



AIR COOLED CONDENSER USERS GROUP

ACC Performance Enhancement Options



Andy Howell

**8th Annual Meeting of the Air-Cooled
Condenser Users Group**

October 3-6, 2016 • Dallas, TX




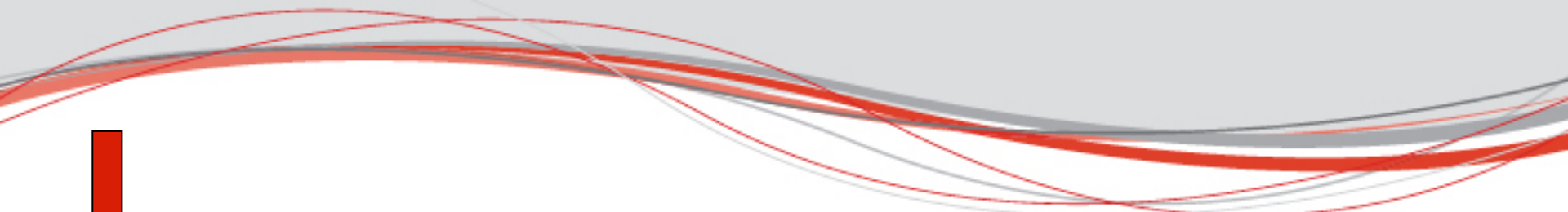
Performance in ACC units

- **limited by heat transfer**
 - ◆ **ambient temperature**
 - ◆ **tube fouling**
- **limited by parasitic load**
- **potentially limited by non-optimal design**



Outcome of limitations

- **Increased cost for generation of electricity**
 - ◆ **higher fuel cost**
 - ◆ **generation deficiency on hottest days**



***Performance is optimized
by design, operation and
upgrade / retrofit options.***

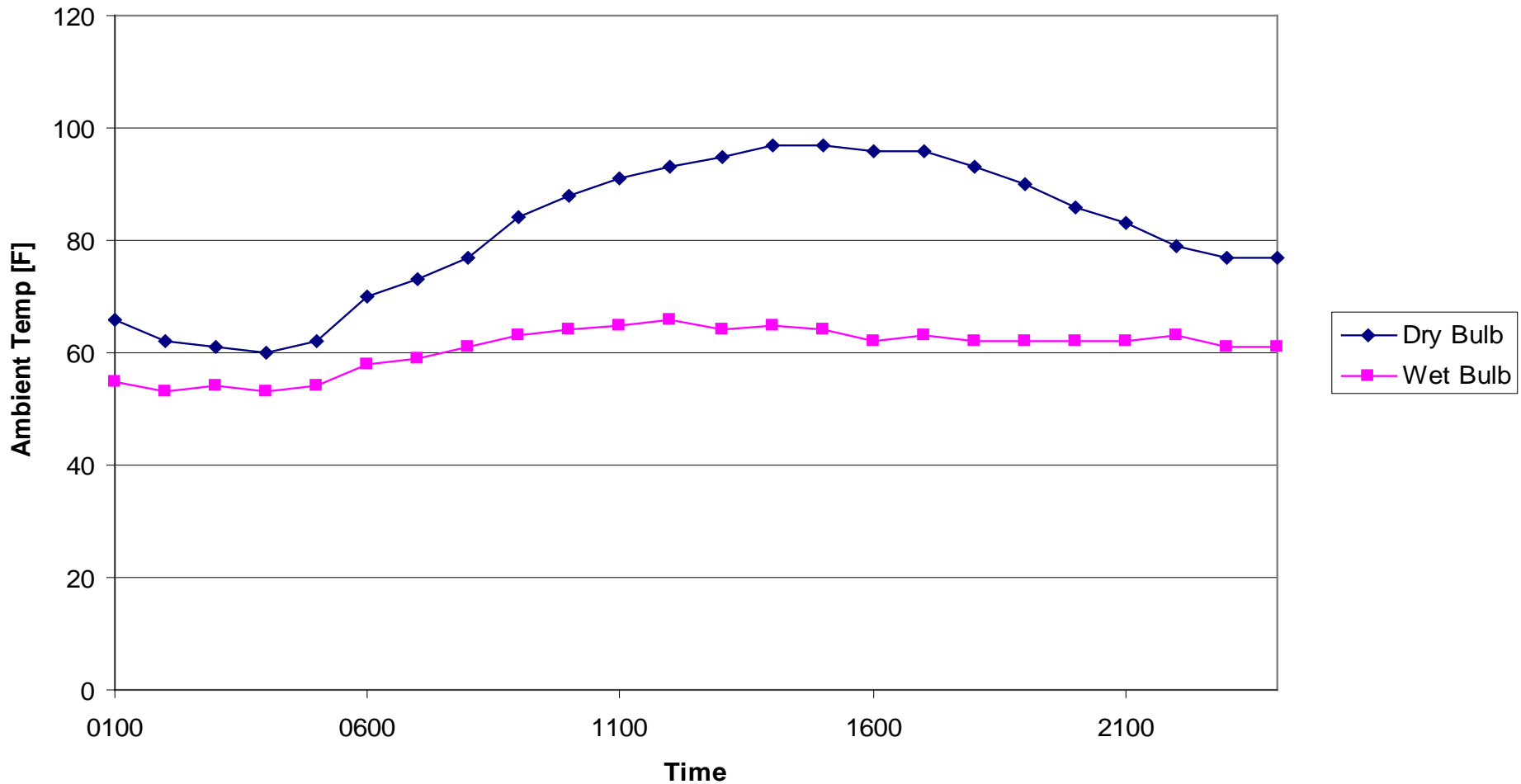


Design Factors

- **ambient conditions:**
 - ◆ **wind**
 - ◆ **temperature**
- **anticipated load demand (internal/customer)**
- **steam distribution**
- **tubes**
- **fans**

