



**Miglioramenti nella
flessibilità dei cicli
combinati:
esperienze recenti
di Ansaldo Energia**

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Miglioramenti nella flessibilità dei cicli combinati: esperienze recenti di Ansaldo Energia

→ ITALIAN ELECTRICITY MARKET SCENARIO

→ AE94.3A4 FLEXIBILITY PACKAGES

⇒ MEL Reduction

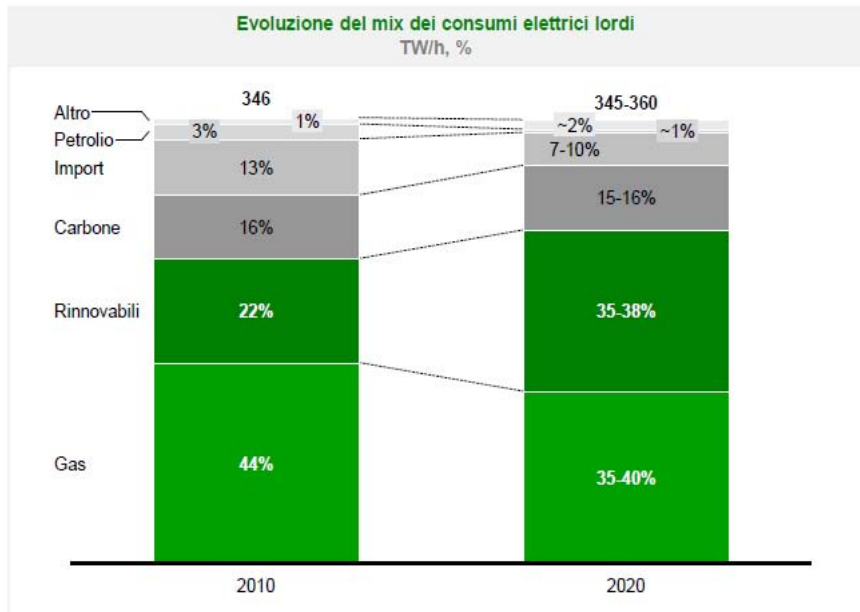
⇒ Grid Support

⇒ Start-up Time Reduction

→ CONCLUSIONS



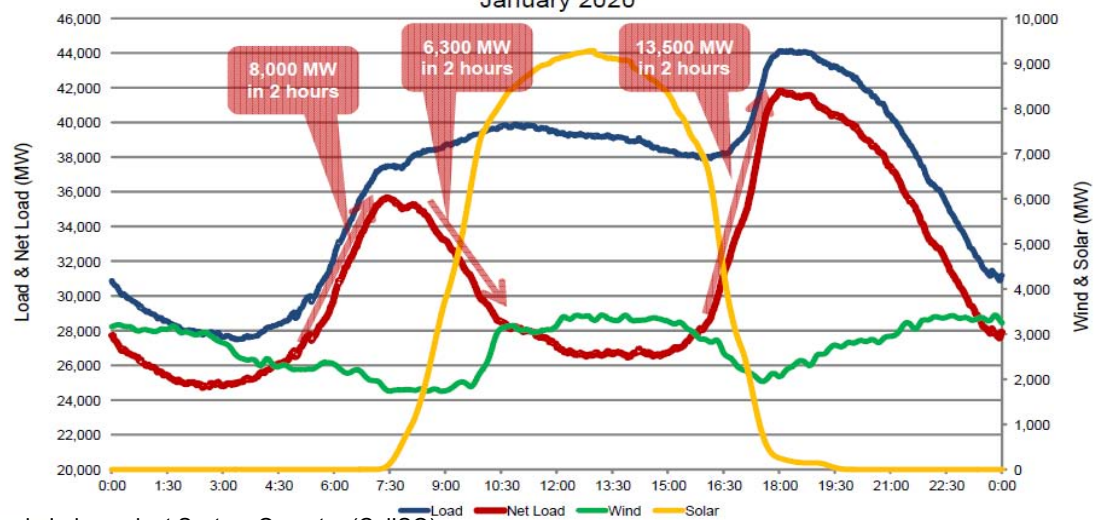
ITALIAN ELECTRICAL MARKET SCENARIO





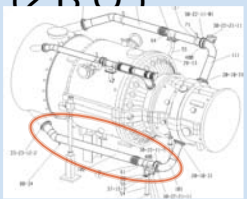
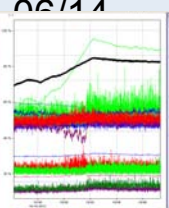
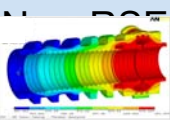
Strategia Energetica Nazionale: per un'energi

Example: California prediction for 2020
→ + 13500 MW in 2 hours



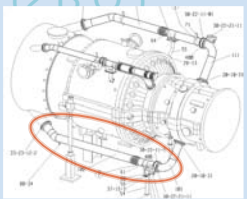
Load, Wind & Solar Profiles – High Load Case
January 2020



SUMMARY OF AE94.3A4 FLEXIBILITY PACKAGES

Package	Tested 		On-going 		
	Item	Benefit tested	Item	Benefit exp.	Timing
MEL Reduction	CO Catalyst	-30÷35 MW	Regulating Blow-off 	-15 MW (2 B.O.)	12/14
	Antiicing	-10 MW			
	Cooling Valves	-3÷5 MW			
	Blow-off open	-8 MW (1 B.O.)			
Grid Support	GT Load Gradient	Up to 30 MW/min (Up to 42 MW/min with SAS-up)	Humming active control	Combustion stability increase (ramps, BL)	
	HCO ON Fast Unloading	Up to 36 MW/min			
Start-up Time Reduction	GT cold load gradient	Up to 13 MW/min	Purge credit	Up to 20 min	Ready
	BOP & HRSG logics optimization	Up to 40 min saved		Start-up strategy customization	06/14

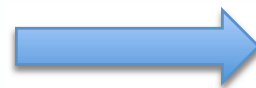
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MEL REDUCTION: TESTED PACKAGES

