THE COAL RESEARCH FORUM

19th ANNUAL MEETING

"CURRENT DEVELOPMENT IN COAL RESEARCH"

"IGSC – A PRESSURISED OXYFUEL CYCLE THAT USES WATER AS A COOLANT"

10TH APRIL 2008

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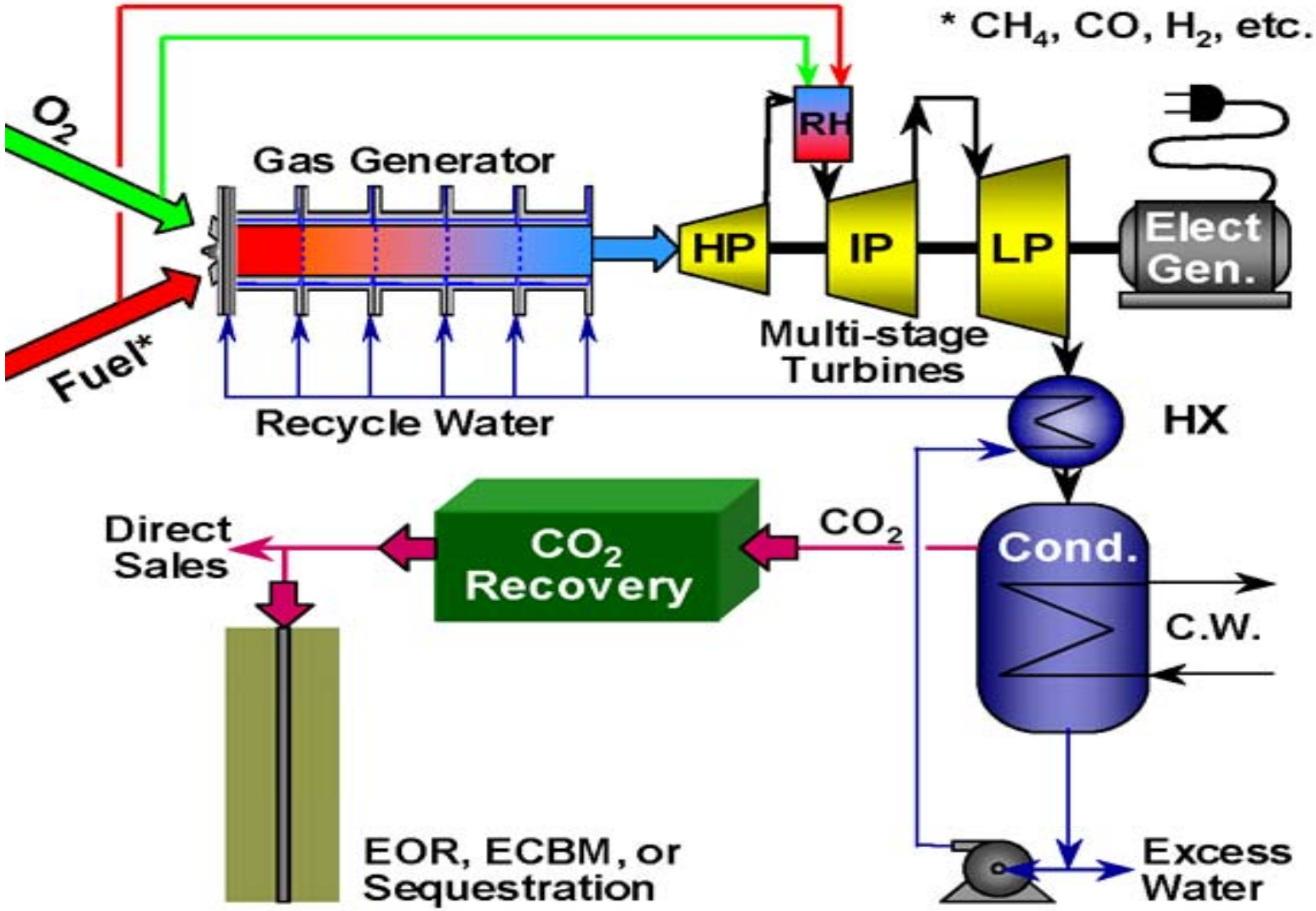
The Original CES Cycle Concept