Design Day: dry bulb vs. wet bulb T

July 14, 2004 Ambient Conditions



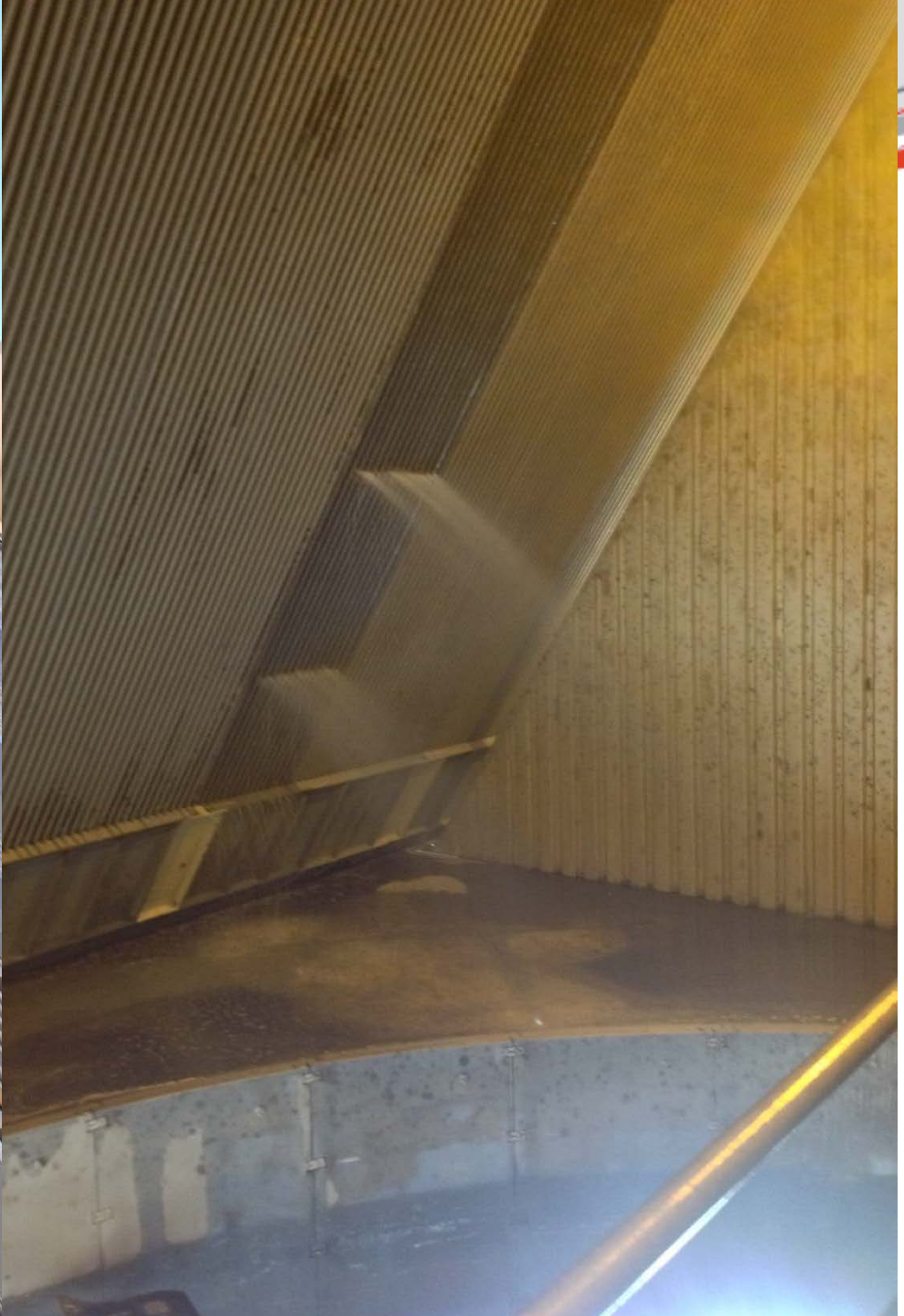


Operation

- external tube cleaning
- air flow management
- spray enhancement
- air inleakage
- misc.







