Energy Efficiency in the Power Sector

17 September 2010

ACTSYS

Preamble

- Power Plants Thermal Efficiency
  - Base efficiency determined by design and configuration
  - Steam boilers ~ 38-42%
  - Gas Turbine Combined Cycle ~ 48-54%
- Operating Plants Challenge
  - Safety and Reliability
  - Efficiency and baseload loss with degradation

Historical Legacy

- Power plants operated under PPA (Power Purchase Agreement) with offtaker
- Offtaker (National Electricity Company) supplies fuel and offtakes electricity
- Power Plant is paid an operational and maintenance fee by the offtaker
- Main obligation of Power Plant is to operate reliably and safely
- Energy Efficiency is secondary importance

Traditional Efficiency Monitoring

- Monthly calculation – divide electricity produced by total fuel consumed
- Reported figure is an average monthly efficiency value which cannot be used to focus corrective maintenance
- Routine maintenance driven mainly by reliability aspects
- An outdated practice with today's global warming threat

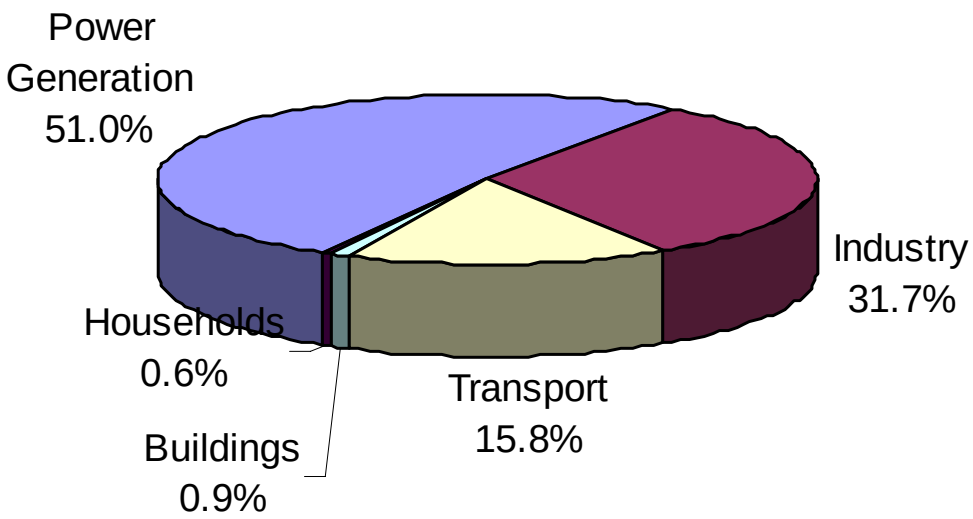
Power Plants Efficiency

		Before	After	Delta	Basis
Average Unit Loading	MW	350	350		
Thermal Efficiency	%	50.0	50.1	(0.1)	
Energy Consumption	GJ/H	2,520	2,515	5.03	
Annual Energy Savings	GJ/Yr			43,459	
	MWh/Yr			12,072	
Fuel Gas Savings	MMBtu/Yr			41,193	
Cost Savings	US$/Yr			288,351	Fuel Cost is US$7/MMBtu
Fuel Savings	ton/Yr			903	Fuel LHV = 48139 kJ/kg
CO_2 Savings	ton/Yr			2,483	Natural Gas composition C:H = 4:1