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20 MW_{th} GAS GENERATOR - 1

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20 MW_{th} GAS GENERATOR - 2

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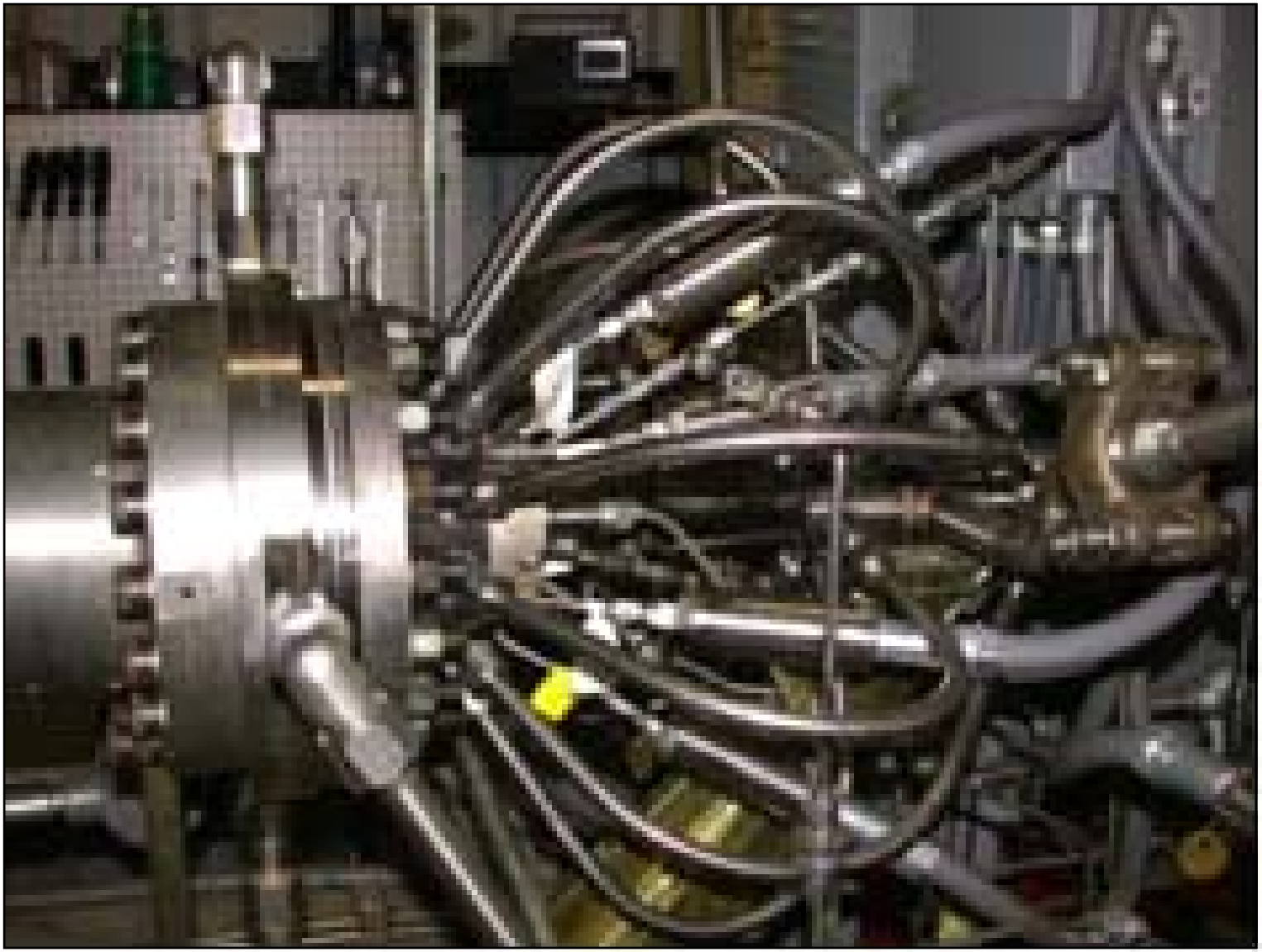
20 MW_{th} GAS GENERATOR - 3