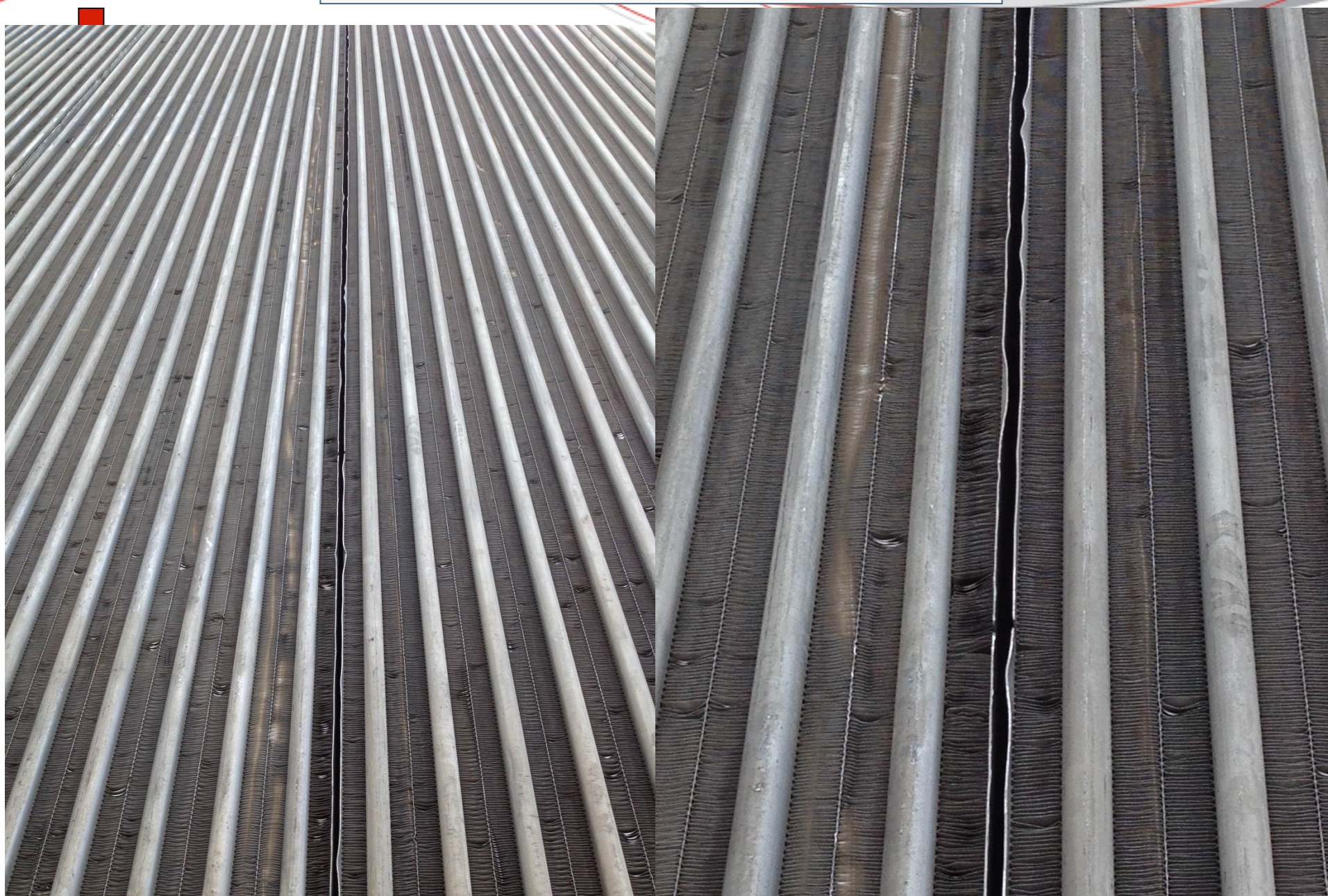




other issues



other issues

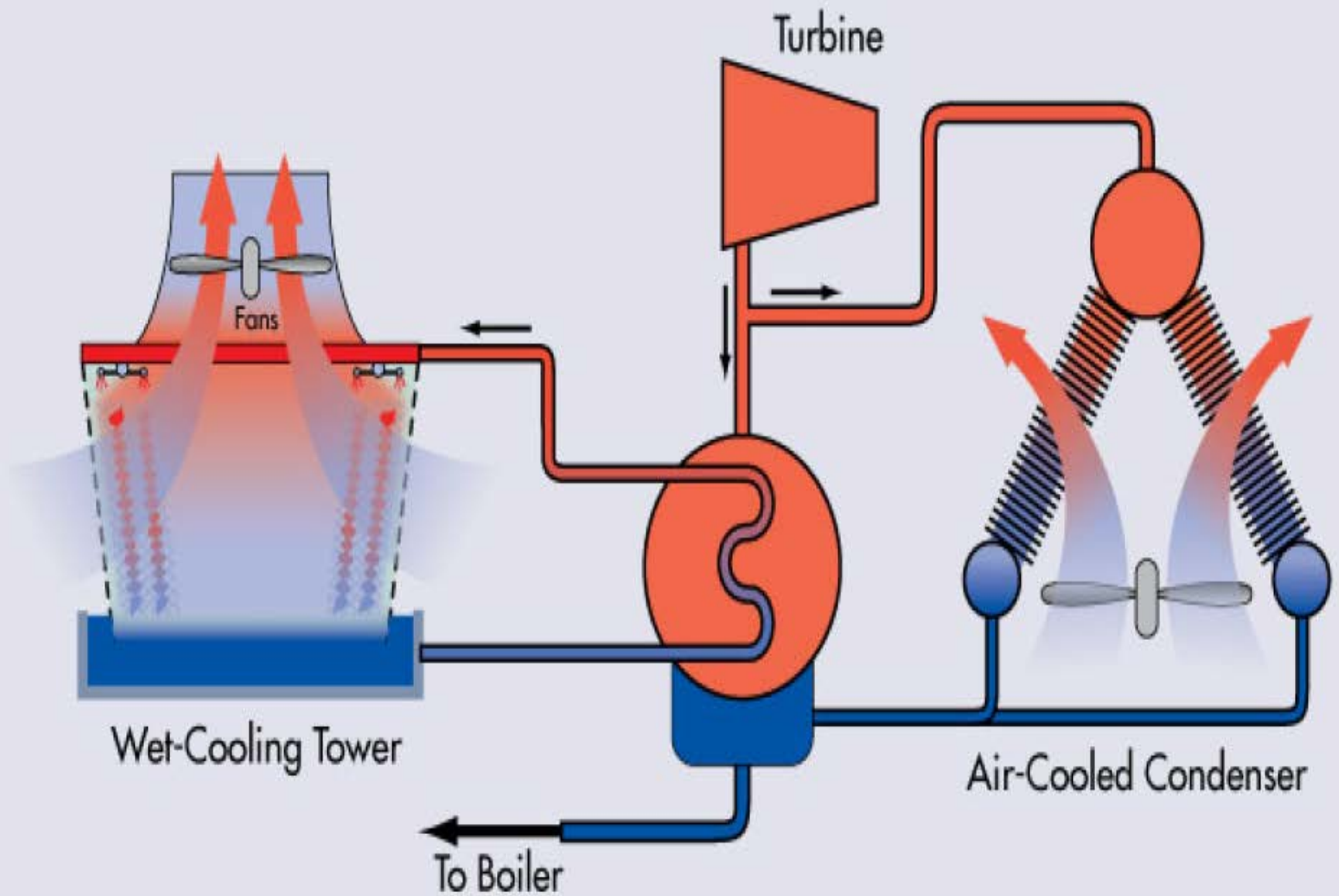