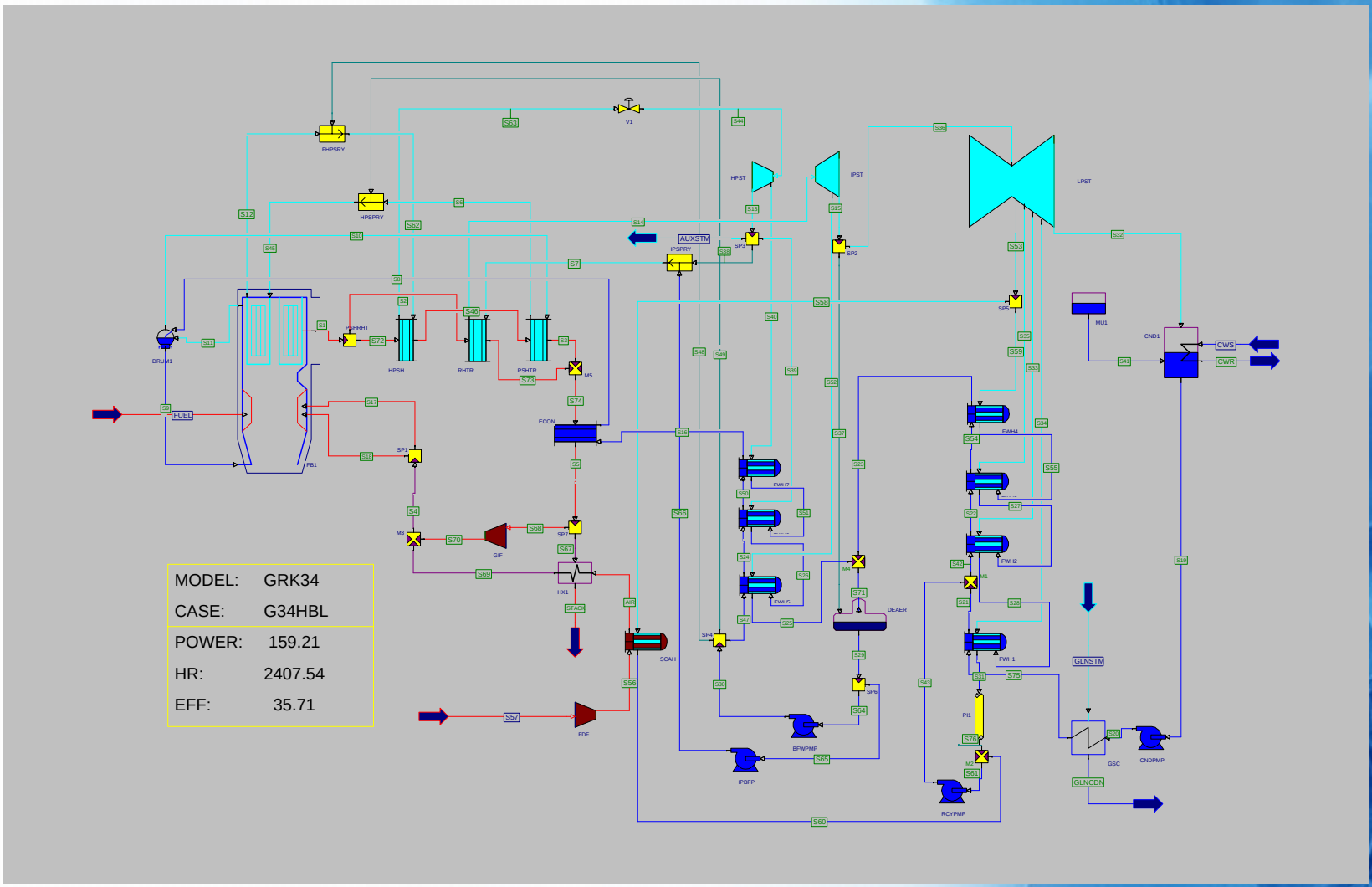
Suntec City					
Annual Energy Cons	MWh/Yr			87,600	10 MW Power consumption

Typically power plants can loose 1-2% thermal efficiency with traditional maintenance