Anti-Icing + cooling valves + CO Catalyst

ANTI-ICING	CATALIZZATORE	Δ LOAD [MW]	CO/NOx [mg/Nm ³]	TV1 [°C]
		0	<30	7,8
✓		-7	<30	12,9 (Tamb 8,3)
	✓	-34	<30	8,2
✓	✓	-41	<30	14,1 (Tamb 9,0)



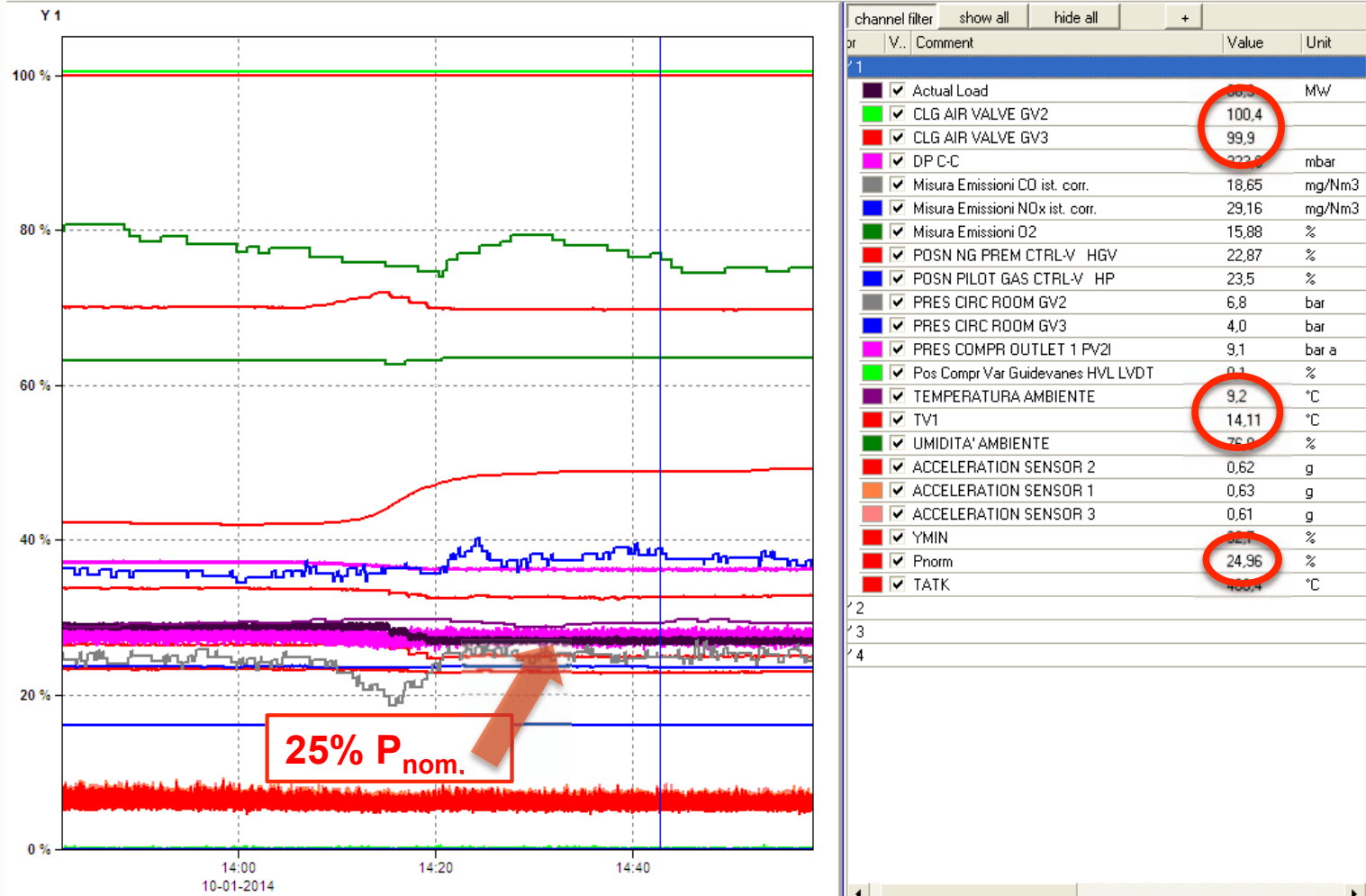
COMBINED CATALYST + ANTI-ICING: -41MW



Load=25% $P_{nom.}$ / $\eta_{TG}=21\%$

MEL REDUCTION: TESTED PACKAGES