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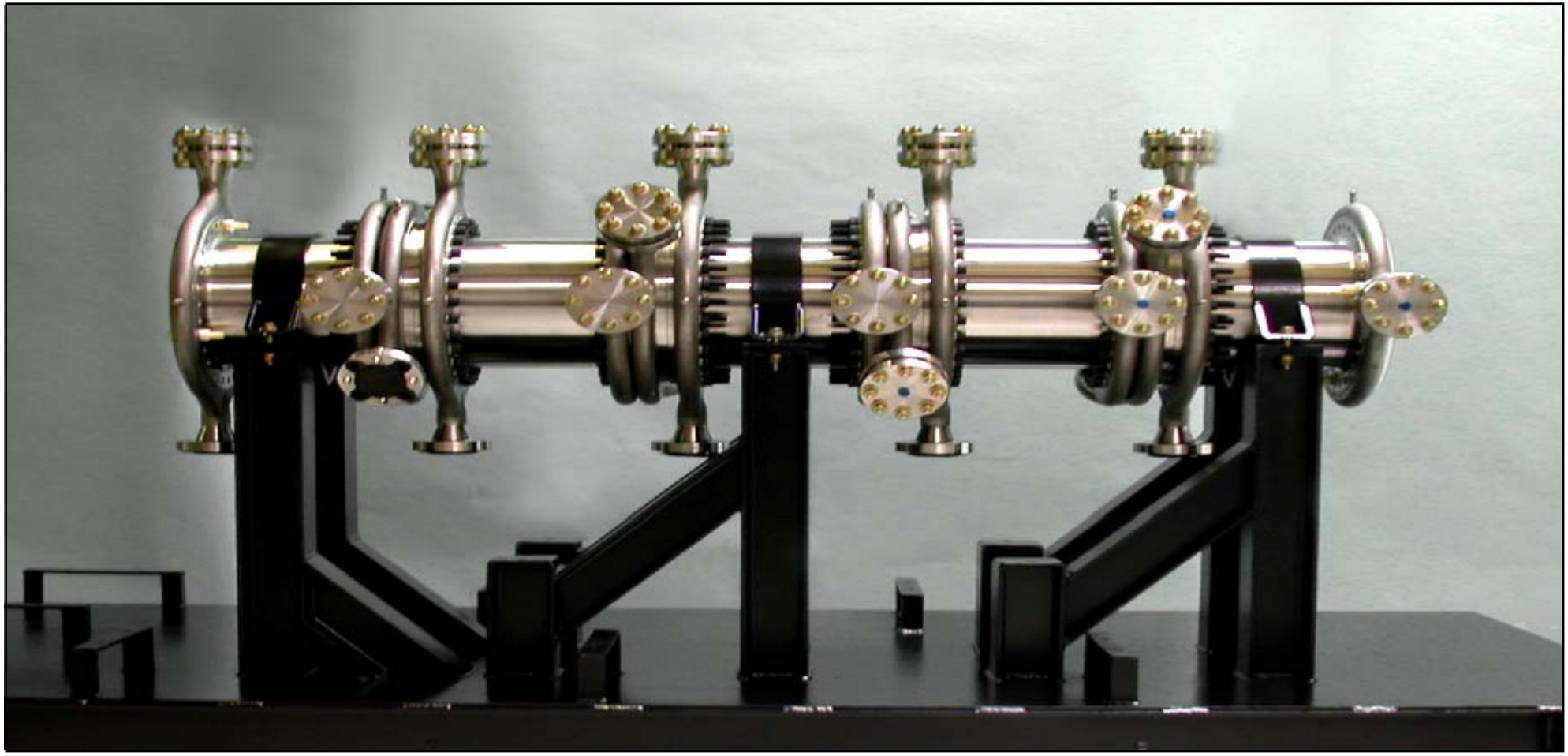
200 MW_{th} GAS GENERATOR