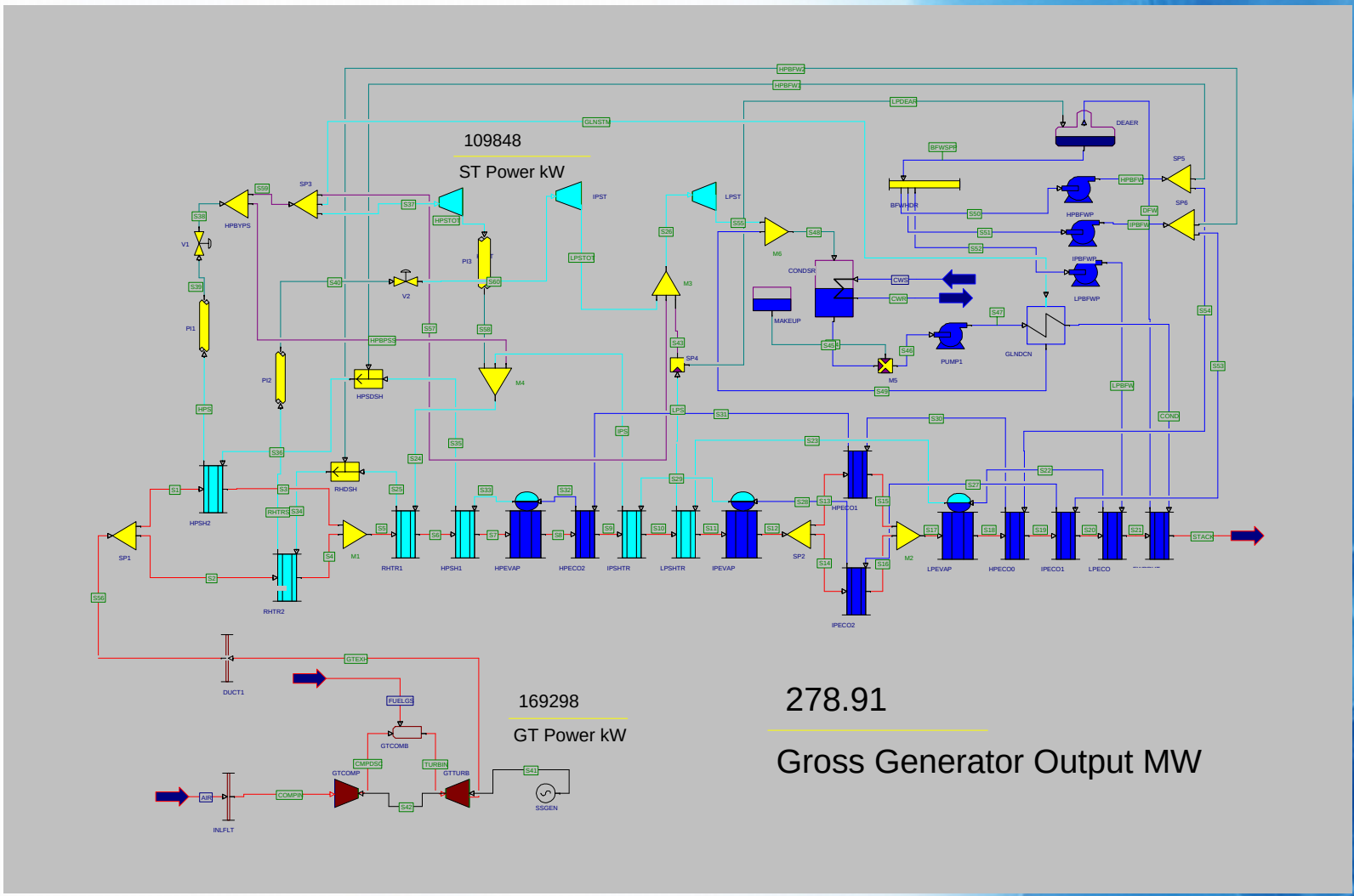
Singapore Fuel Consumers



Steam Power Plant



Combined Cycle Plant



GT Compressor Fouling