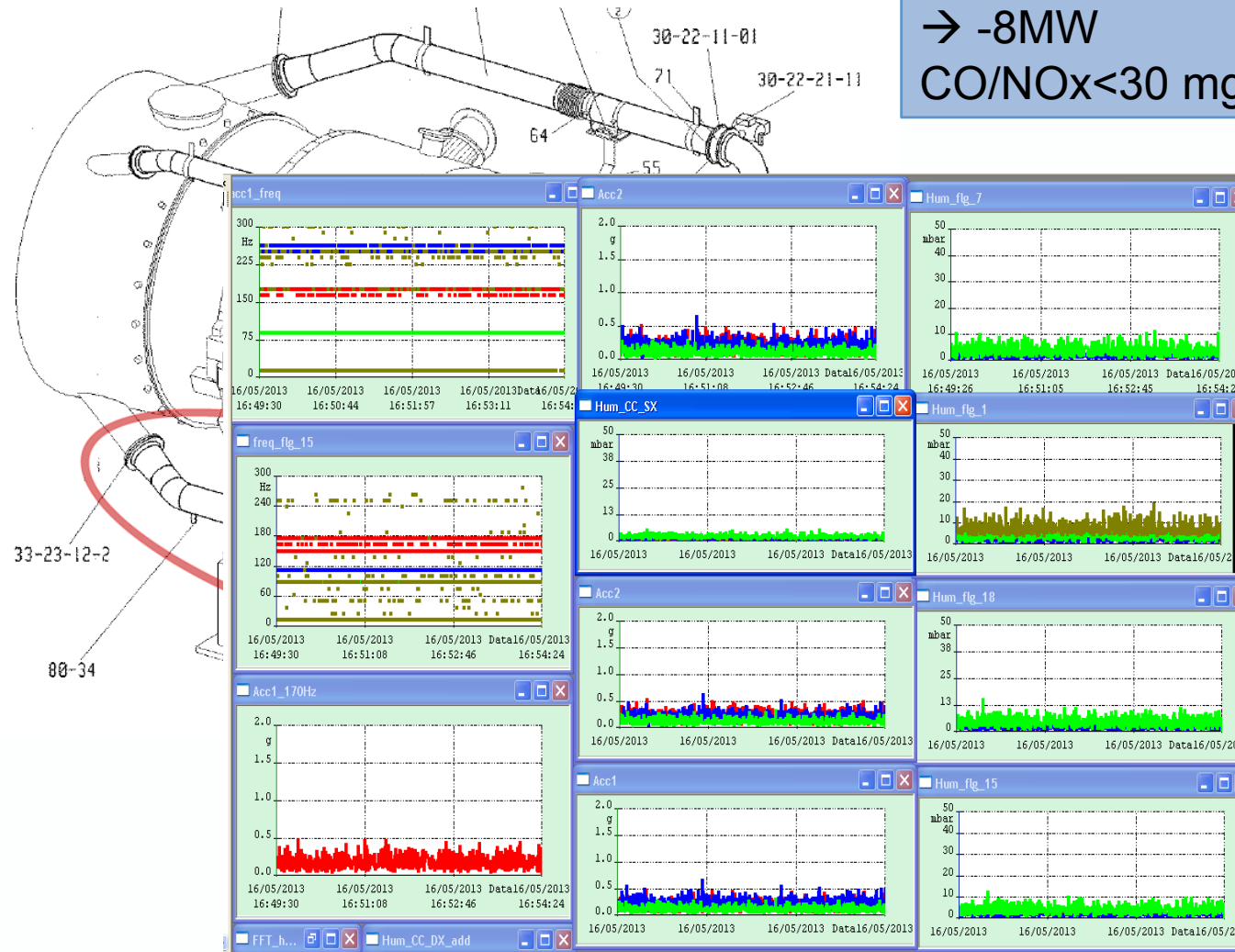
Anti-Icing + Cooling Valves + CO Catalyst





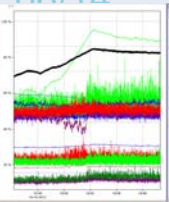
MEL REDUCTION: TESTED PACKAGES

Blow-Off valves: A1.I opened

→ -8MW
CO/NO_x < 30 mg/Nm³

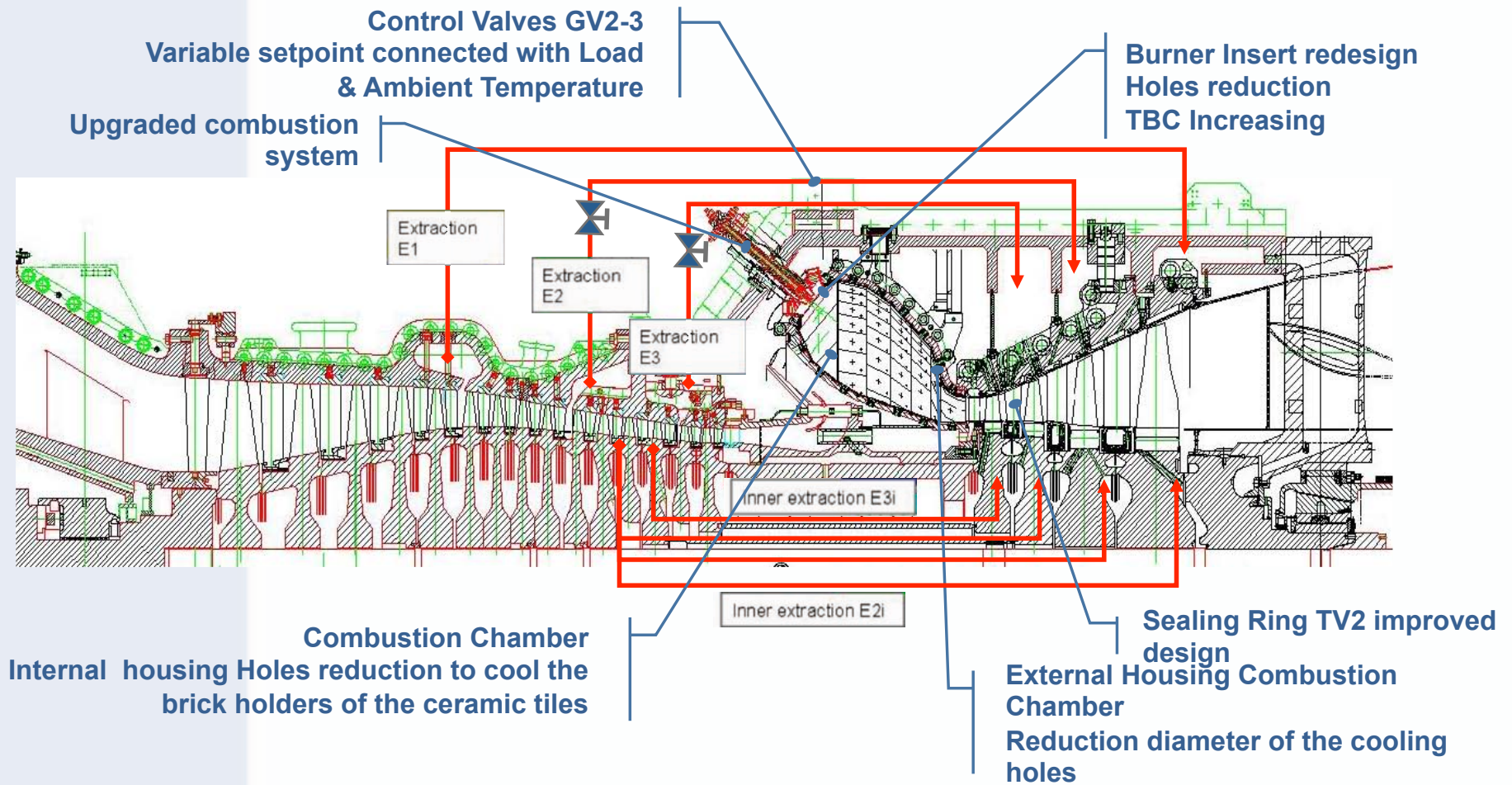


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LOAD GRADIENT: SAS-UP CONFIGURATION