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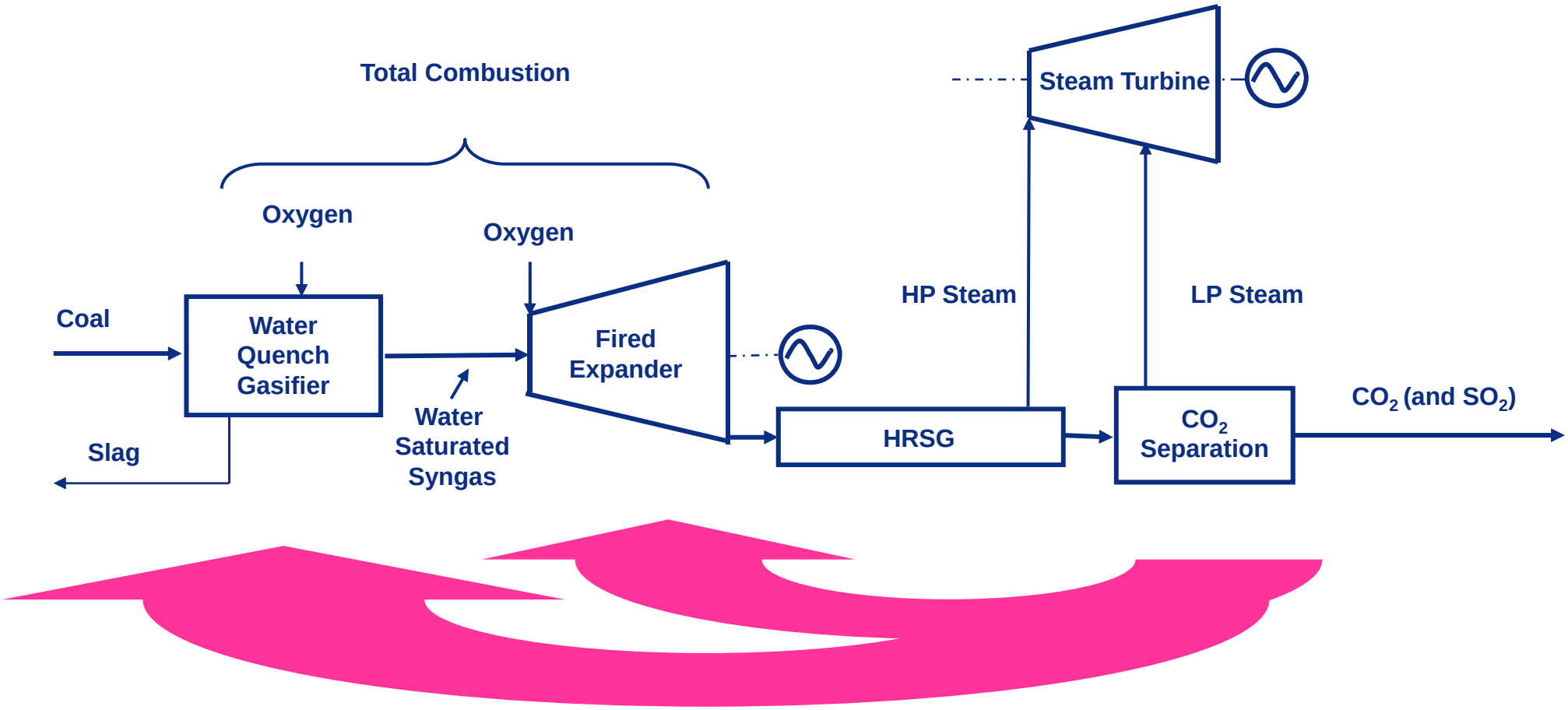