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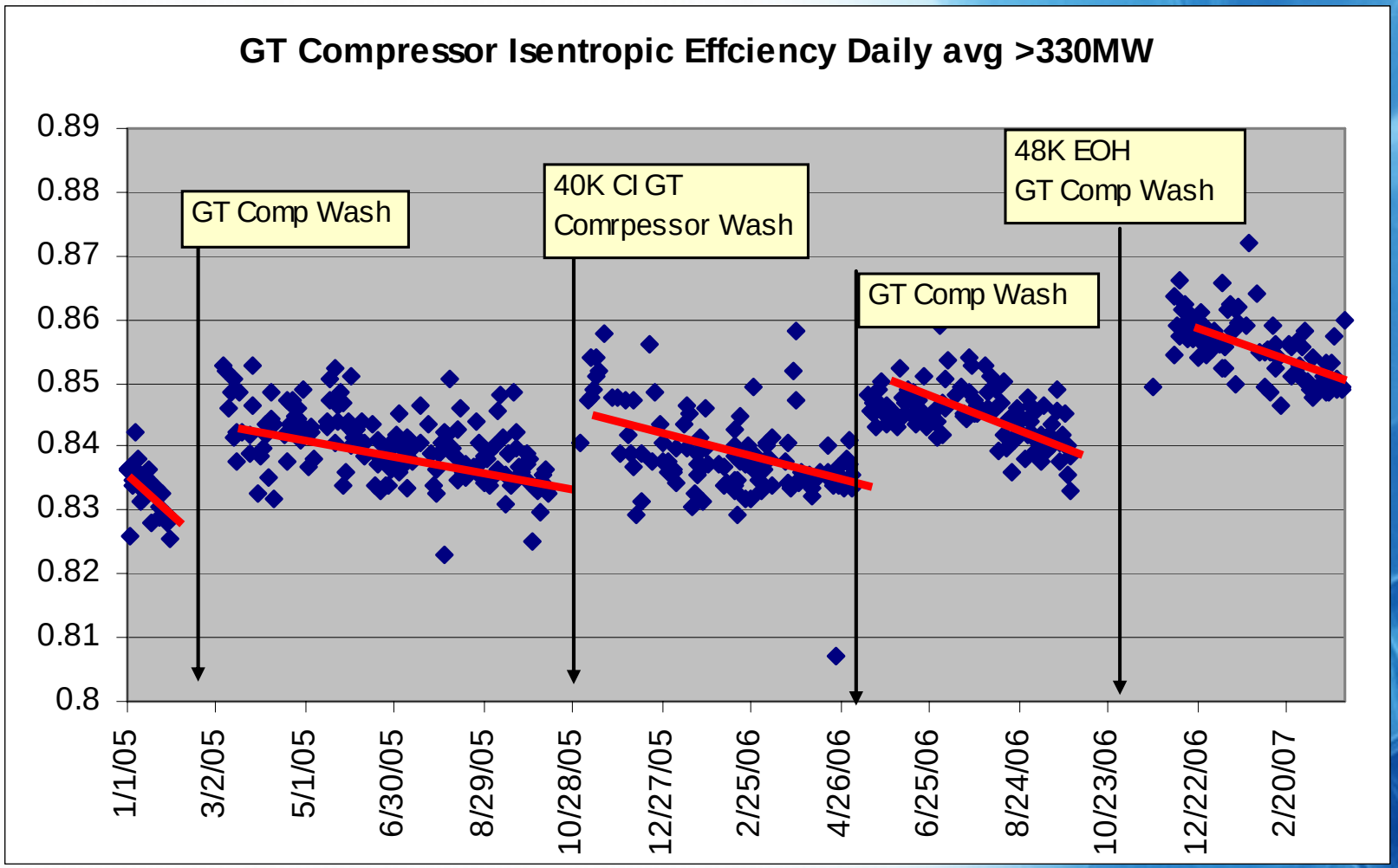
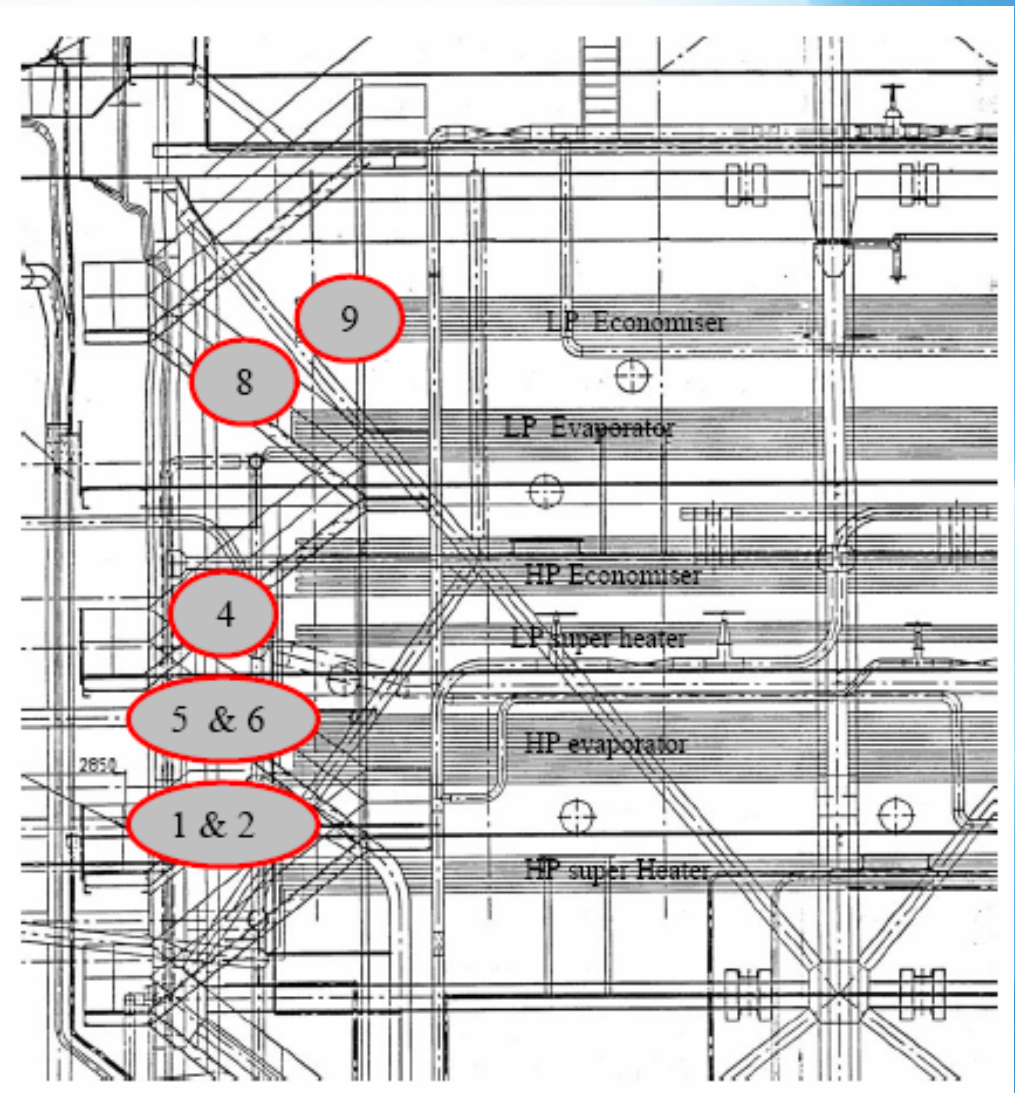