✓ **Combustion Chamber cooling optimization**



GT LOAD GRADIENT IMPROVEMENT

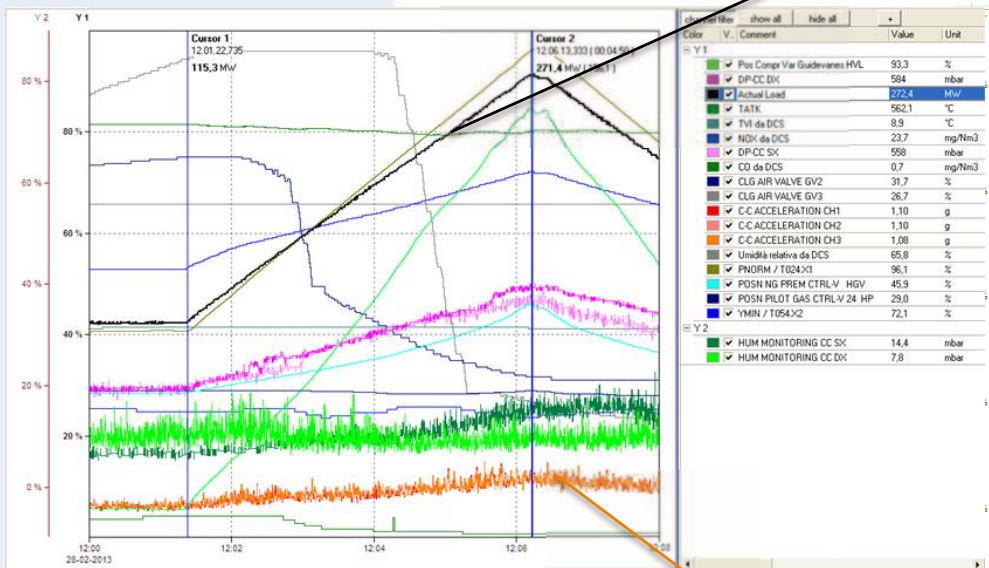
- ✓ Load Ramp Test: Initial Target 32 MW/min from Minimum to 97% Load
- ✓ NOx Target < 30 mg/Nm³ (Diffusion Pilot Burners + SAS up)
- ✓ Target matched and improved: 42 MW/min with stable condition

