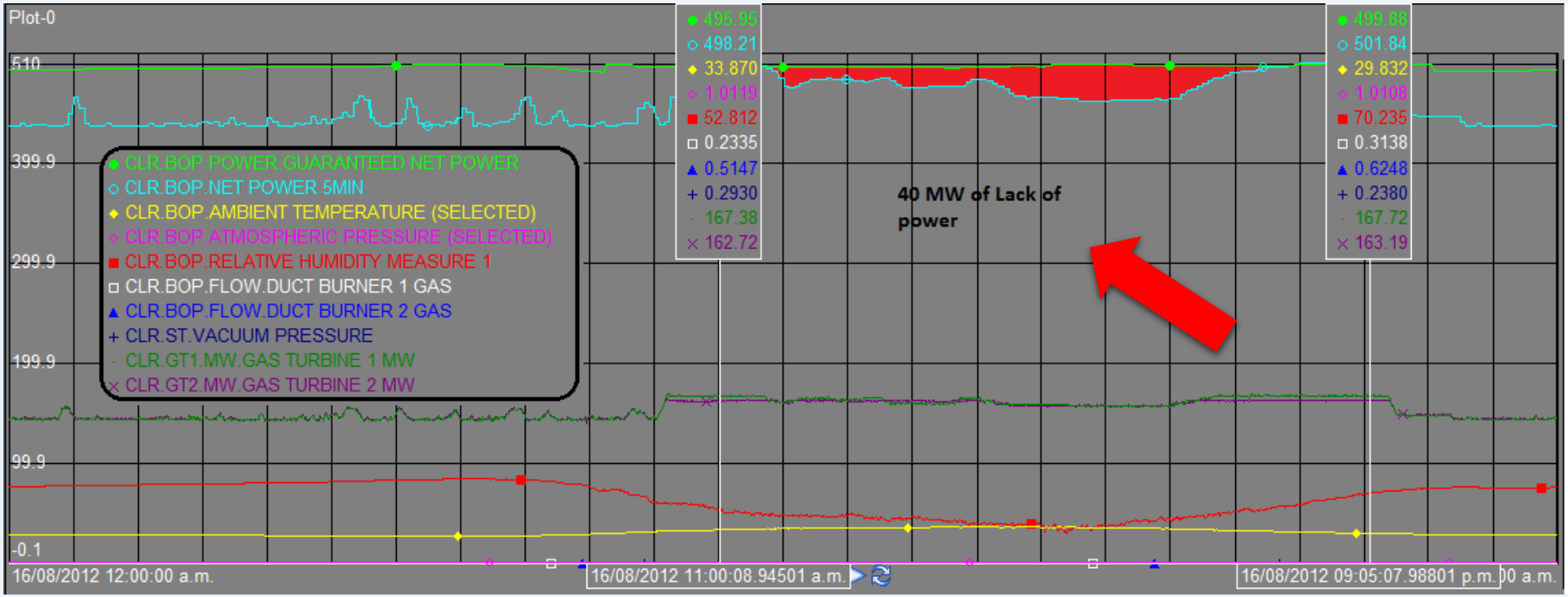
General ACC Improvement Considerations

CONTENT

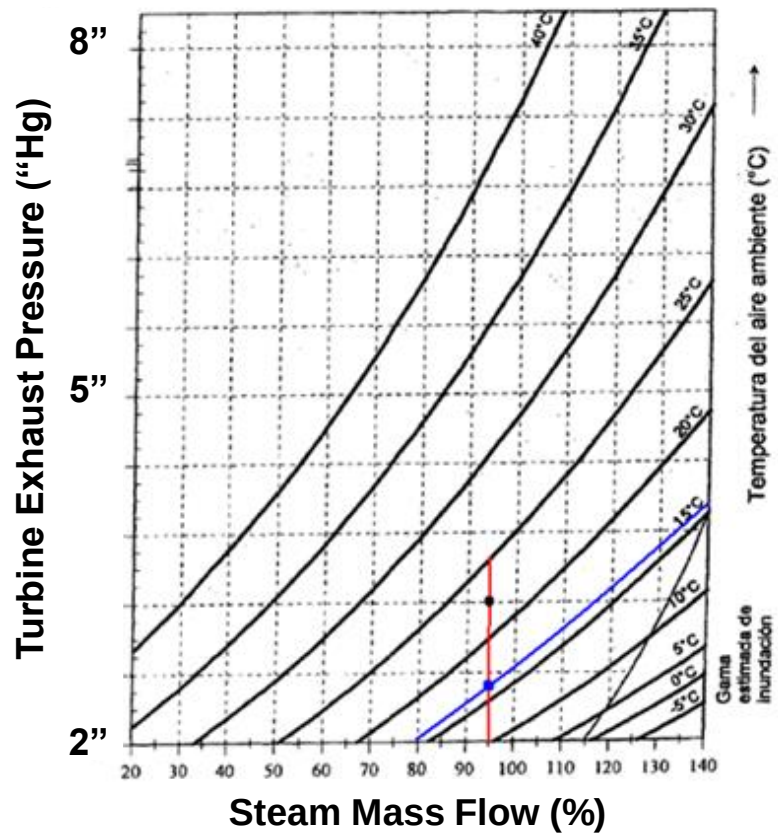
Typical Problem

High steam turbine backpressure from the main condenser, limiting power output, during summer:



Typical Problem

- Even though condensers originally correctly sized, specified and supplied, there is ACC degradation through the years (fouling, tube damage).