HRSG Fouling



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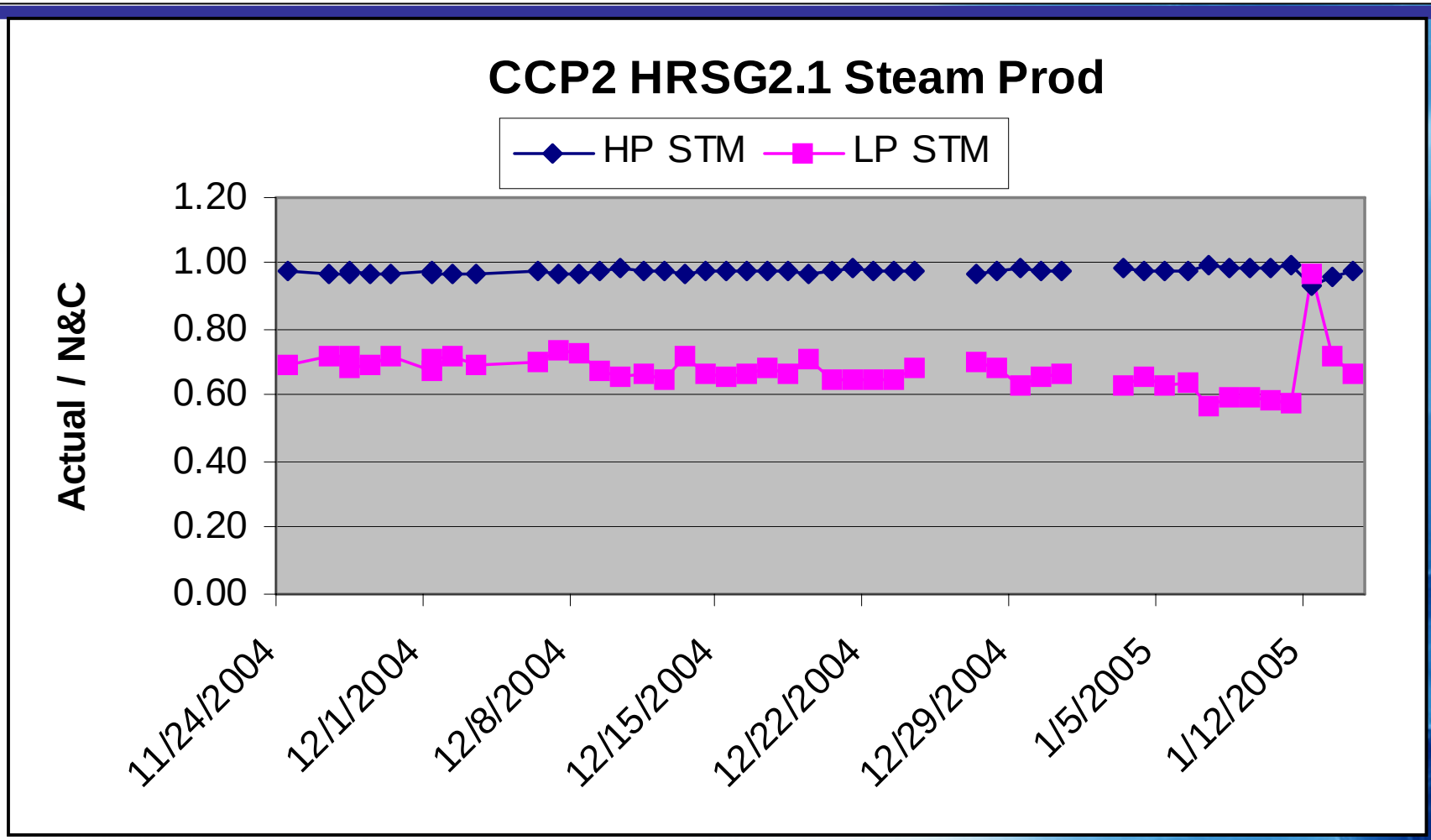
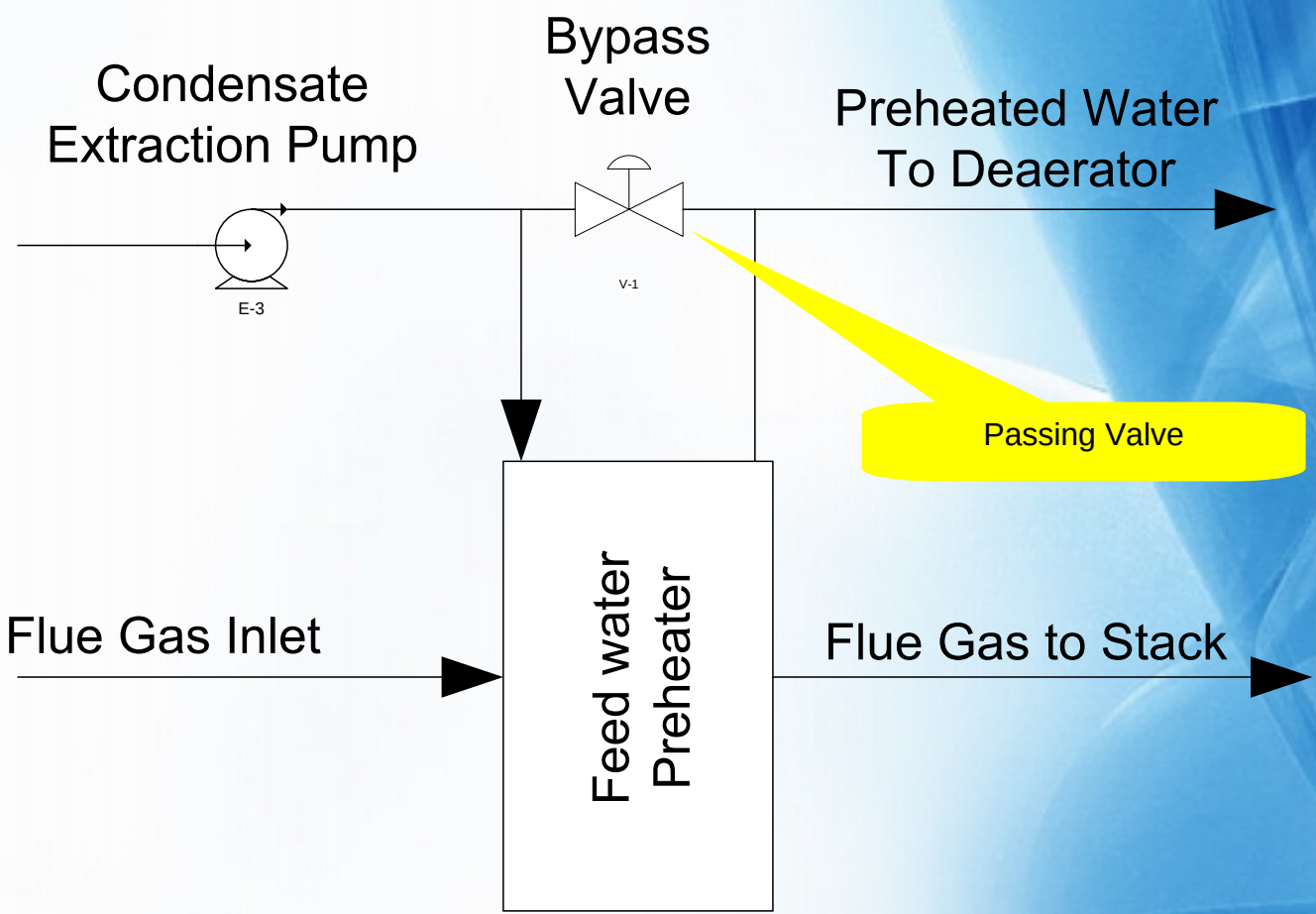