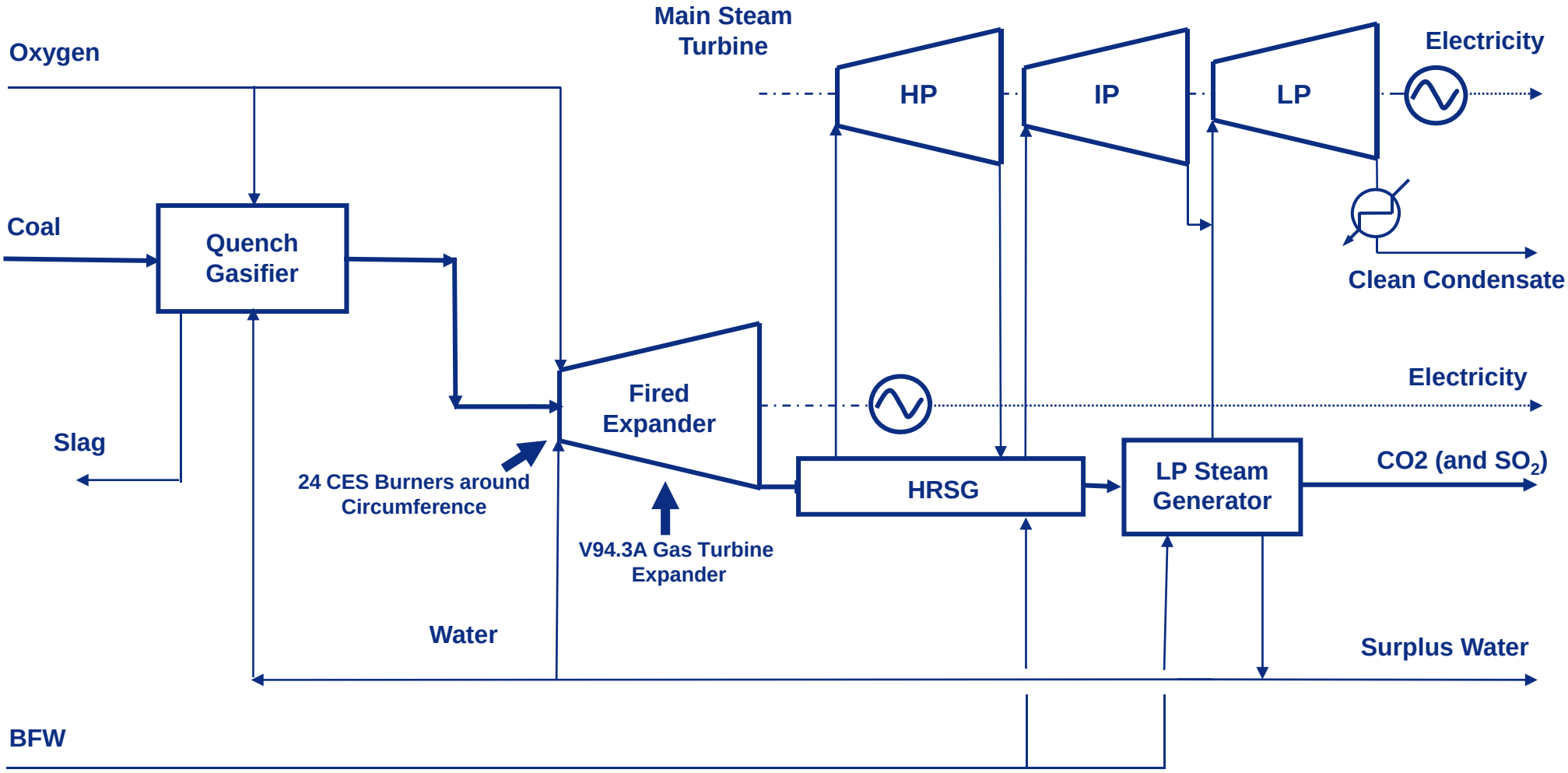
IGSC Project Development – List of Cases