- Performance mostly affected at higher temperatures and winds.



Heat Rate= 335.86 MW =100%

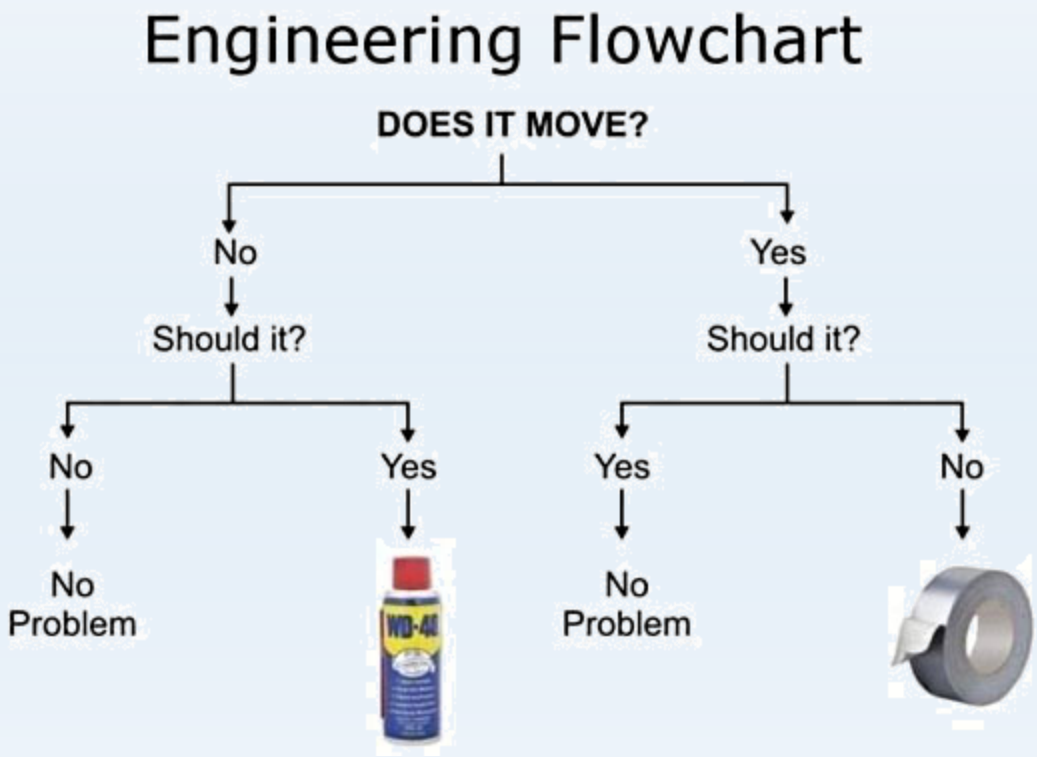
Jan 19th 320 MW= 95.27%
16.673 °C
11 kPa of pressure

Design Point 95.27%
16.673°C
8.7 kPa

In this example, for 320 MW of condenser load, 16.7°C of ambient temperature, and without wind, we have **0.7 inHg higher than design point**.