Retrofit Construction

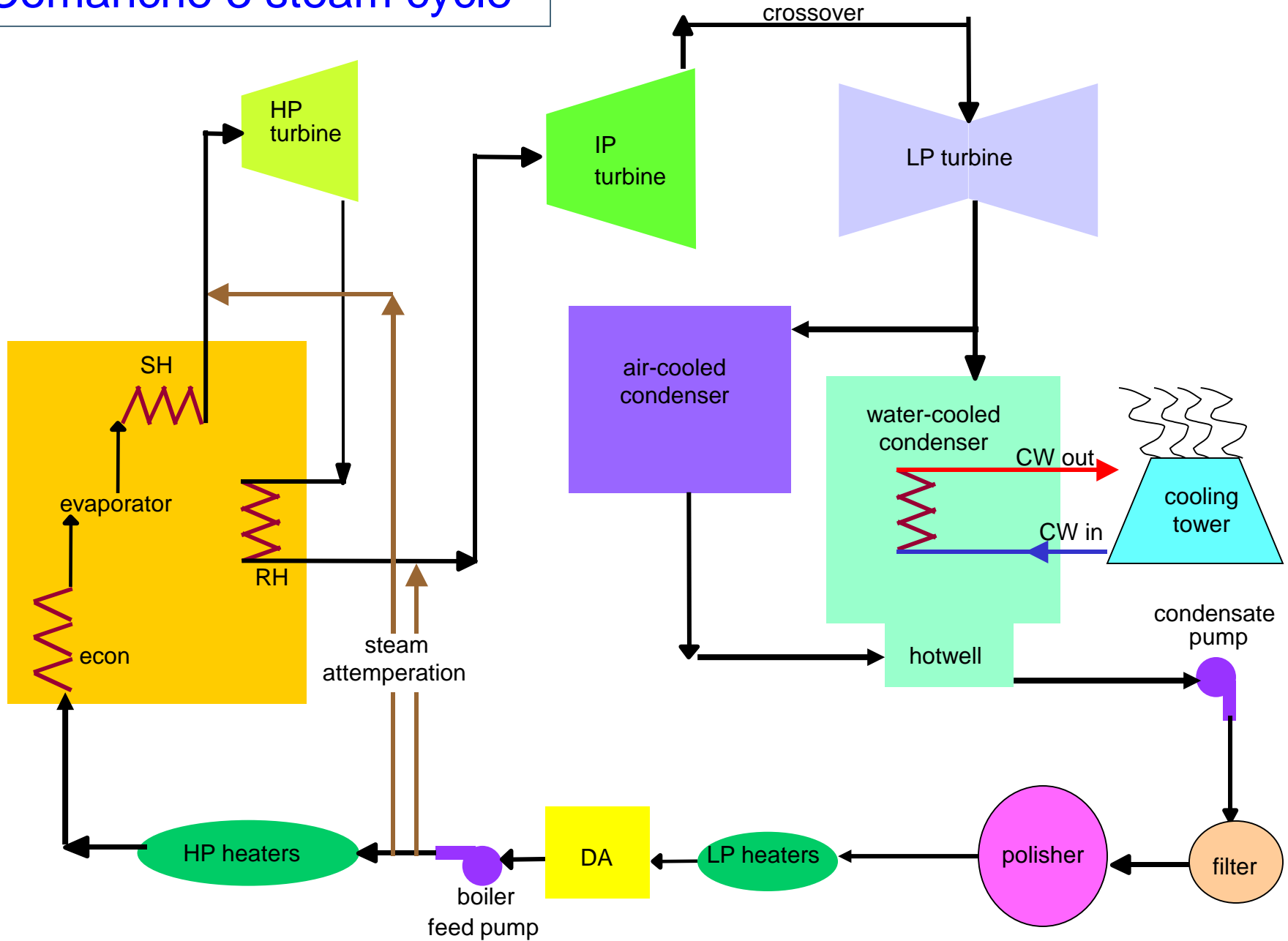
- add wet cooling (parallel)

