



TURBINE AIR SYSTEMS

POWER-GEN ASIA

**CASE STUDY FOR RETROFIT OF
TURBINE INLET COOLING IN
BATAM, INDONESIA**

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Introduction

- ◆ About Medco Power
- ◆ About TAS
- ◆ Turbine inlet cooling – the impact
- ◆ Indonesia project execution
- ◆ Operating results
- ◆ Conclusions

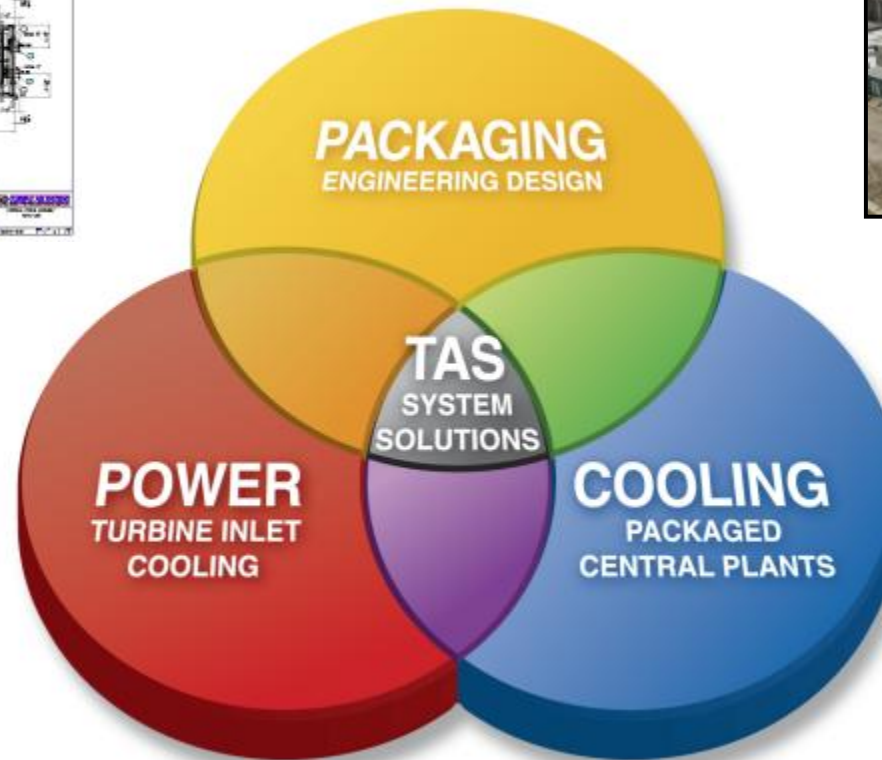
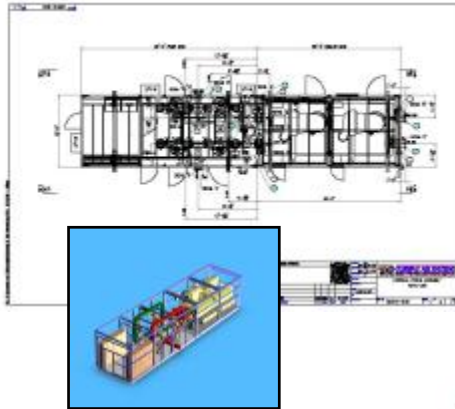


About Medco Power

- ◆ Independent power developer based in Jakarta
- ◆ Subsidiary of Medco Energi Internasional
- ◆ Recent projects:
 - PT Dalle Energi Batam – 2 X RB211
 - PT Mitra Energi Batam – 2 X RB211
 - 340 MW Sarulla Geothermal Power Project in Indonesia