DESIGN DATA			
Medium		Exhaust steam	
Flow	kg/s	143	1.13 M # / Hr
Turbine exahust pressure	mbar	126	3.7 “Hg
Steam enthalpy	kJ/kg	2492	
Design Pressure	bar,g	0.5	14.8 “Hg
Design Temperature	°C	120	248 °F
Ambient air temperature	°C	24.7	77 °F
Ambient air pressure	mbar	1011.5	29.9 “Hg
Number of fans		32	
Fan shaft power consumption (per fan)	kW	82	
Motor capacity	HP	150 (112 kW)	

General Considerations: **Use what you already have…**



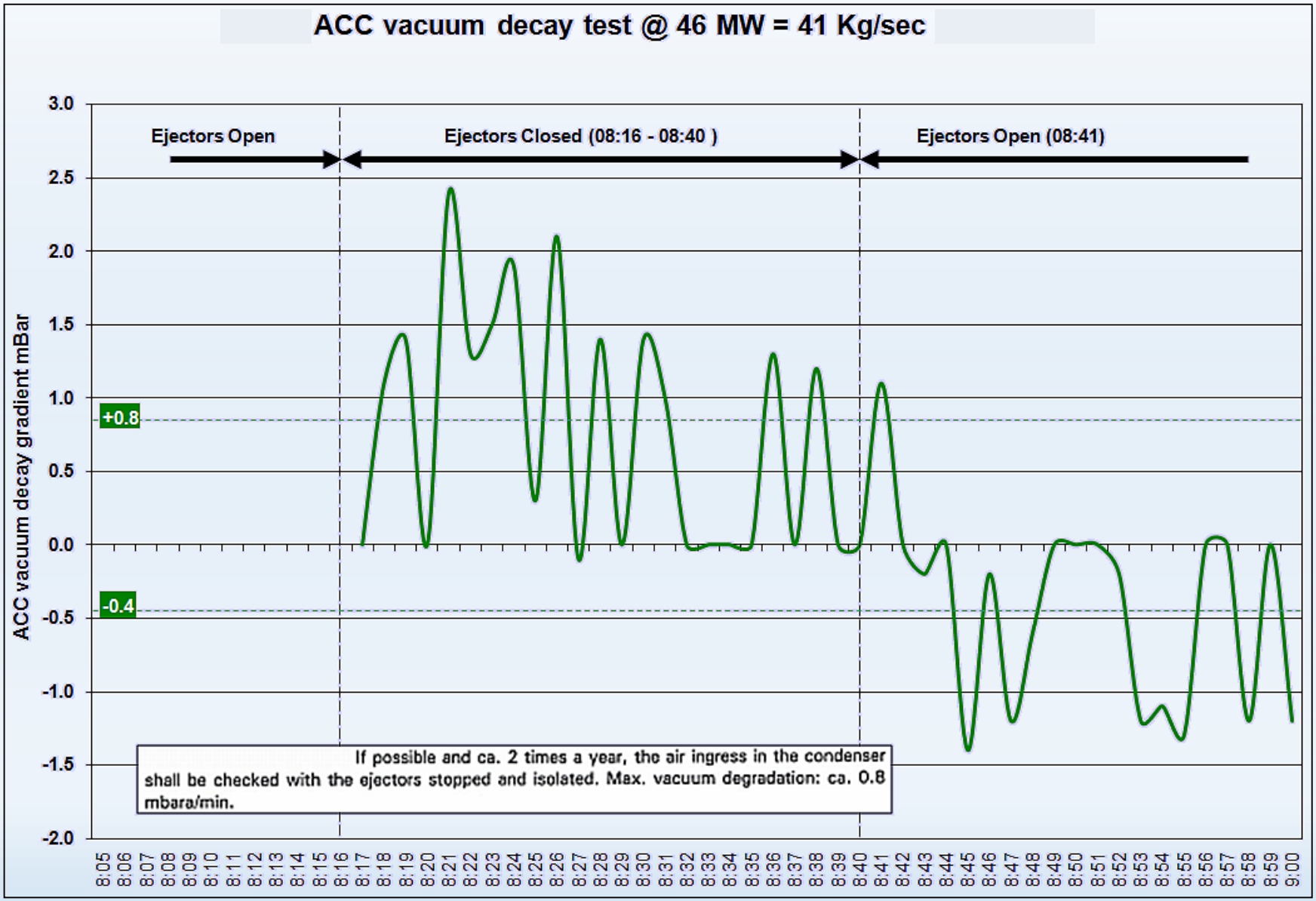
Wash Thoroughly…

- Inside to outside and then outside to inside.
- Detailed washing.
- Pressure wash (1,250 & 5,000 psig).
- Seldom use chemicals.