Hybrid Cooling

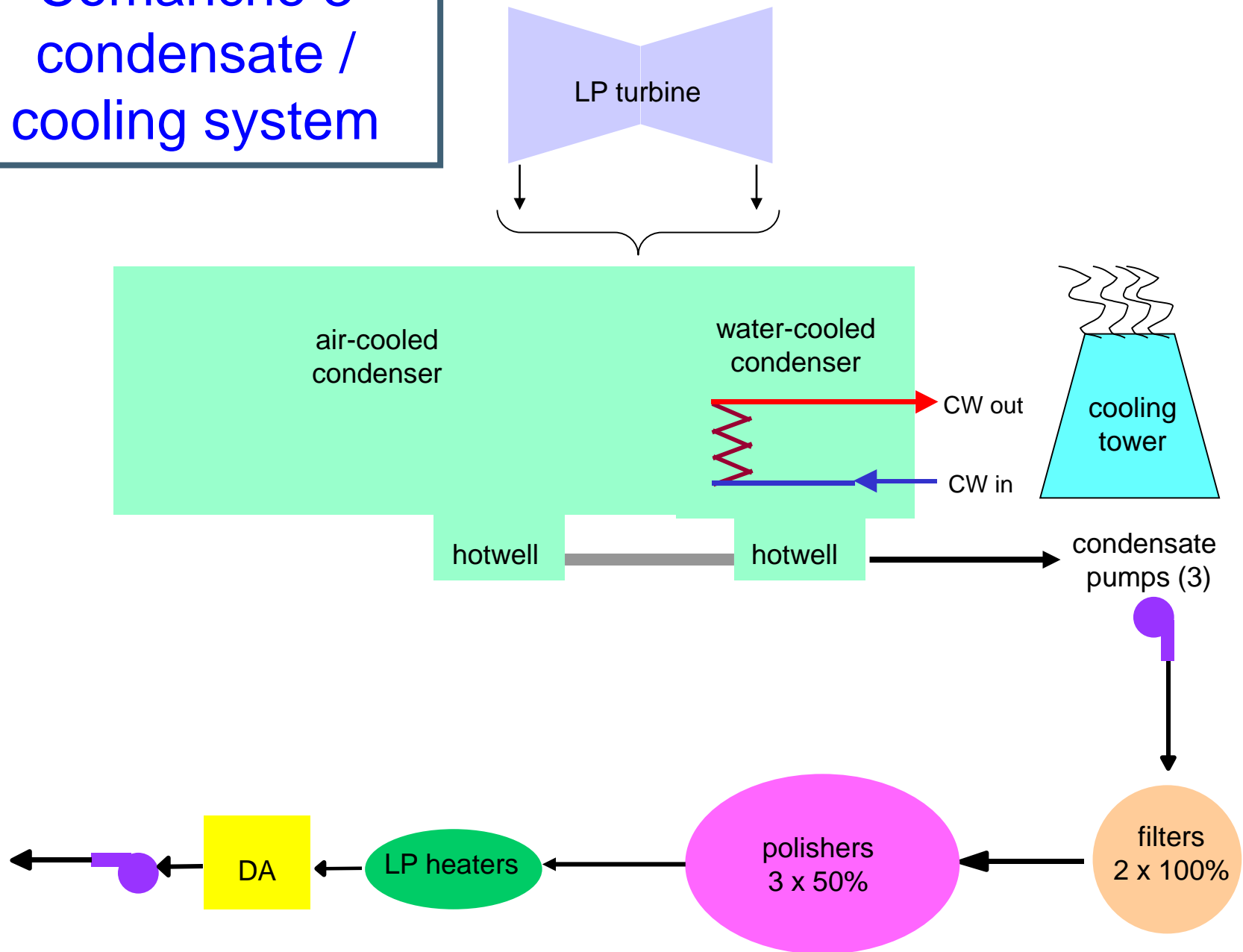




Comanche 3 steam cycle



Comanche 3 condensate / cooling system





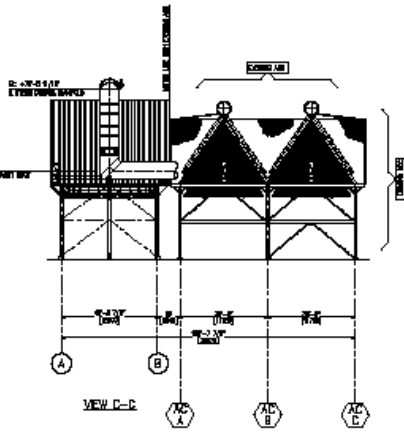
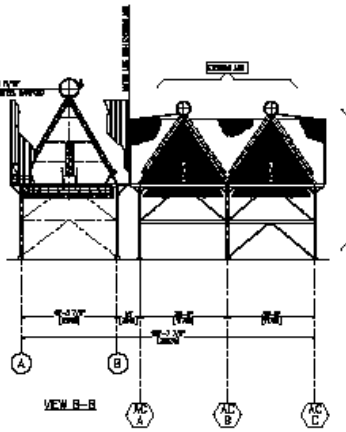
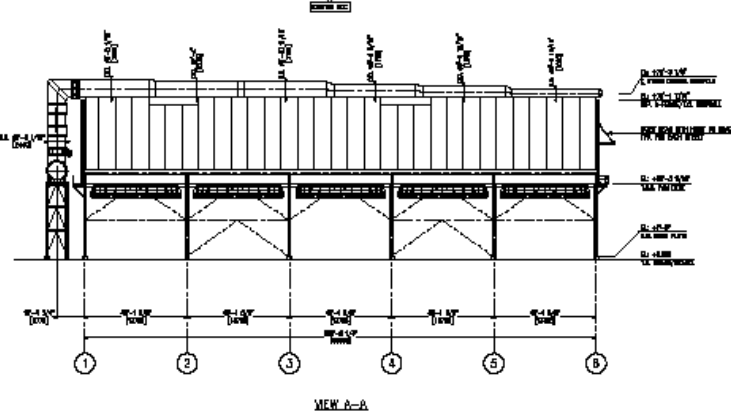
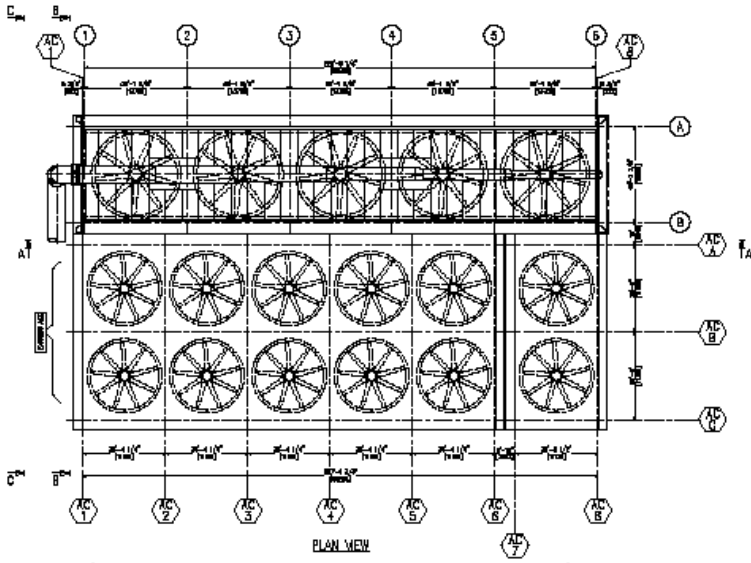




