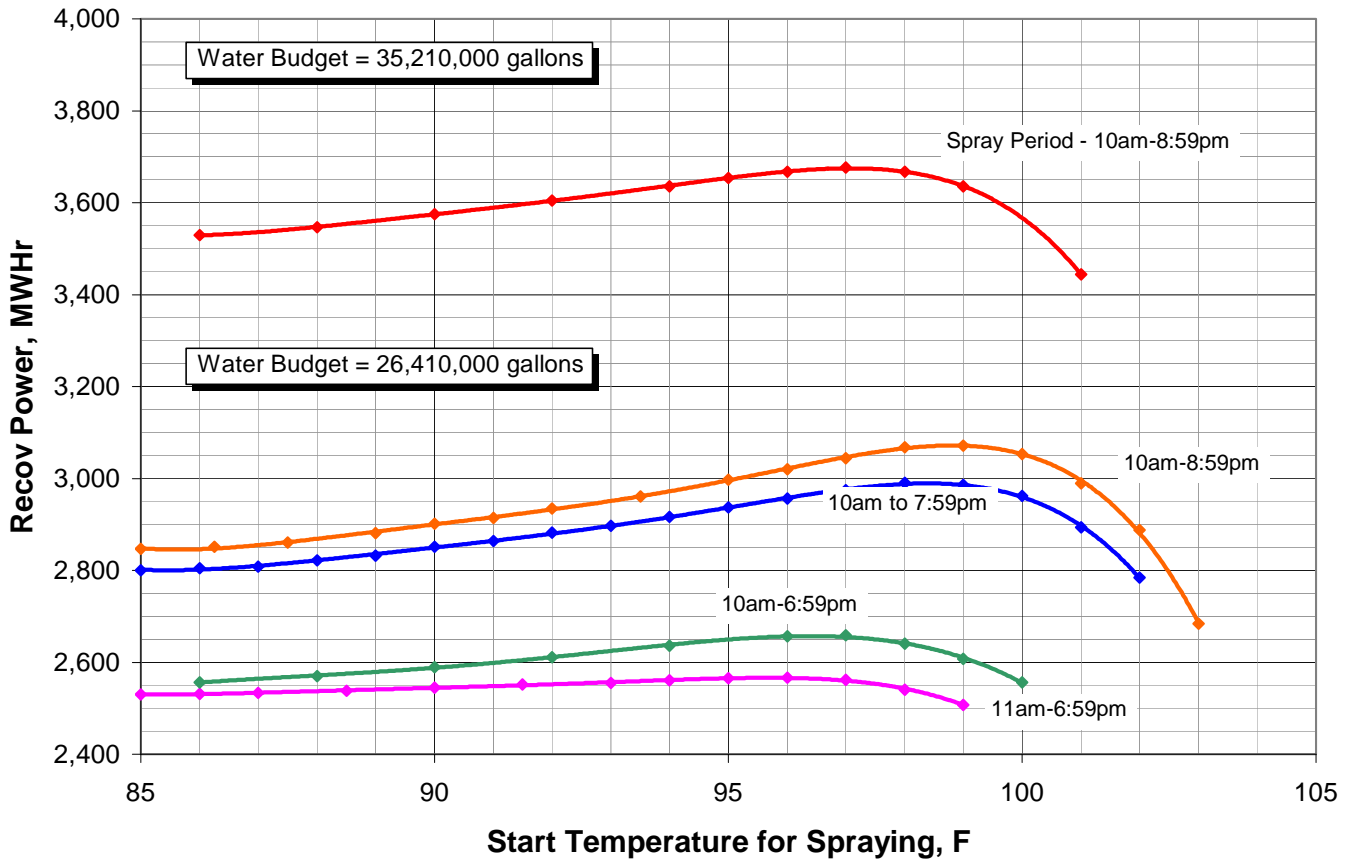
Turbine Back Pressure vs Spray Rate - July

EIDorado LLC



Power Recovery

Recovered Power vs Start Temp vs Spray Period



Now What?

⊕ Showstoppers

- Surface wetting
- Rainback
- Cost (Approx \$0.5 M for 40 cell, plus \$0.7 M to 2.0M for water treatment and storage)

⊕ Approaches

- Nozzle choice/location
- Flow modeling
- Demisters