Avoid Leaks and Bypasses, Use Your Cooling Air…

- Galvanized sheet metal, pop rivets and red gasket forming RTV silicone go a long way in order to plug air leakages and bypasses, thus making effective use of the air and forcing it through the fins… which should be regularly inspected for those "small dings and bents".

Check Tightness: Vacuum Decay Test…

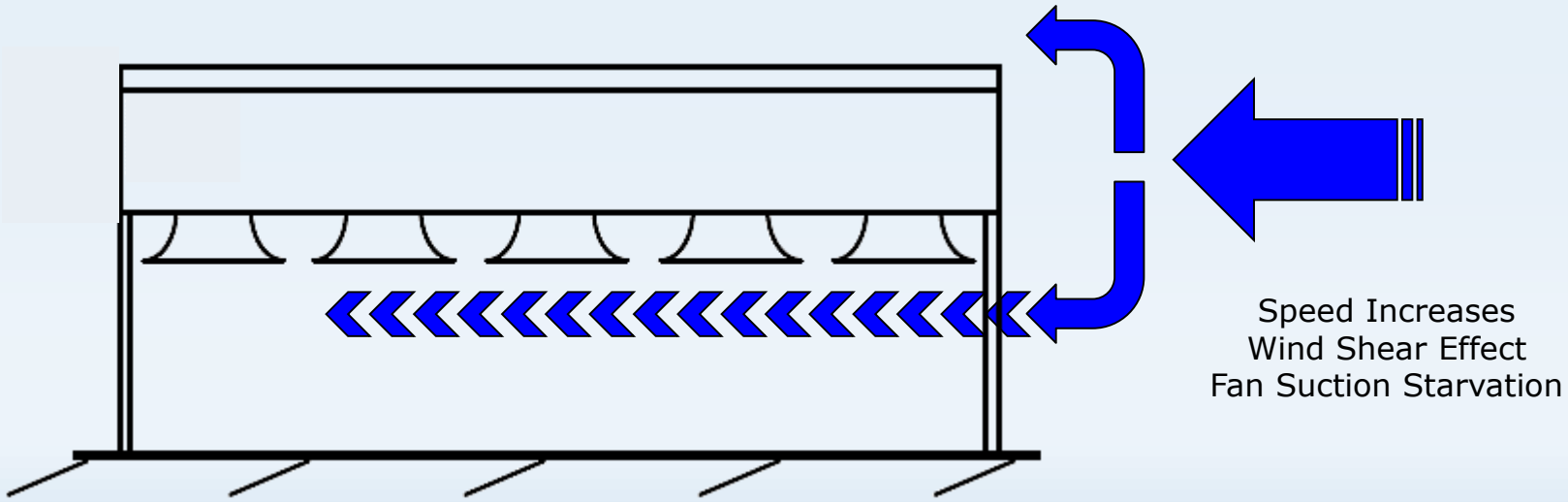


Wind Countermeasures:

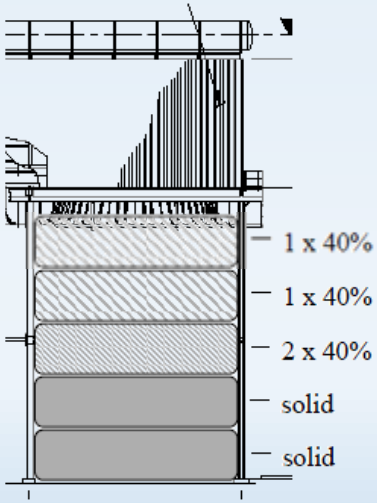
Wind Countermeasures:

- One of the most detrimental impacts on ACC performance is suction starvation (when the fans turn but do not push air upwards), which in turn is driven by wind shear resulting from the high wind velocity going across the fans suction underneath the ACC.

- Therefore, think WindWalls and WindScreens…



Wind Countermeasures:



Fans Upgrade

Fans Upgrade

- Although ACC operation was right on design specifications or better, it was found that Fan Power to Condensing Surface Ratio was much lower than other plants. That is, the surface area was good, but fan power to increase air mass flow was lacking.
- Same was seen when comparing Fan Power to Steam Mass Flow. The asset was being under-utilized…

Plant	# Fans	HP / Fan	Total HP	Exchange surface (m2)	Relation (HP / m2):	% PLANT 1:
PLANT 1	15	100	1500	556964	0.00269	0%
PLANT 2	32	150	4800	629264	0.00763	183%
Plant A	20	91.189496	1823.78992	302620	0.00603	124%
Plant B	40	140.80731	5632.2924	N/A		