Retrofit Construction

- add wet cooling (parallel)
- **additional cells**

NSC NS2 – Wygen 1 ACC Expansion



GENERAL NOTES

- 1 BENCH OR BENCH MATS, ALL CHAIRS ARE WITH A BACKREST OF 2" WIDE (1.0%).
2 SEATING PLACING ONLY UNDER STAIRCASE CHAIRS, PLACING IN SET 104 AND 105.
3 FOR LEFT OF STAIRCASE CHAIRS AND CHAIRS, SUPPLY FOR STAIRCASE CHAIRS LEFT SPECIFICATIONS.
4 FOR CHAIRS OF STAIRCASE CHAIRS, SUPPLY FOR STAIRCASE CHAIRS LEFT SPECIFICATIONS.
5 ALL CHAIRS ARE IN SET 104 AND 105.
6 FOR CHAIRS OF STAIRCASE CHAIRS, SUPPLY FOR STAIRCASE CHAIRS LEFT SPECIFICATIONS.

TYPE LAST BOMBING	REASON	SEC. AND OTHER	PLACED AND PLUM	REASON IN RECORD RECORD	REASON PLACED PLUM	REASON PLACED PLUM	REASON PLACED PLUM	REASON PLACED PLUM	REASON PLACED PLUM	REASON PLACED PLUM	REASON PLACED PLUM
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			REASON IN THE RECORD	--	--	14.2	14.2	14.2	14.2	14.2	14.2