About TAS



TAS Experience - Worldwide





TURBINE AIR SYSTEMS

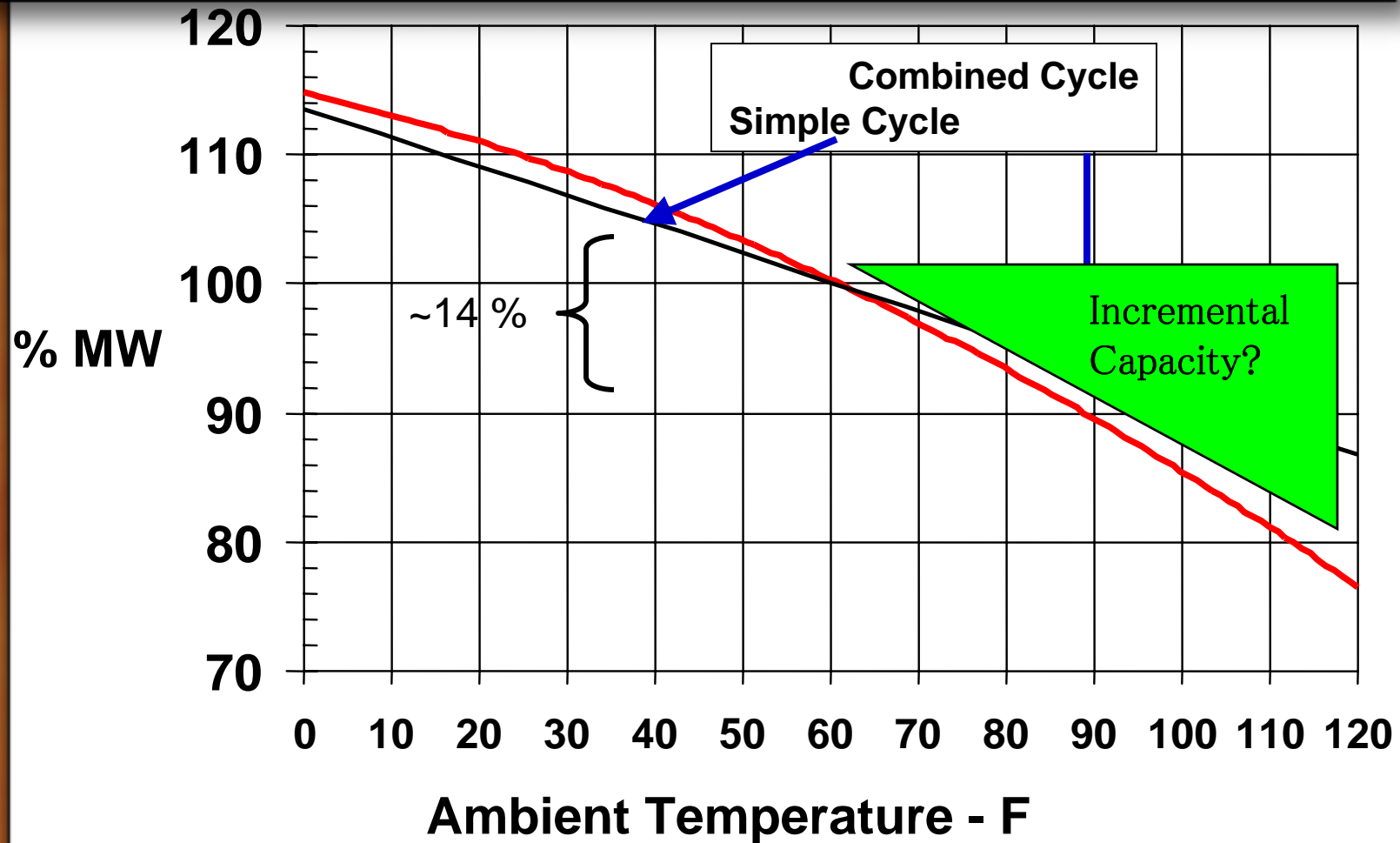
Turbine Inlet Chilling the Impact