Plant	# Fans	HP / Fan	Total HP	Steam Flow (kg/s)	Ratio (HP / kg/s)	% Over Plant 1:
PLANT 1	15	100	1,500	81	18.5	0%
PLANT 2	32	150	4,800	155	31.0	67%
Plant A	20	91	1,824	68	26.9	45%
Plant B	40	141	5,632	134	41.9	126%

Fans Upgrade

- No water source, at all. Therefore, must focus on increased dry cooling capacity, at minimum cost (no additional cells or ACC enlargement).
- Thus, ACC fan system upgrade from 100 HP to 200 HPs, which entails replacing electrical switchgear, cabling, motors, gearboxes and fans, as well as structural checks for load bearing and resonance issues.
- With 200 HPs, the ACC comes right between the ratios seen for other ACCs regarding power to surface and power to steam flow:

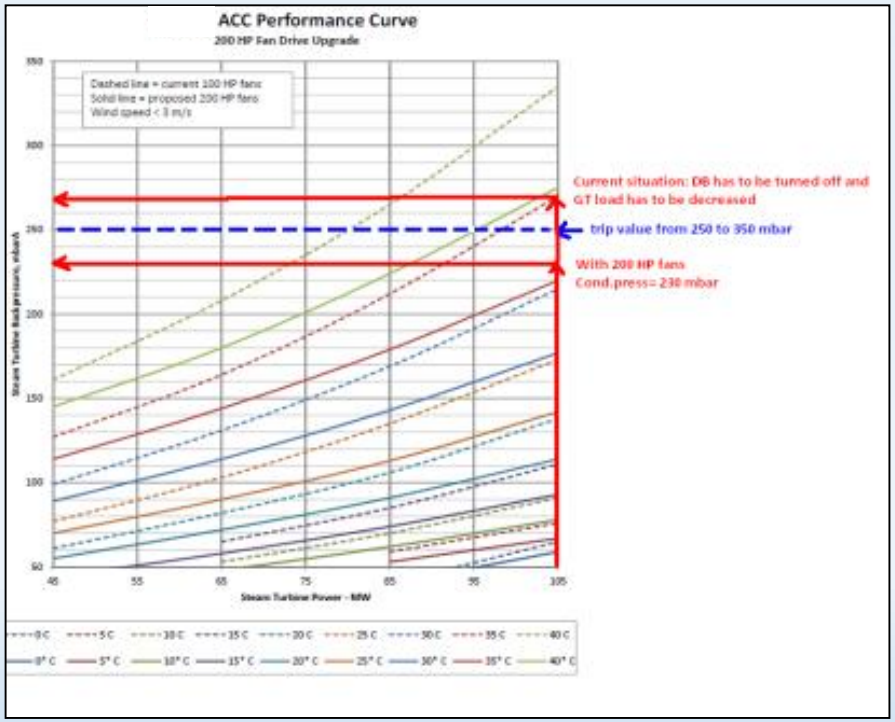
Plant:	# Fans	HP / Fan	Total HP	Exchange surface (m2)	Relation (HP / m2):	% Plant 1:
PLANT 1	15	200	3,000	556964	0.00539	100%
PLANT 2	32	150	4,800	629264	0.00763	183%
Plant A	20	91	1,824	302620	0.00603	124%
Plant B	40	141	5,632	N/A		

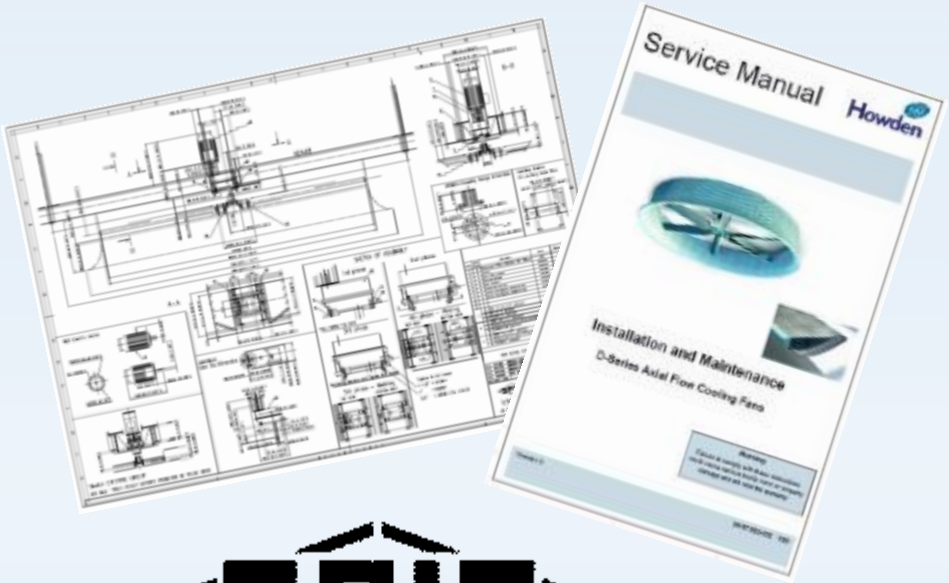
Plant:	# Fans:	HP / Fan:	Total HP:	Steam Flow (Kg/s):	Ratio (HP / Kg/s):	% Over Plant 1:
PLANT 1	15	200	3,000	81	37.0	100%
PLANT 2	32	150	4,800	155	31.0	67%
Plant A	20	91	1,824	67.9	26.9	45%
Plant B	40	141	5,632	134.28	41.9	126%