REFUGEE STATUS

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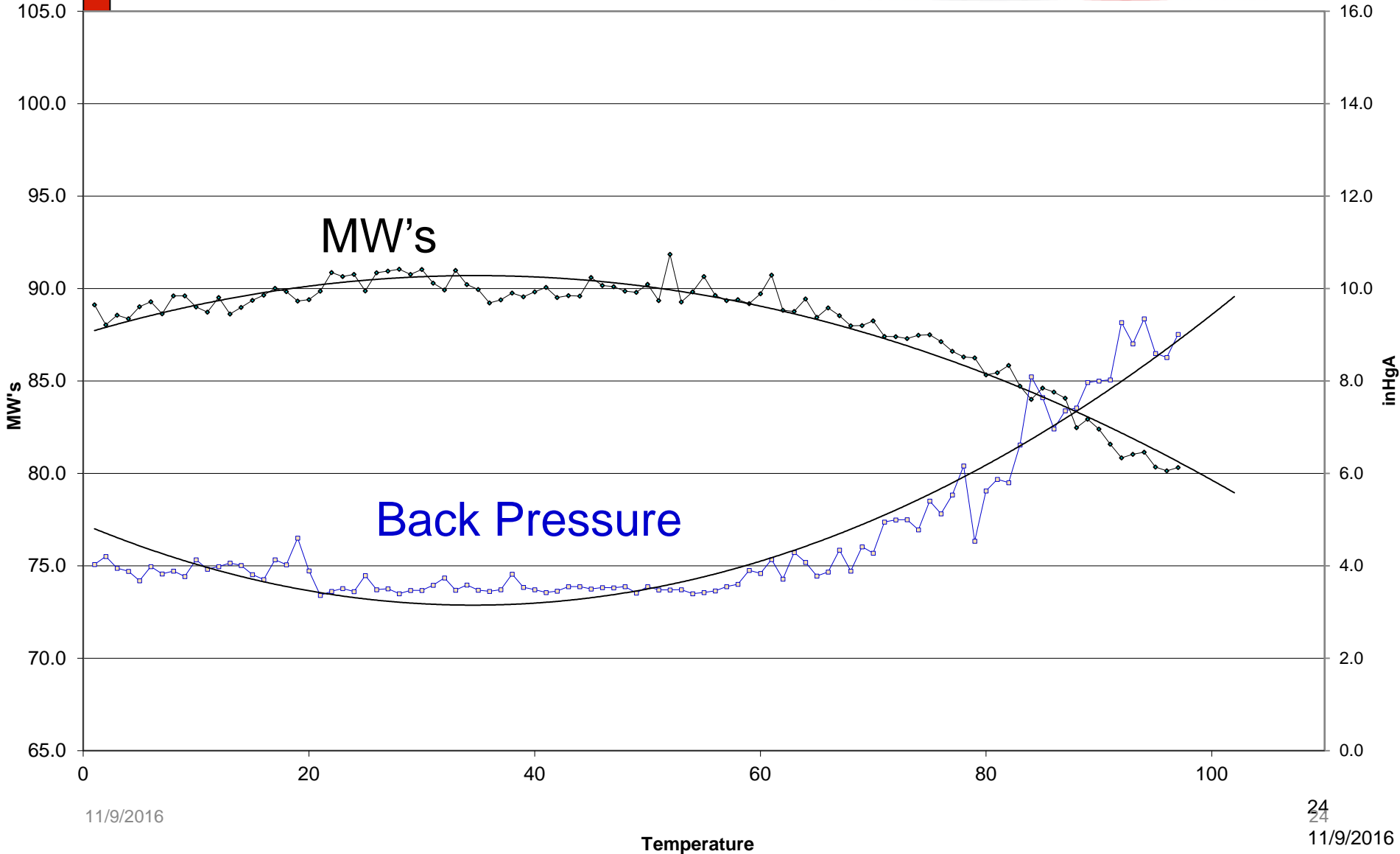
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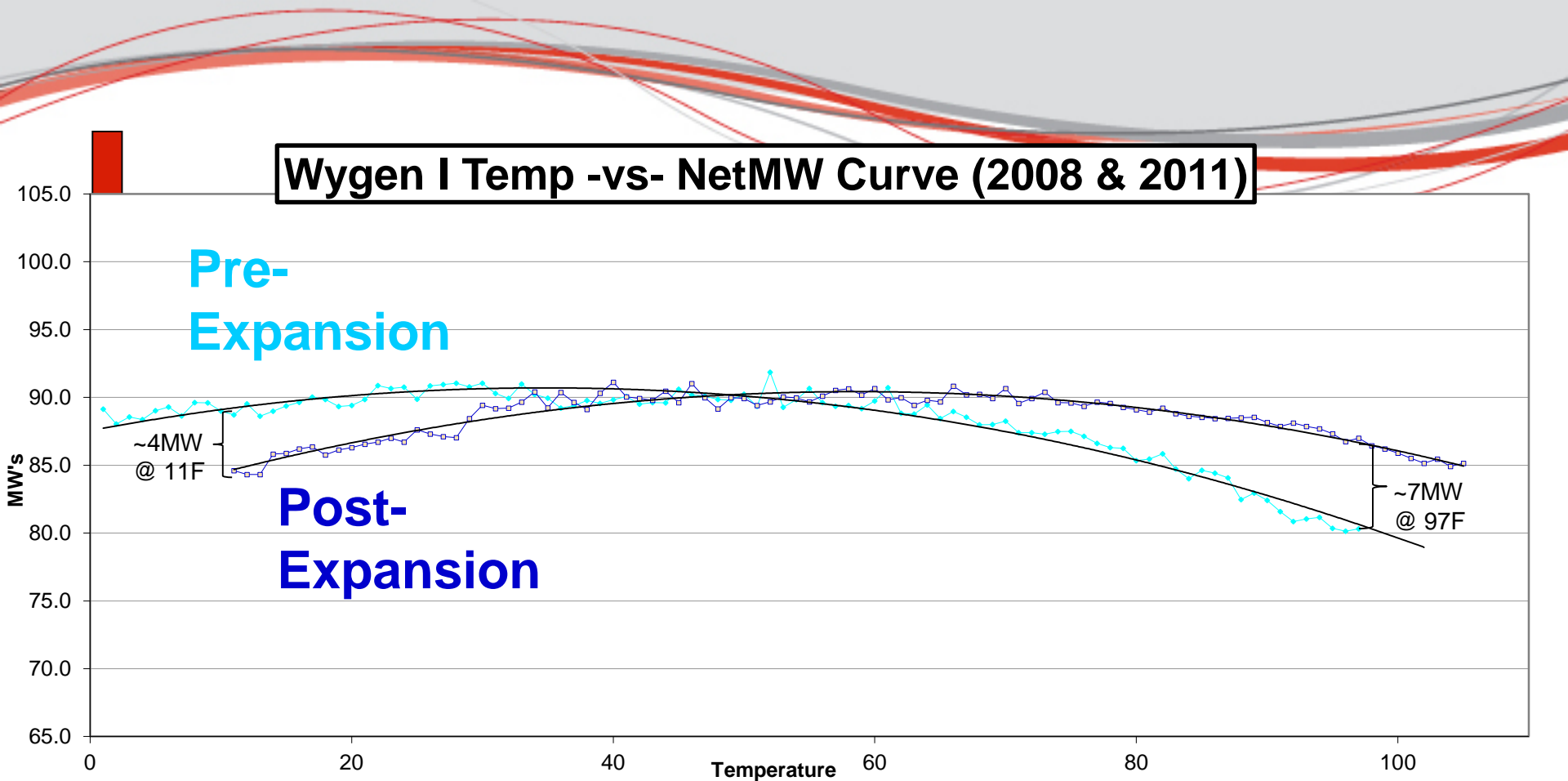
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No.	Date	Name	Remarks	Sheet
1	10-10-66	AS	Final Issue	1
2	10-24-66	AS	REVISION BY BUD GIBSON	2
3	"	"	"	"
4	"	"	"	"
5	"	"	"	"
6	"	"	"	"
7	"	"	"	"
8	"	"	"	"
9	"	"	"	"
10	"	"	"	"

PROJECT NO.	66-10000	AS - 10000	BY - 10000	DATE - 10-10-66
SCALE	Sheet		Sheet	
PROJECT	Missile Vehicle Program, Inc.			
LOCATION	Los Angeles Station - Unit 2			
DATE	10-10-66			
BY	AS			
CHECKED	AS			
APPROVED	AS			
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Wygen I Temp -vs- NetMW Curve (2008)