115→270 MW
32 MW/min

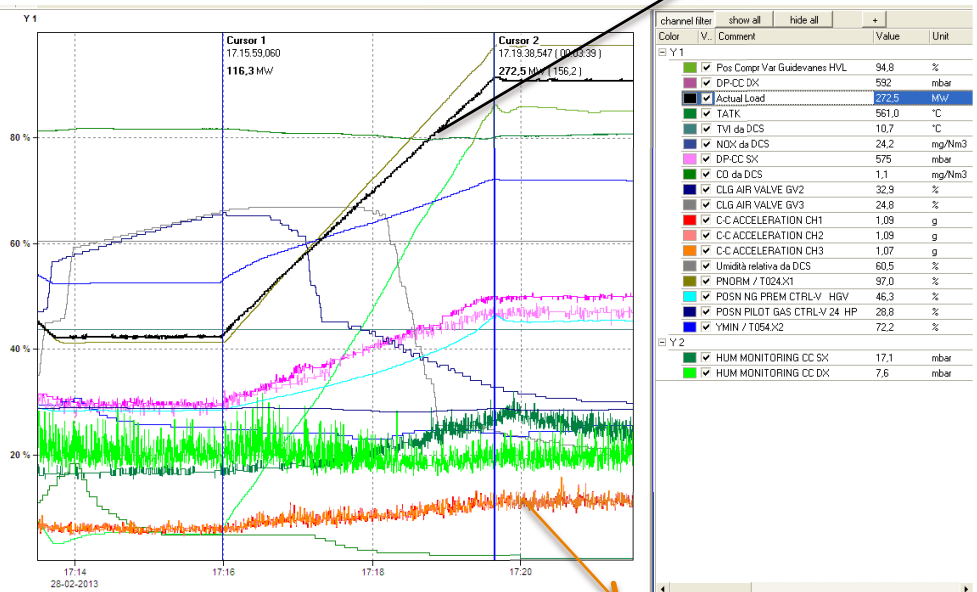
Load

115→270 MW
42 MW/min

Load



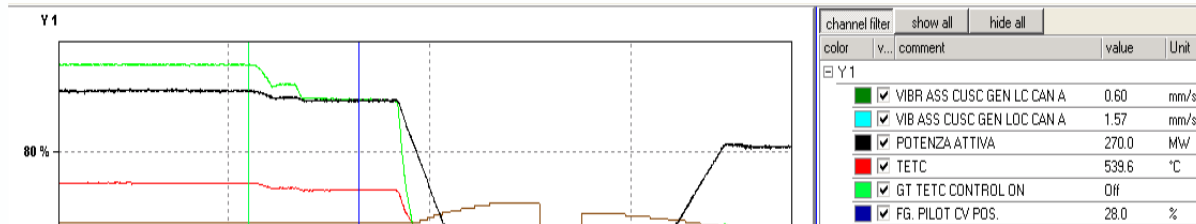
Combustion Dynamics



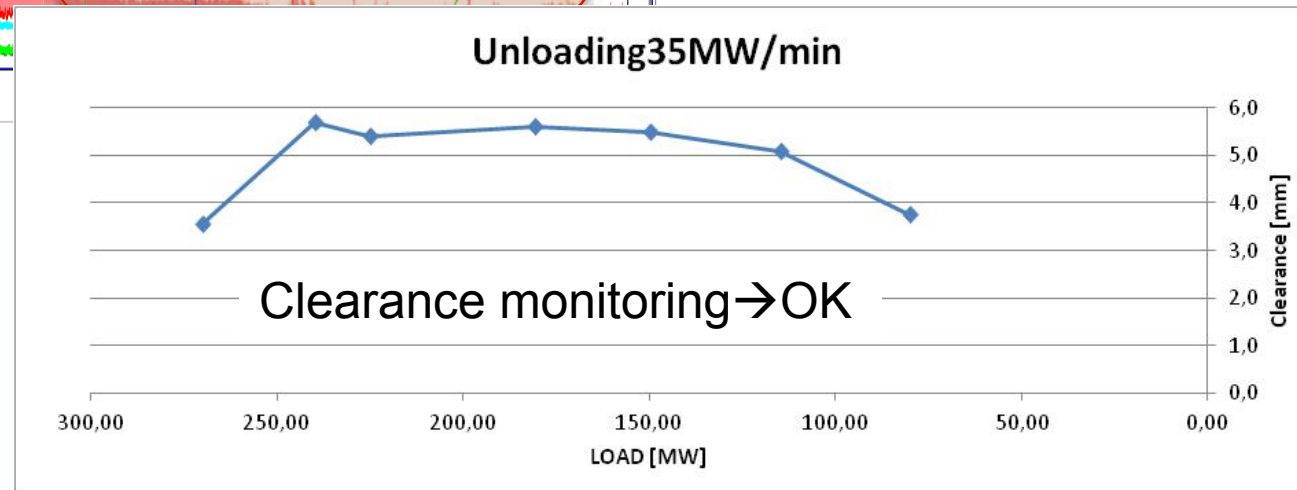
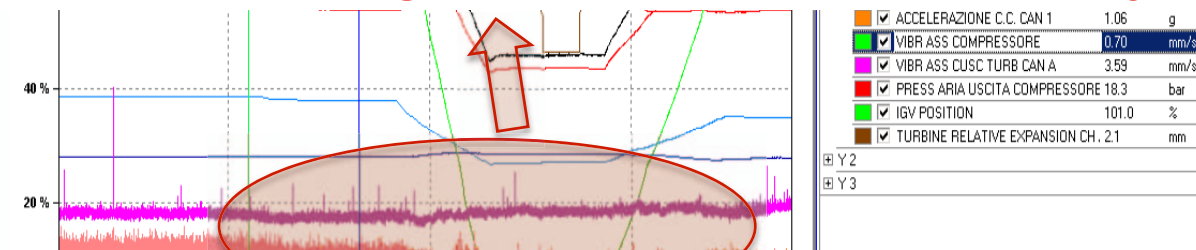
Combustion Dynamics

GT LOAD GRADIENT IMPROVEMENT



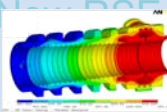
- ✓ Fast Unloading load rate increase with HCO on
- ✓ Unloading 100% → 5% IGV @ 36MW/min