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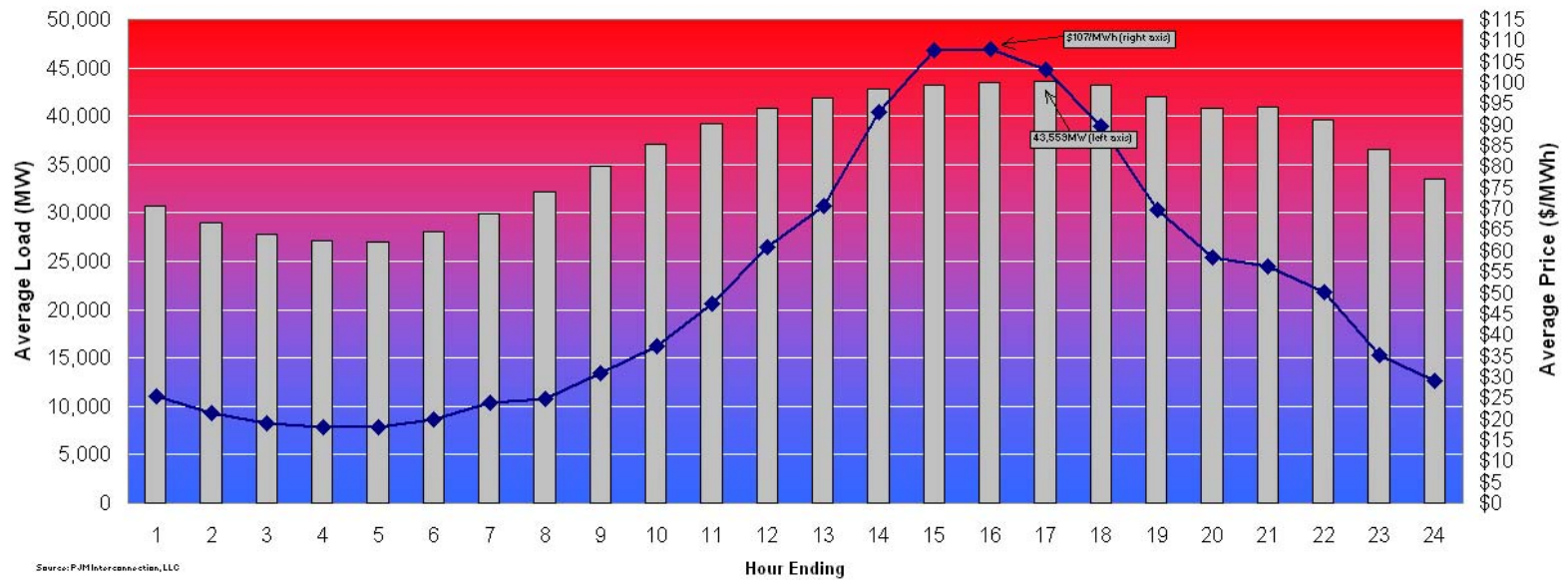
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Temperature Degradation