Passing Valves



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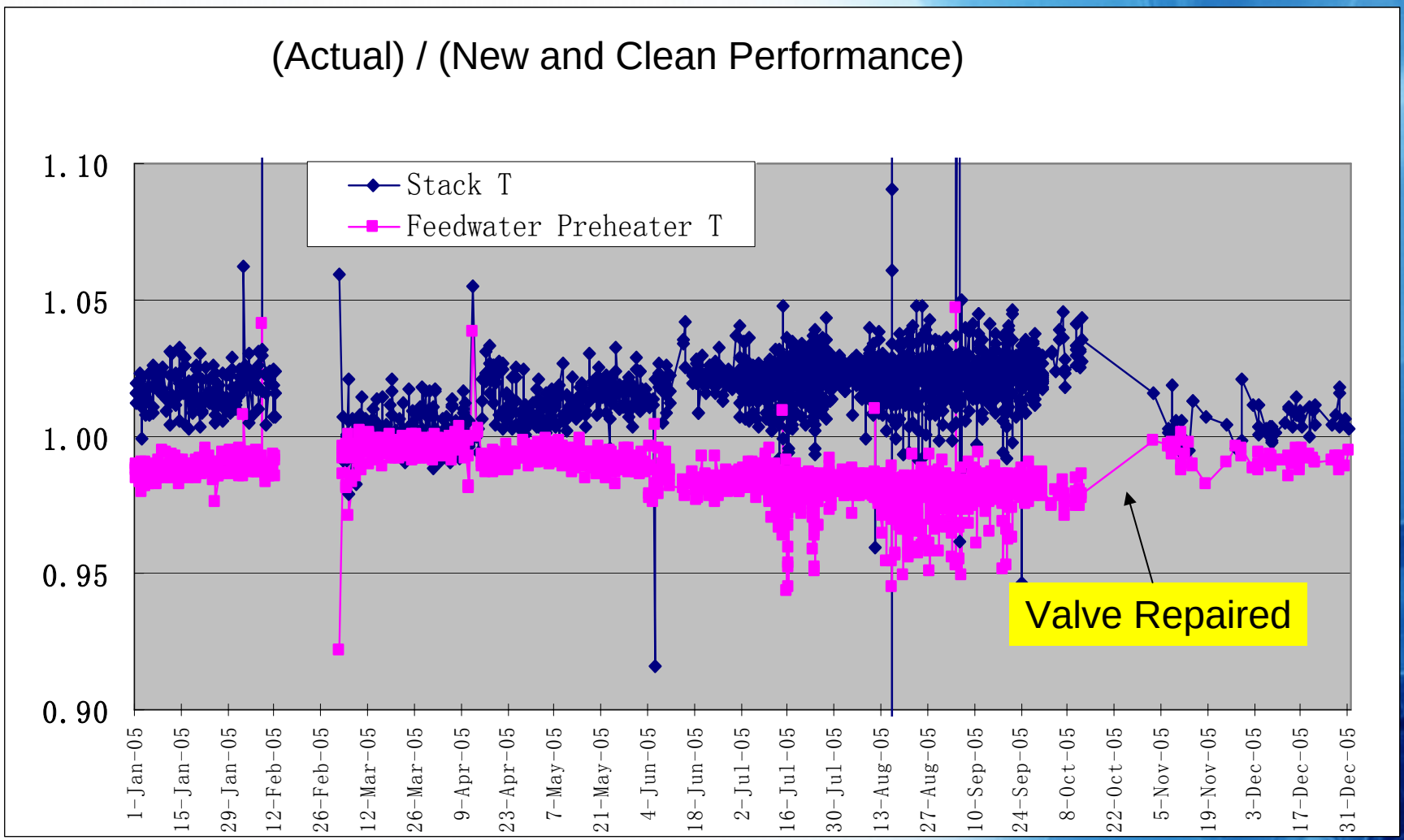
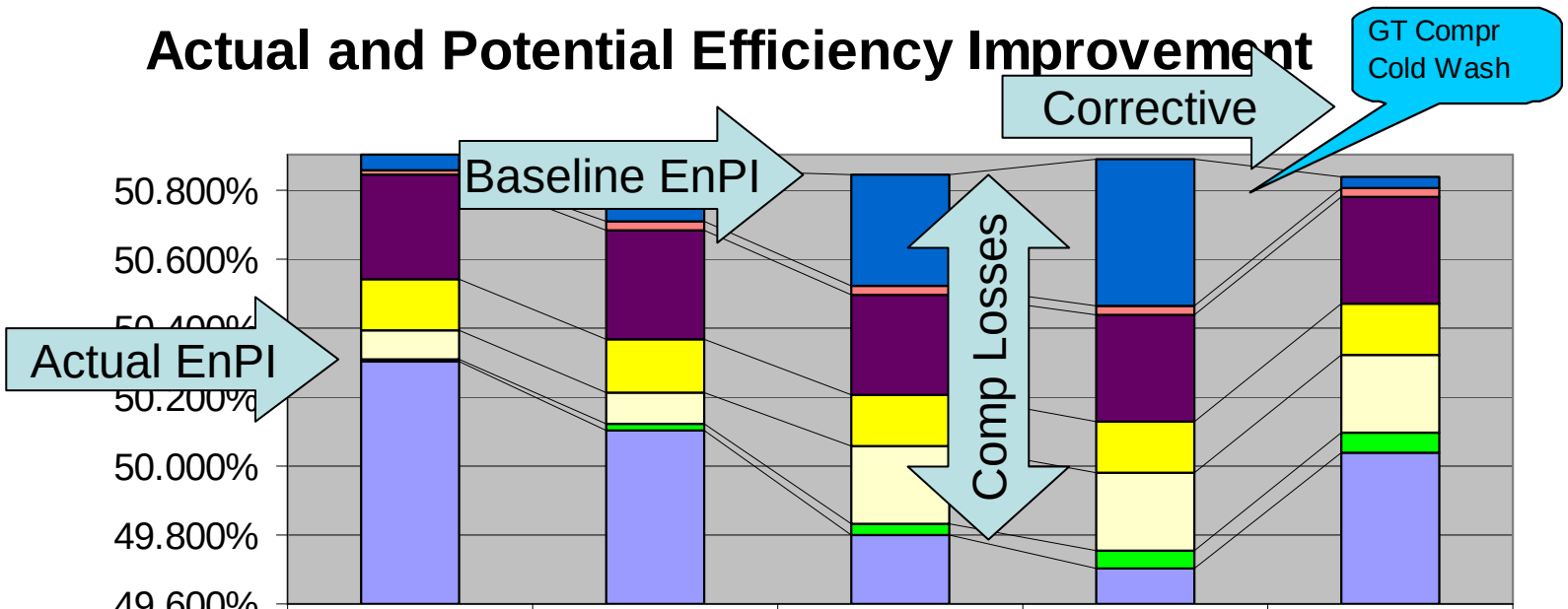