No impact on bearing vibration and combustion stability

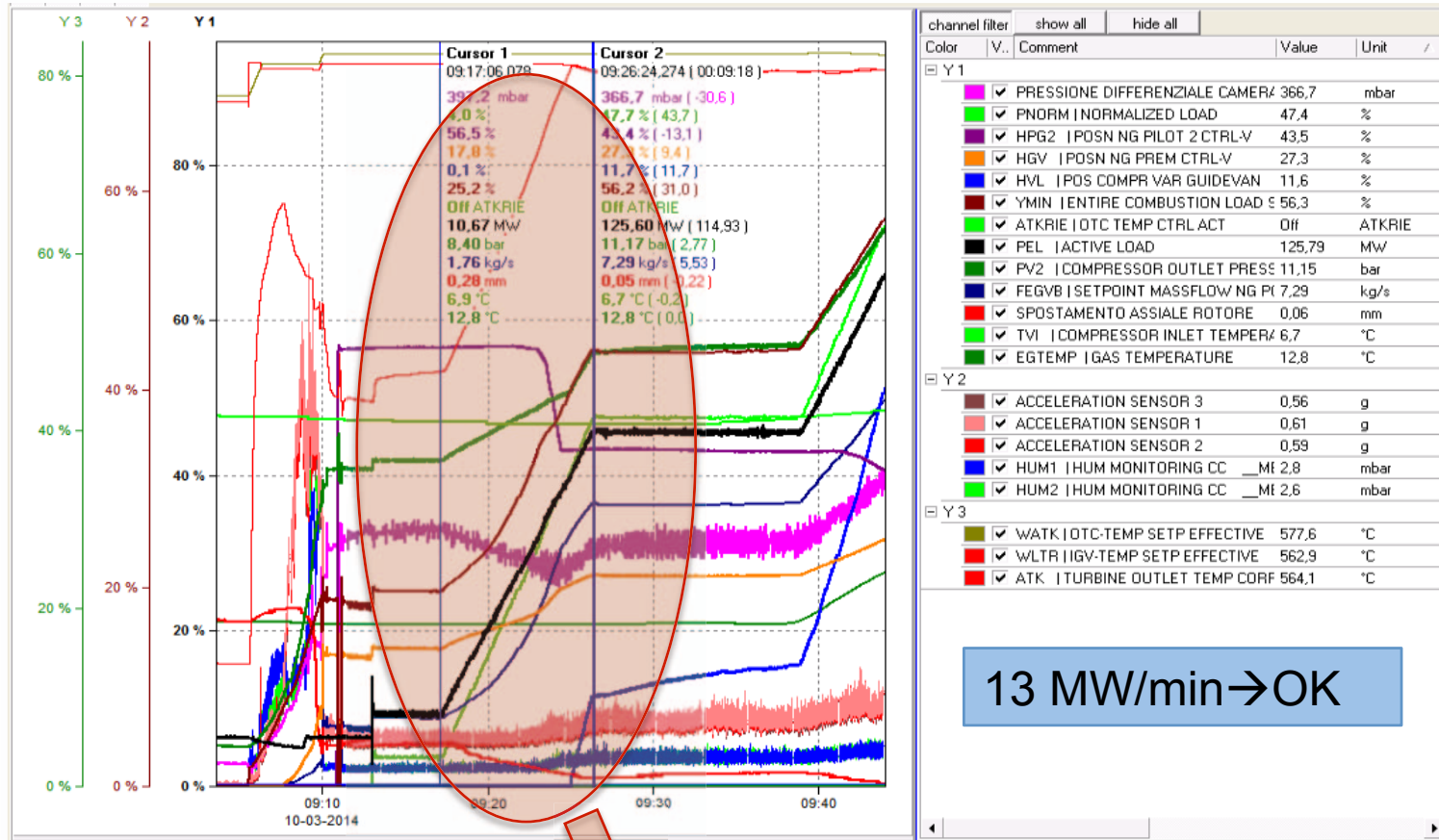


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GT COLD LOAD GRADIENT

FSNL → MEL @ 13 MW/min



13 MW/min → OK

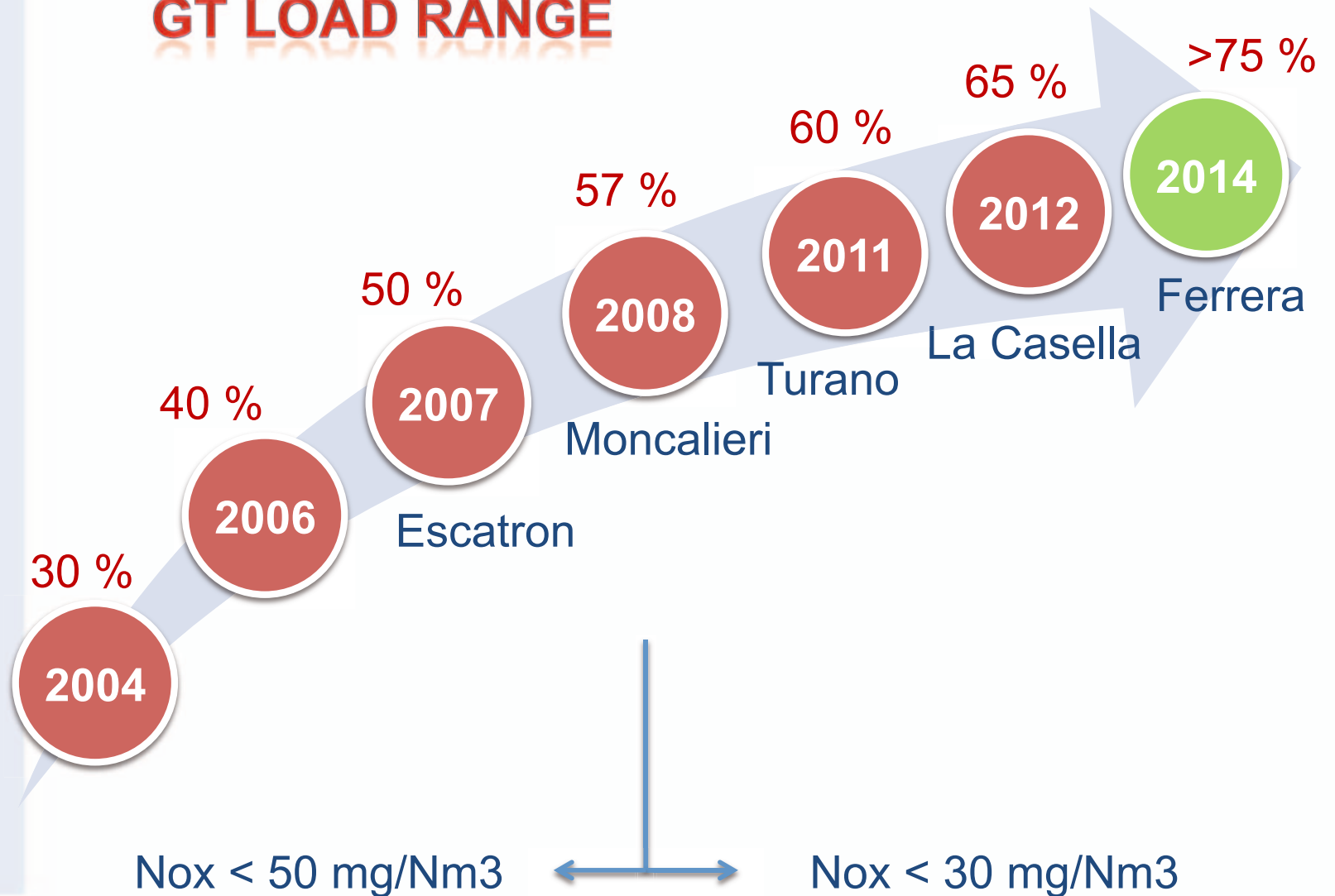
10 → 125 MW in 9 min

BOP & HRSG LOGICS OPTIMIZATION

- ✓ HRSG start-up ramp optimisation: variable GT load gradient as function of HRSG HP drum pressure → SAVED UP TO 15'
- ✓ ST minimum steam conditions for start up (permissives) → SAVED UP TO 20'
- ✓ Better operation of drains and vents to reduce steam lines warming up time → SAVED UP TO 5'