Capturing High Value Markets

Aug 2001 Load & Day Ahead Pricing



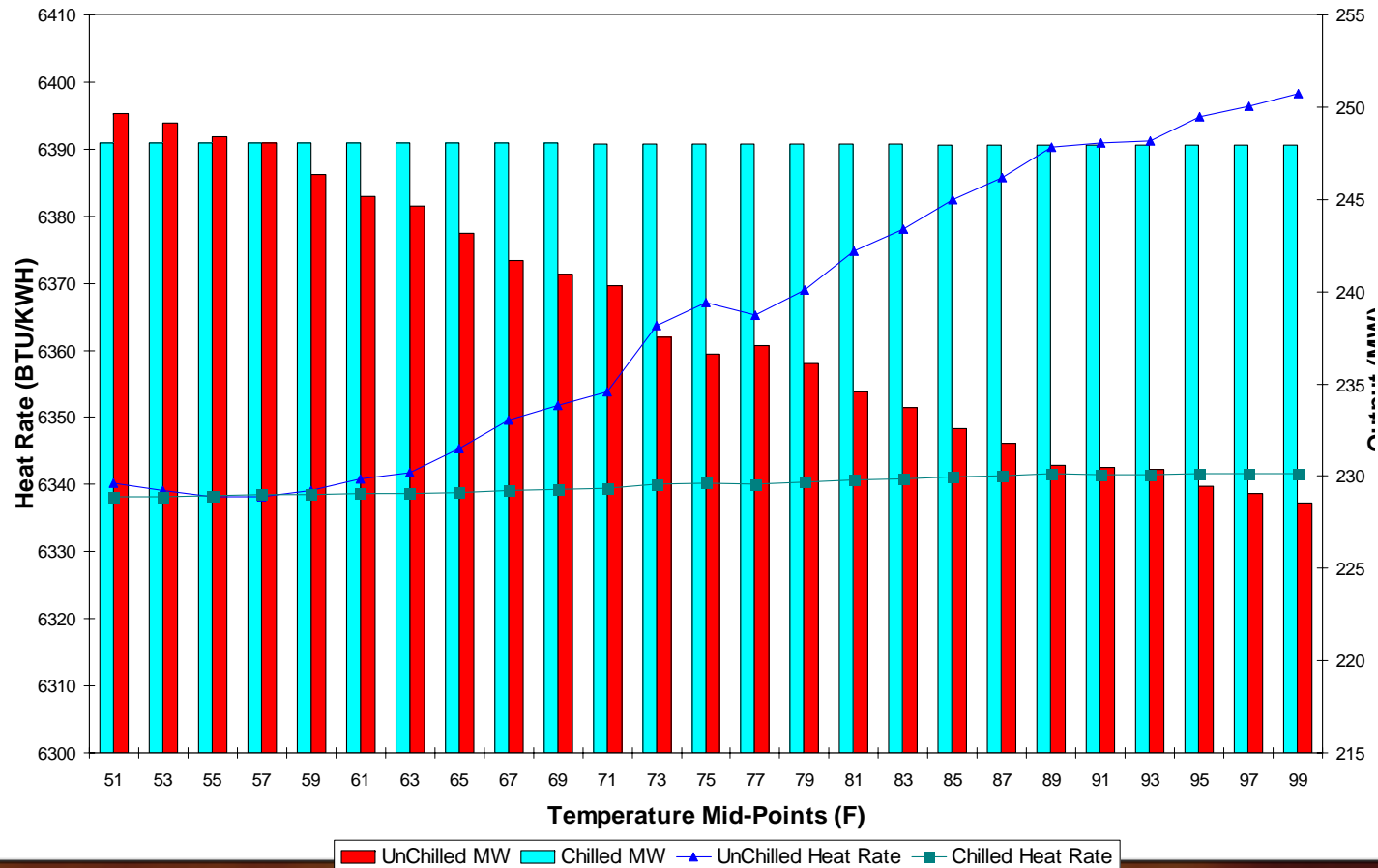
- ◆ Large daily demand peak AND price peak benefit TIC
- ◆ Generation mix will determine the value of off-peak power
- ◆ Weather profile contributes to power demand & price peak