- **DEVELOPMENT**
  - **Mark 1**
  - **Mark 2**
  - **Mark 3**
- **BASE - For the Review Report**
- **UTILITY – For New Power Stations**
- **RETROFIT – For Existing Power Stations**
- **INDUSTRIAL – Also for a Hatfield Demo Plant**

The IGSC Flowscheme
(Brayton and Rankine Cycle)



IGSC – 1200 MW Utility Case



Siemens SGT5-4000F (V94.3A)
Gas Turbine Combustion Chamber

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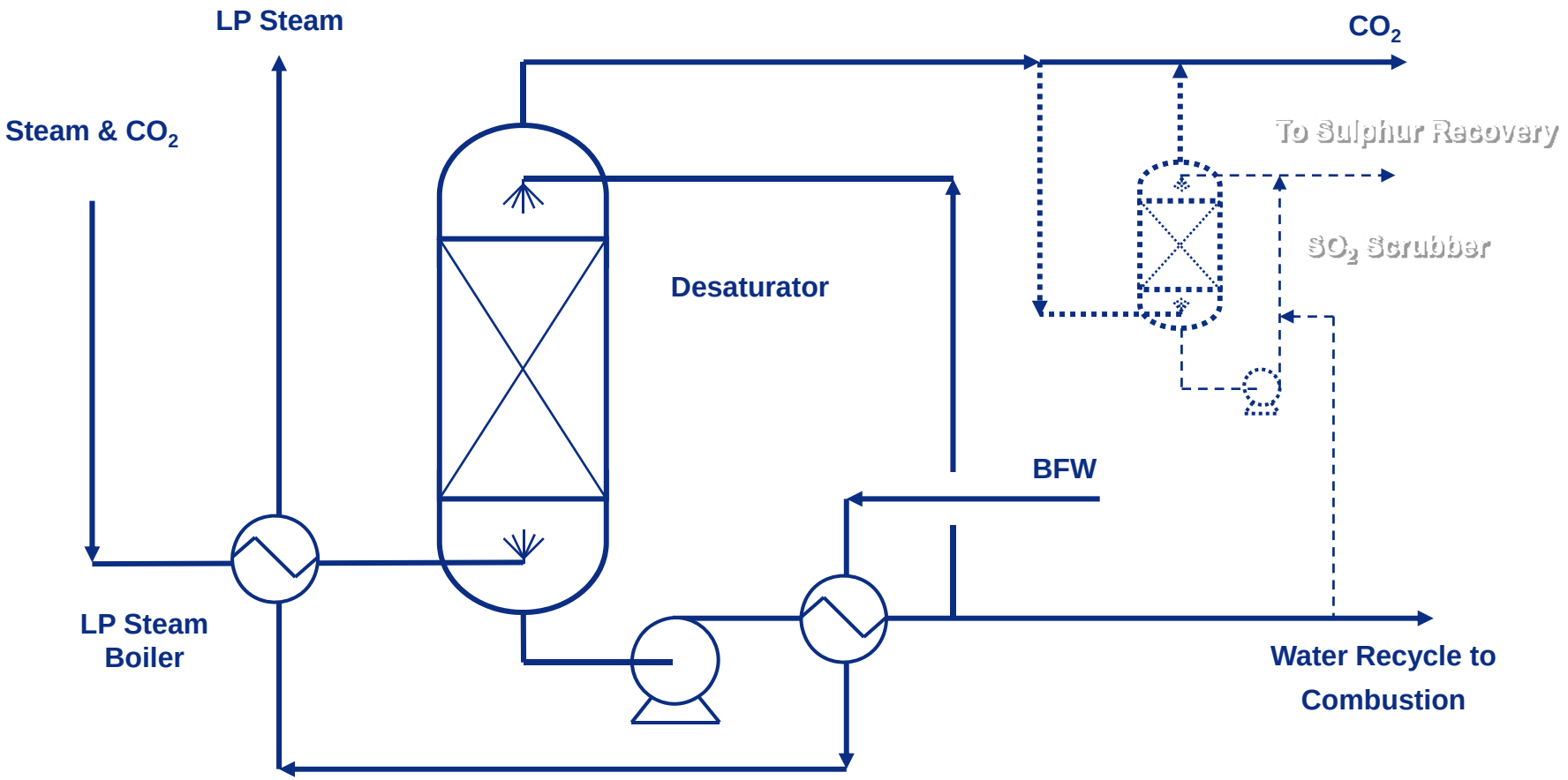
CO_2 Removal/LP Steam Generation