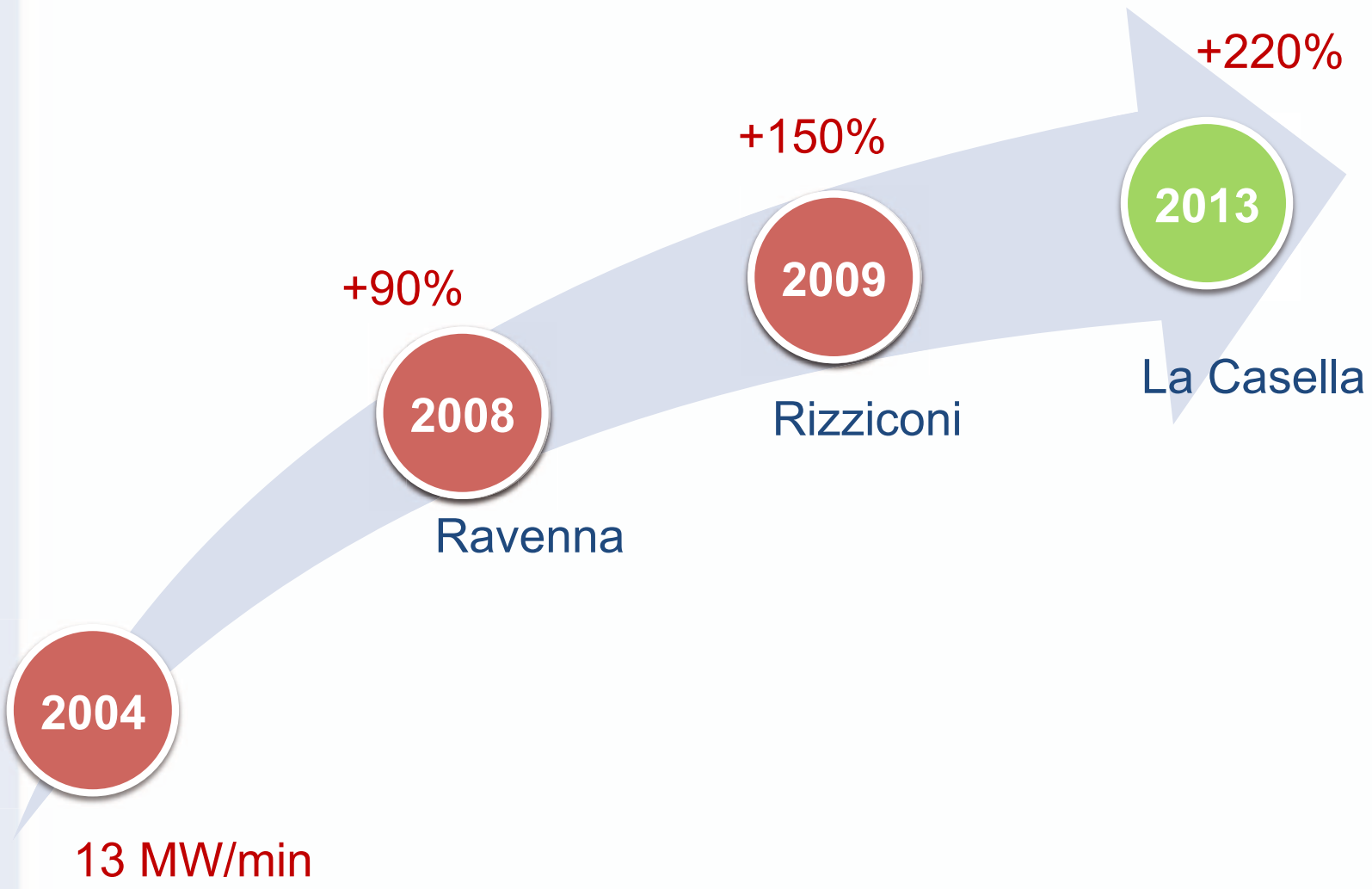
CONCLUSIONS: GT LOAD RANGE UPGRADE

GT LOAD RANGE



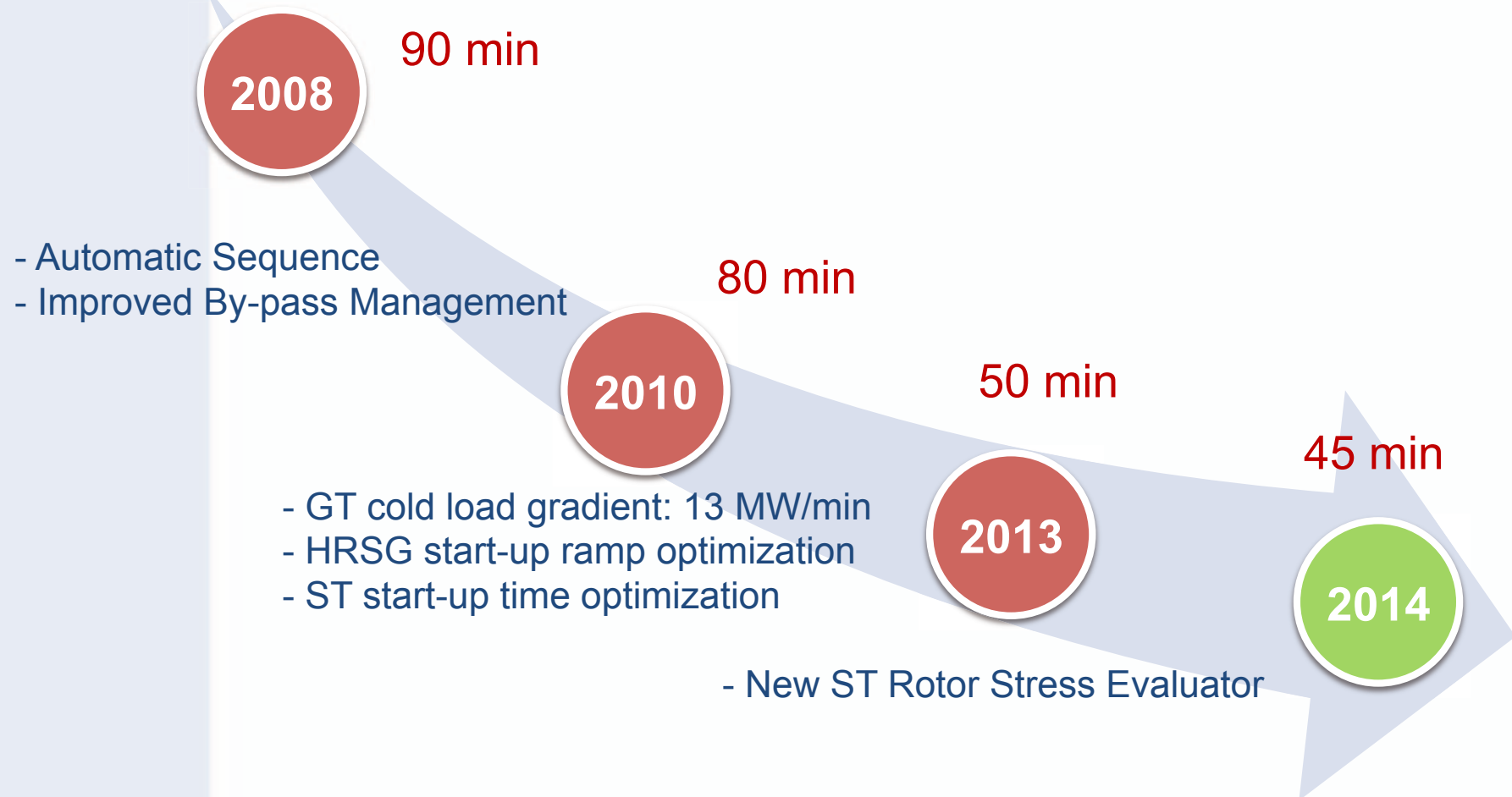
CONCLUSIONS: GT LOAD GRADIENT UPGRADE

GT LOAD GRADIENT



CONCLUSIONS: START UP TIME REDUCTION

HOT START-UP TIME FOR REF. 1+1 CCPP



***Thank you
for your attention***



BACK-UP

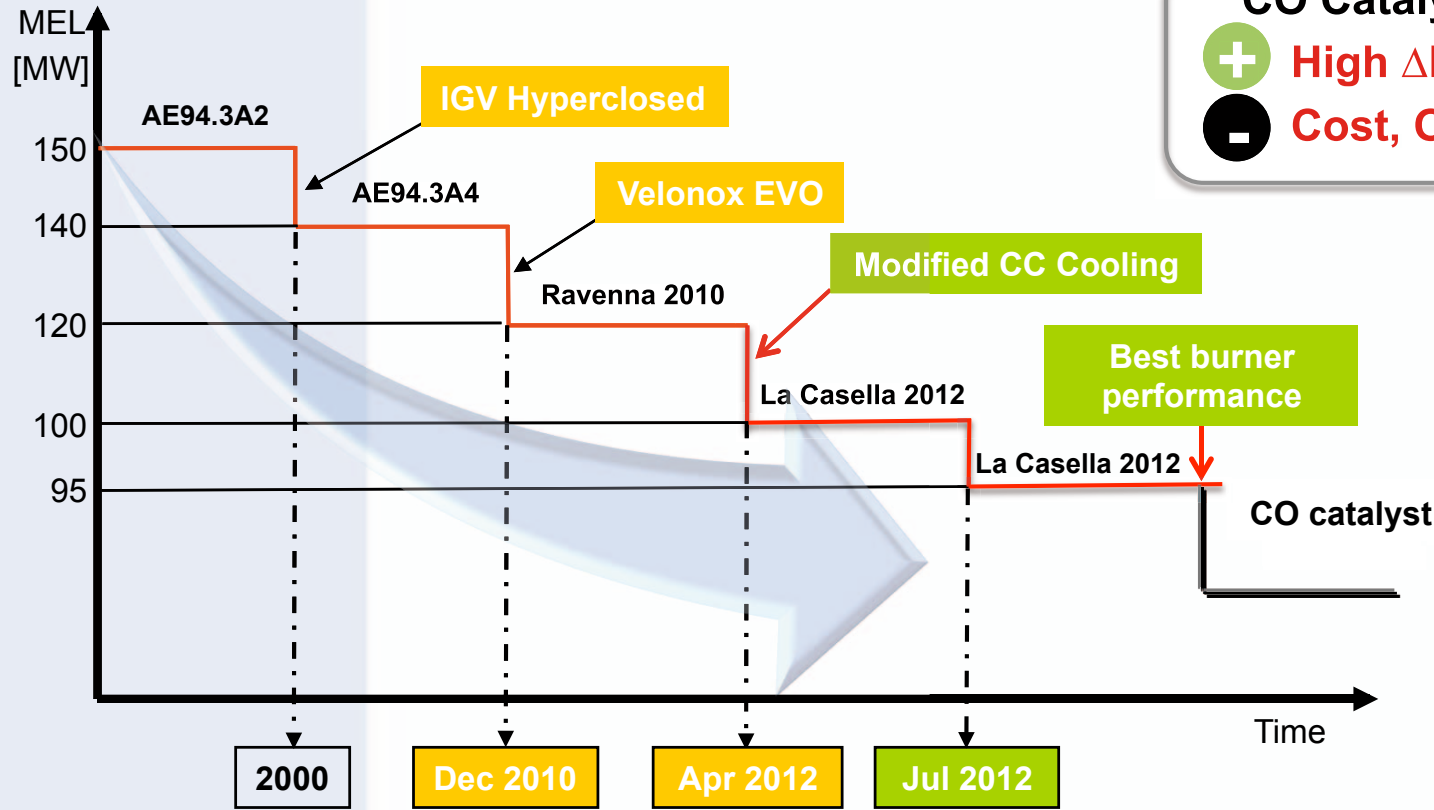


MINIMUM ENVIRONMENTAL LOAD REDUCTION

Antiicing

- Compressor Bleed: **+** Δ Power, Cost **-** Efficiency
- External heat Exchanger: **+** Δ Power, Efficiency **-** Cost

Main CC & Burner improve

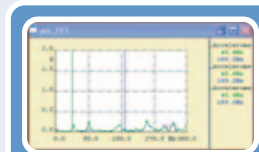


CO Catalyst

- +** High Δ Power, High efficiency
- Cost, Outage (\approx 2wks)



CONTROL SYSTEM PACKAGES



HUMMING ACTIVE CONTROL

- Humming Monitoring to improve Combustion Stability Control Logic
- Acts on Fuel Valve & TETC control to prevent instability growth



EMISSIONS CONTROL

- Integration of exhaust composition measure in control logic



FUEL FLEXIBILITY

- Modify the control strategy to rapidly compensate the fuel quality change



Cooling valves control optimization

- Cooling valves control optimization based on GT load



Tuning4seasons

- Gas / air control optimization based on ambient and operating conditions



Antiicing control

- SW modification to enable compressor bleed antiicing for MEL reduction

MEL	Ramp Stability	Performance
	X	X
X		
X	X	
X		X
X	X	X
X		

ANSALDO «EFFICIENCY»