Incremental Energy & Efficiency

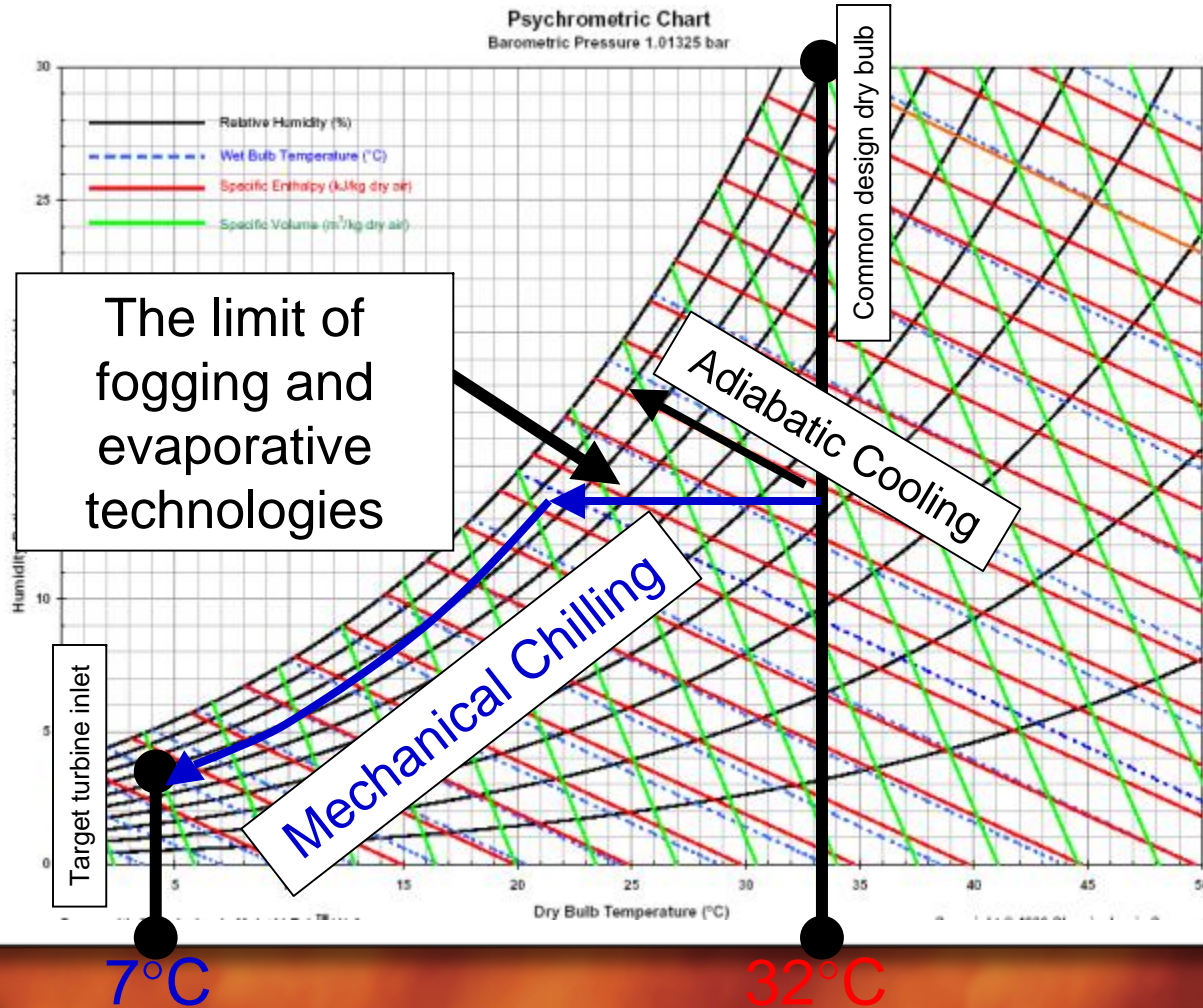


Representative Plant Performance Curve



7FA CC evap cooled vs. Full TES

Chilling vs. Other Options (Metric)



Economics of inlet chilling

	209FA	209FA Chilled
Capital Cost (installed)	\$315M (\$492/KW)	\$336M (\$465/KW)
Base MW (35°C)	658	740
Heat Rate (BTU/KWH)	6,385	6,425 (+0.6%)
Non-Fuel O&M	\$4/MWH	\$0.8/MWH (chiller) \$3.64/MWH (both)
Fuel Cost	\$34.8/MWH	\$35.0/MWH
Total Generation Costs	\$38.8/MWH	\$38.6/MWH (-0.5%)

Assumptions:

1. Non-fuel O&M: GT parts, labor, maintenance, repairs, water treatment
2. US\$ 5/MMBTU Gas



Improvement in Generation Economics

PT Dalle Energy Batam

- ◆ System installed in parallel with new unit installation as a retrofit – not in base design
- ◆ Owner is PT Dalle Energy Batam
- ◆ Located in Batam
- ◆ Performance guarantees critical
- ◆ Integration with site activities