Efficiency Monitoring



	Nov 06	Dec 06	Jan 07	Feb 07	Mar 07
GT Compressor Fouling	0.051%	0.150%	0.320%	0.423%	0.030%
BFP Inefficiency	0.012%	0.020%	0.025%	0.026%	0.026%
LP Bypass	0.300%	0.320%	0.288%	0.310%	0.310%
HP Bypass	0.150%	0.150%	0.150%	0.150%	0.150%
Condenser Fouling	0.085%	0.092%	0.224%	0.225%	0.225%
IAF Pressure Drop	0.005%	0.022%	0.033%	0.054%	0.054%
Actual Efficiency	50.300%	50.100%	49.800%	49.700%	50.040%

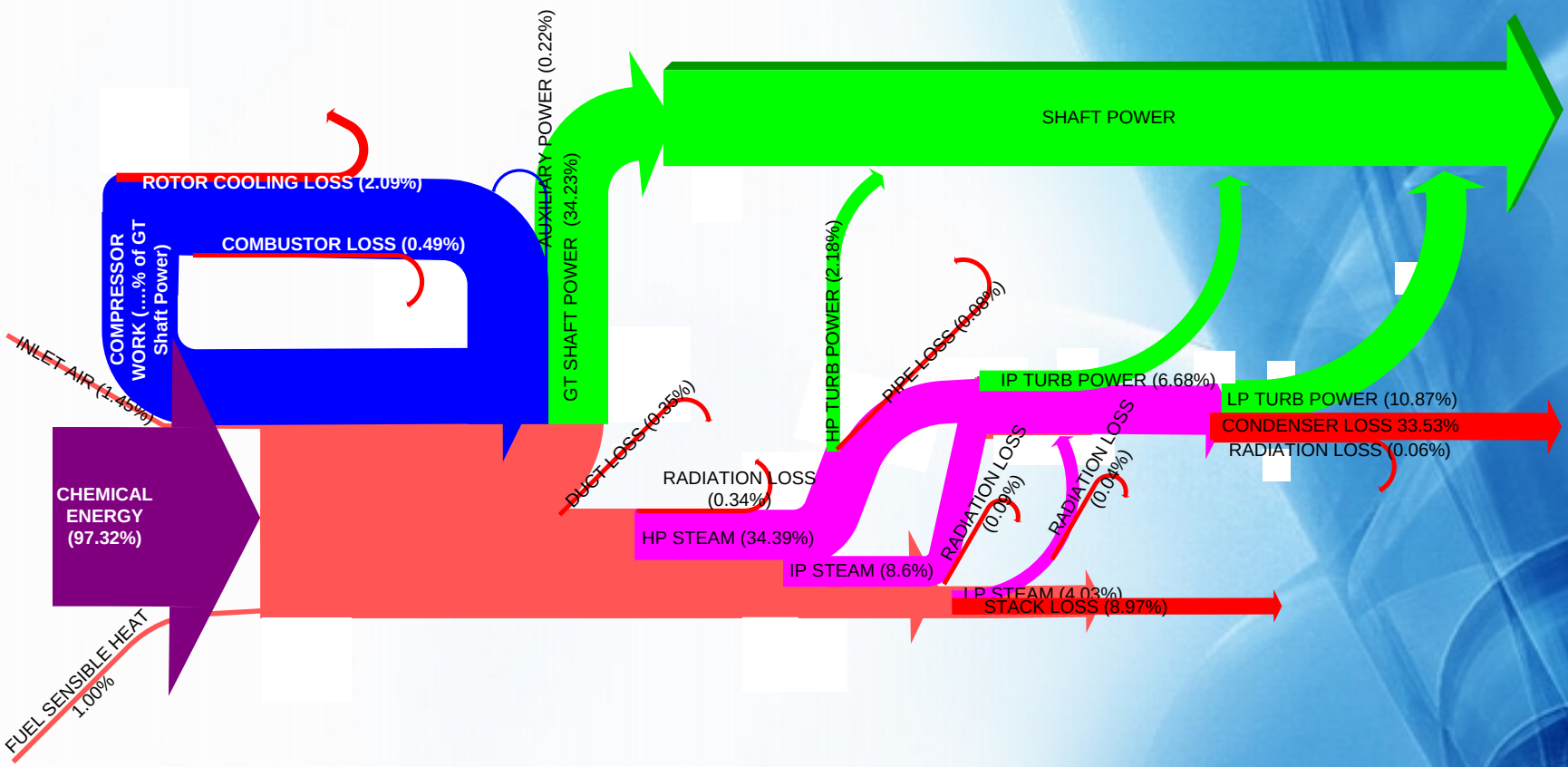
Power Plant Energy Monitoring

- Quantification of the entire plant heat balance using thermodynamic modeling software
- Calculate using models the (New and Clean) performance of the respective plant component and compare with actual
- Quantify the performance gap of each plant component in terms of effect on overall plant efficiency

Energy Management Framework

- Thermodynamic Performance Monitoring program in place
- KPI on max deviation thermal efficiency from New and Clean
- Ownership of KPI not only by Energy Manager but also all support engineering disciplines
- Regular updating of investigative efforts and corrective maintenance plans
- Improvement Initiatives List

Thank You



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