Additional MW at Ambient Temperature >60F

- Measured Additional 7MW @ 97F Ambient Temp

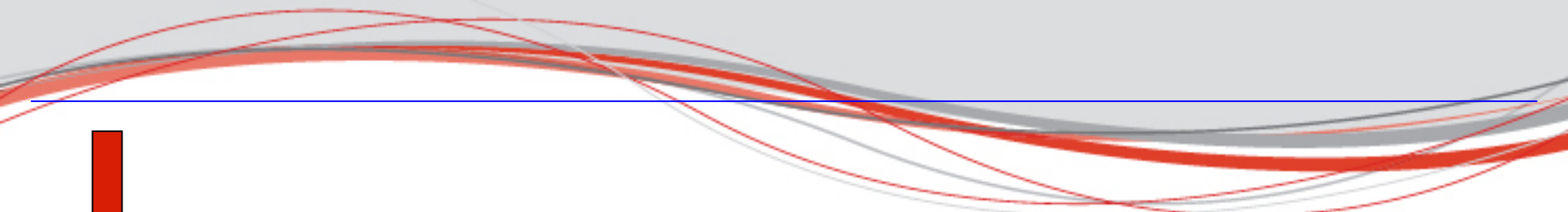

Less MW Production at ambient Temperature <32F

- Measured Less 4MW @ 11F Ambient Temp
- More Conservative operation during cold weather.



Retrofit Construction

- add wet cooling (parallel)
- additional cells
- **fan / motor upgrades**

- 
- 
- No water source, at all, to consider a Parallel Condensing System.
 - Solution must focus on increased dry cooling capacity, at minimum cost (no additional cells or ACC enlargement).
 - ACC fan system upgrade from 100 HP to 200 HPs, which entail replacing electrical switchgear, cabling, motors, gearboxes and fans, as well as structural checks for load bearing and resonance issues.



15 new motors, gearboxes and fans were selected. 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 m³/s air flow, 125 vs. 71 Pa static pressure.
- 1.12 to 2.24 MW's auxiliaries consumption increment.

ORIGINAL SUPPLY



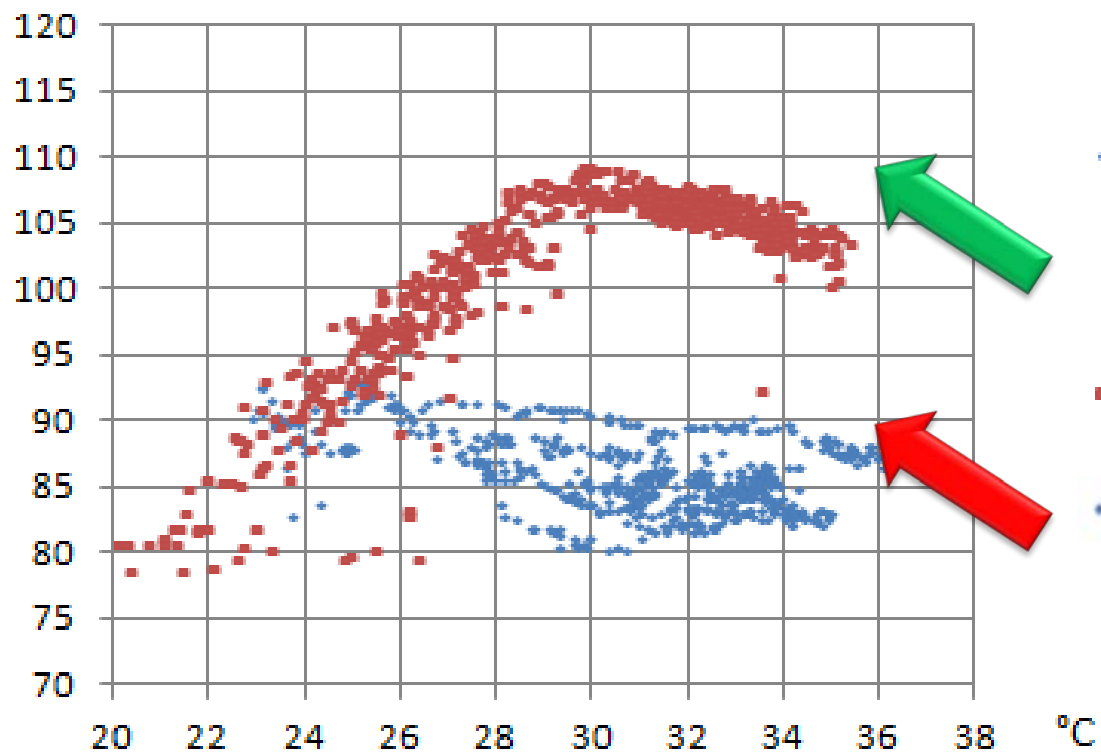
UPGRADED



The most relevant results after fans upgrade are:

- Auxiliaries consumption increase by about 1.12 MW's due to larger fan drive system.
- Complete elimination of the backpressure limitation, with a significant and sustained improvement of at least 120 mBar (3.5 inHg).
- Power output increase due to condenser pressure reduction and now 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).

MW



• ST POWER VS AMB TEMP
BEFORE OUTAGE

■ ST POWER VS AMBIENT TEMP
AFTER OUTAGE

• ST POWER VS AMB TEMP
BEFORE OUTAGE



Conclusions

- **ACC performance is critical to low-cost unit operation.**
- **Initial design is critical to achieve suitable unit-specific baseline performance.**
- **Operating actions optimize performance of the existing unit.**
- **Retrofit options can improve performance and improve cost-effective operation.**



AIR COOLED CONDENSER

USERS GROUP

Discussion:

- **designing for performance**



AIR COOLED CONDENSER

USERS GROUP

Discussion:

- **designing for performance**
- **O&M activities**



AIR COOLED CONDENSER

USERS GROUP

Discussion:

- **designing for performance**
- **O&M activities**
- **retrofit options**