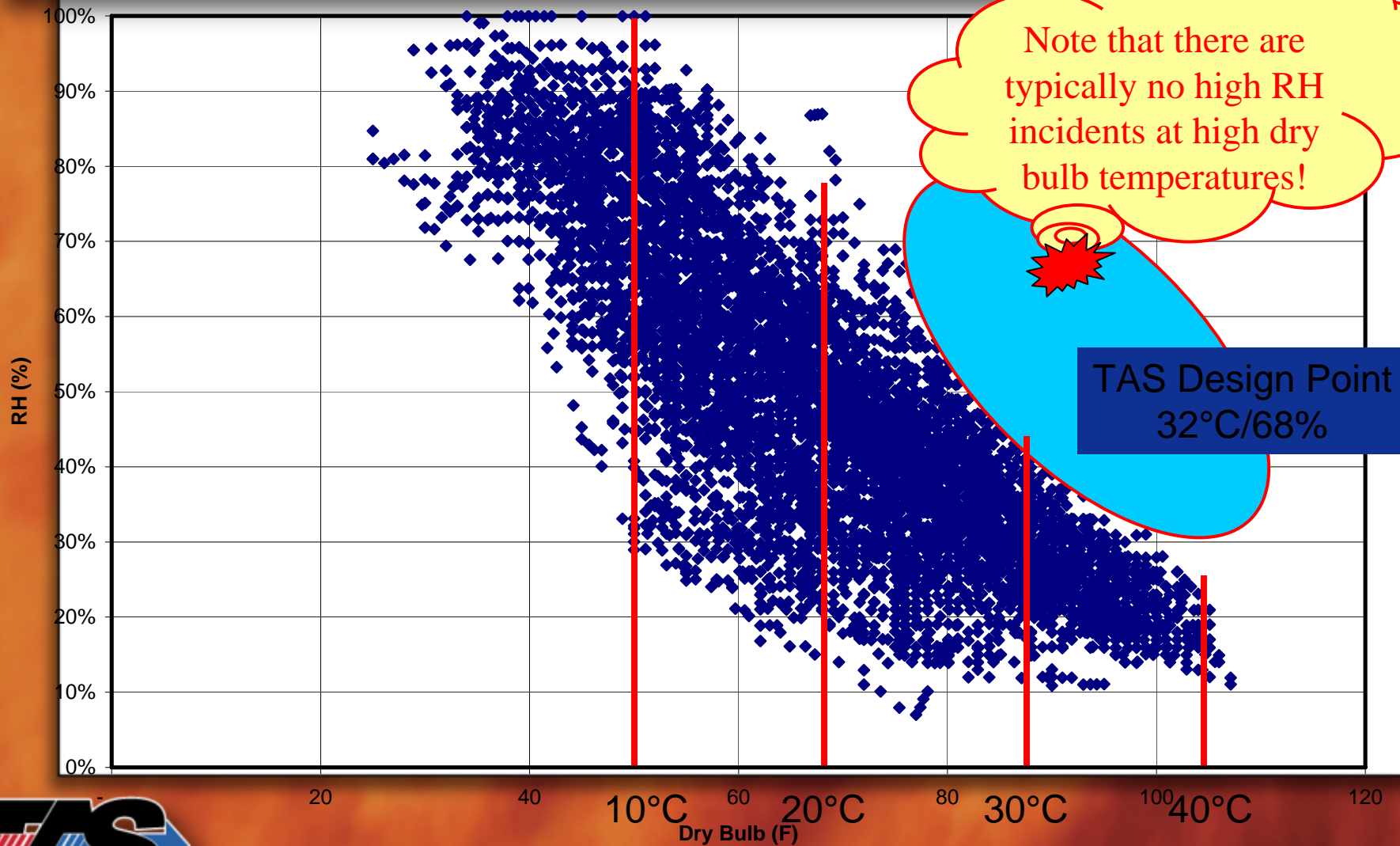


Project Execution

- ◆ System design
- ◆ Manufacturing
- ◆ Shipping
- ◆ Installation
- ◆ Startup and commissioning
- ◆ Actual Results