Fans Upgrade

With help of SPIG engineering & procurement 15 new motors, gearboxes and fans were replaced. The main differences with the original supply are:

- Significantly improved ACC performance under adverse conditions.
- No additional water needed.
- 9 vs. 4 blades, which inherently minimizes vibration and resonance.
- 730 vs. 542 m^3/s air flow, 125 vs. 71 Pa static pressure.
- 1.12 to 2.24 MW's auxiliaries consumption increment.

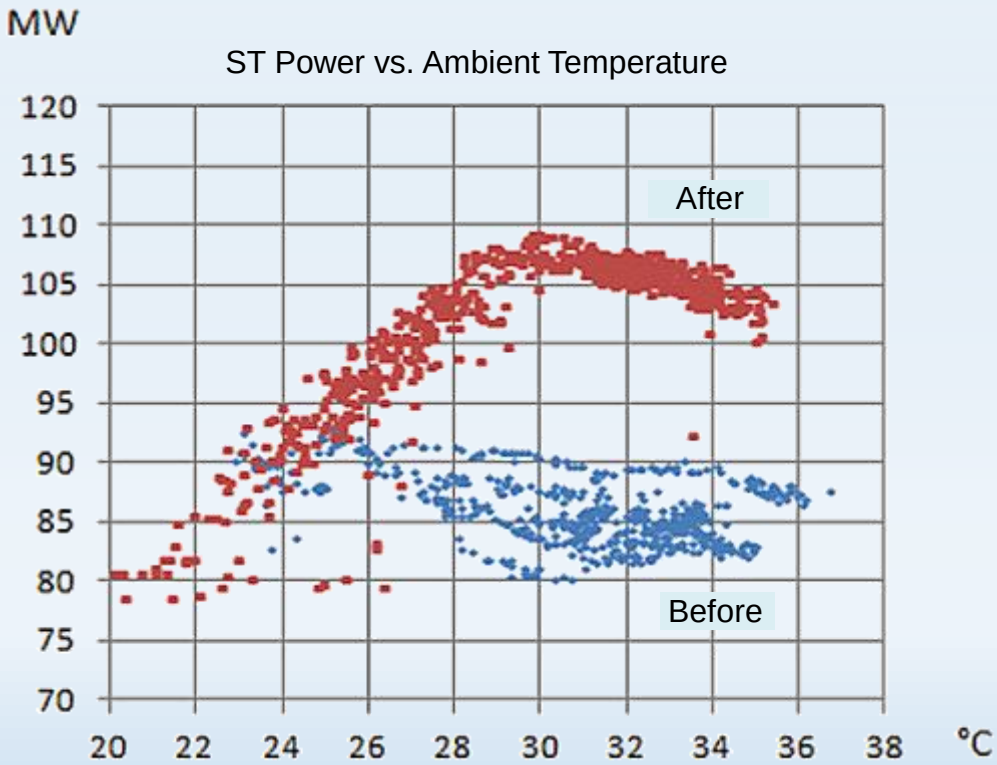




Fans Upgrade

Results after fans upgrade:

- Auxiliaries increase of 1.12 MW's due to larger fan drive system.
- Reduction of the backpressure limitation, improvement of 3.5 inHg.
- Power output increase with the possibility of increasing condenser load, thus steam flow through the turbine and more power.
- Heat rate improvement due to lower condenser pressure and thus lower backpressure on the steam turbine (more "free" power).



General ACC Improvement Considerations

Thank You