Choosing a Design Point



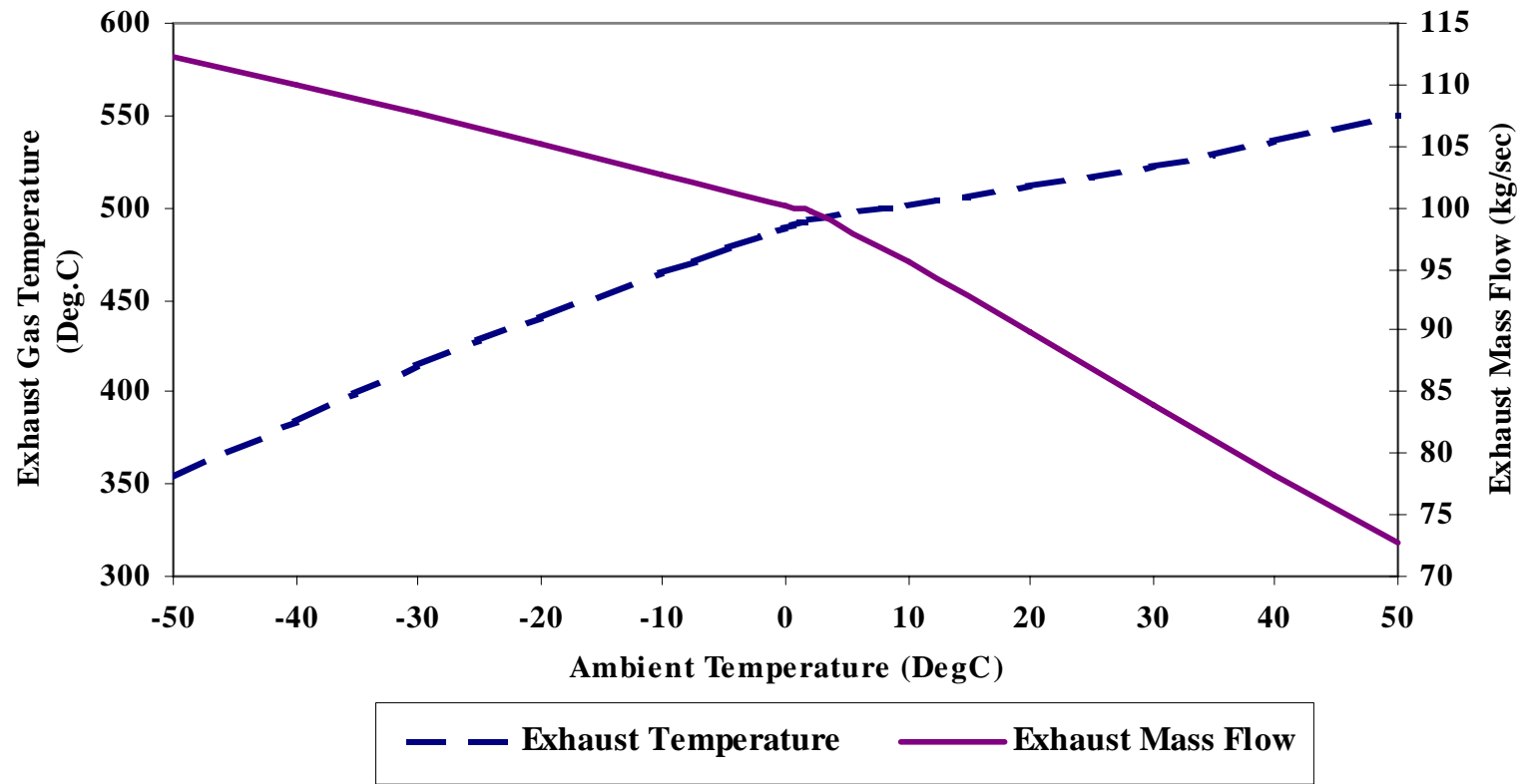
Batam Summary

- ◆ Site conditions:
 - 32°C dry bulb & 27°C wet bulb
- ◆ Cooling to 13°C
- ◆ 20% incremental power - +9MW Net
- ◆ 1-2% heat rate improvement
- ◆ Incremental personnel: 0
- ◆ No impact on GT maintenance intervals or costs
- ◆ Chiller non-fuel O&M costs: US\$0.50/MWH

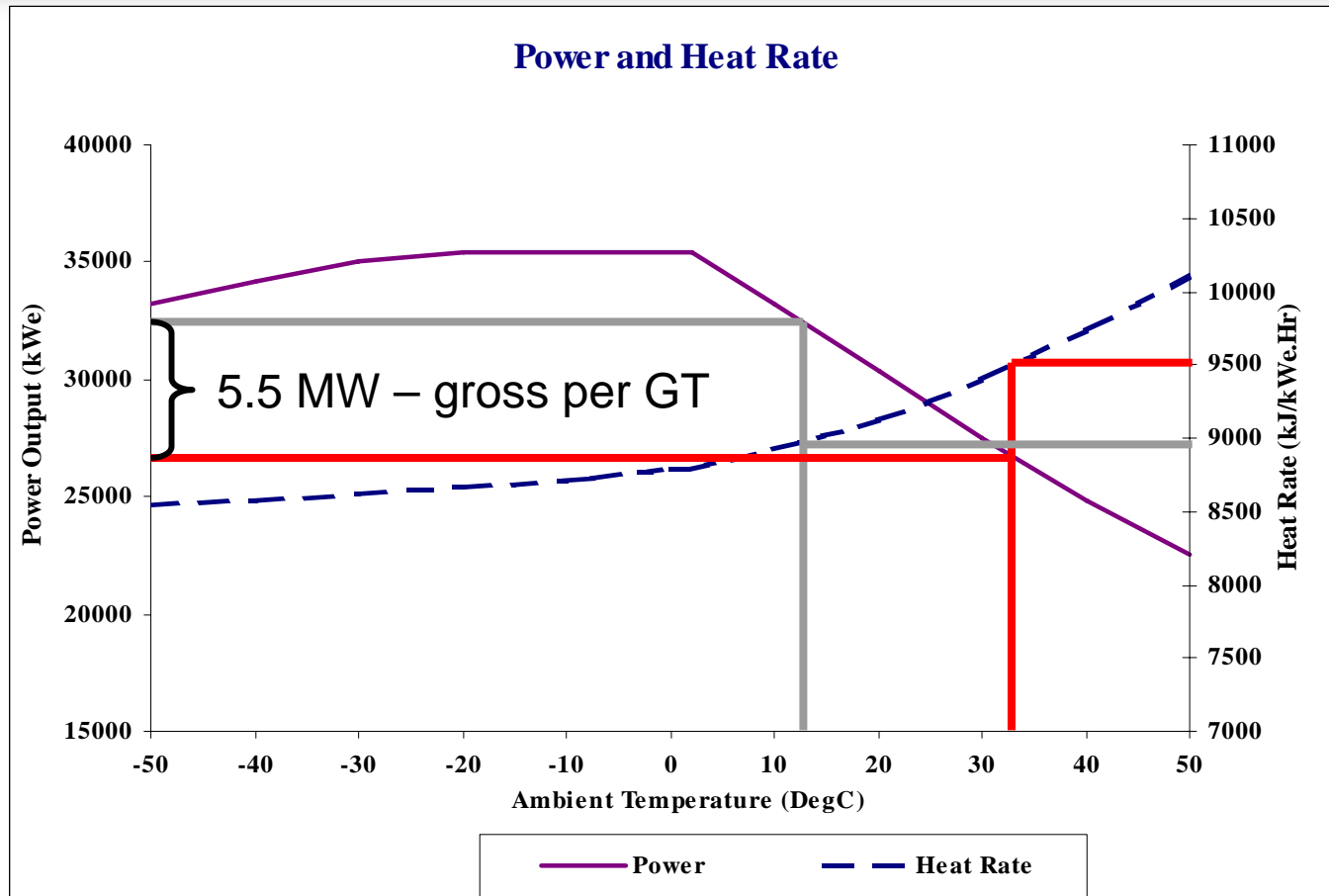


RB211 Air Flow

Exhaust Gas Conditions



RB211 6761 Power & Heat Rate



Batam Site Prior to Chiller



Delivering the Solution

- ◆ Site visits to confirm conditions and dimensions saved much time and effort
- ◆ Knowledgeable owner required
- ◆ Quality local supply of external structures and piping available – no issues
- ◆ Minimizing site interference is critical



Project Execution (cont.)

- ◆ Experienced shipping personnel necessary, but with this, process went well
- ◆ Local contractors had a learning curve on chilled water systems
- ◆ Modular solution critical to the overall solution
- ◆ Solutions provided required for startup and commissioning



Modular Retrofit Kit



Chiller Package On Site



Retrofit in Place Prior to Connection



Filterhouse Complete



Actual Measured Results

- ◆ Total project costs – on budget
- ◆ Heat Rate – 1-2% less than base plant
- ◆ +9 MW NET for 2 X RB211 at 32°C



Summary

- ◆ Turbine inlet cooling is accepted worldwide
- ◆ For power producers that need more power – great value proposition
- ◆ The humidity in Asia is not a problem
- ◆ Simple cycle plants running well for long periods
- ◆ Combined cycle plants benefit also as proven by installation on advanced GT's