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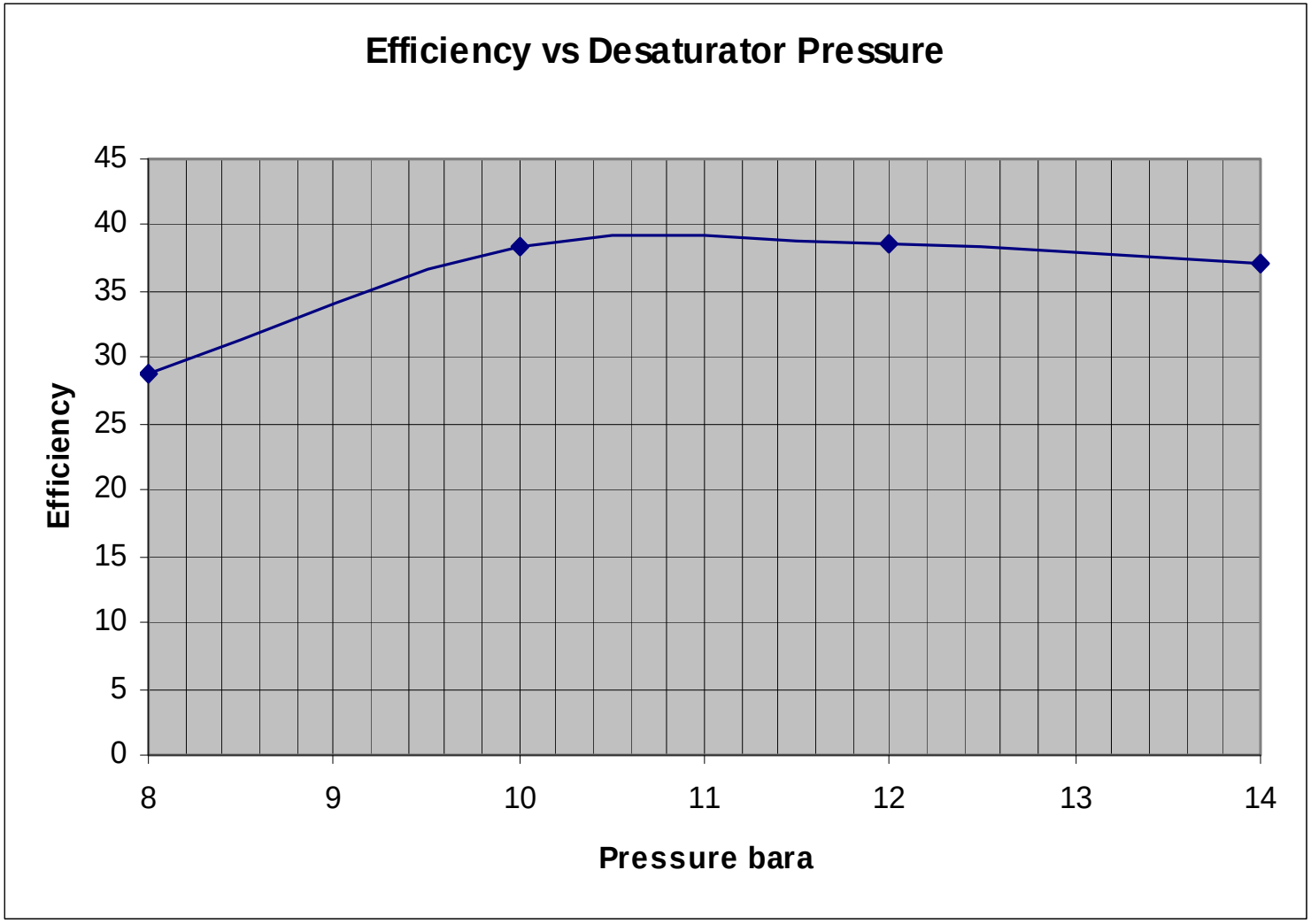
Typical Sensitivity to Desaturator Pressure



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New Power Plant Options with CCS - 1

	Pre-Combustion IGCC	Post Combustion Oxyfuel		Flue Gas Scrubbing not Considered
		CO2 Recycle	IGSC Water Recycle	
Coal Preparation	Grind to 200 mesh	Grind to 200 mesh	Grind to 200 mesh	Wet or dry feed
ASU	40%	100%	100%	95% Oxygen
Energy Conversion	Gasification GT Combustors	Coal Combustion	Gasification CES Burners	Total Combustion
Shift System	Yes	No	No	
Heat Recovery	Steam Raising	Steam Raising	Steam Raising	
Acid Gas Removal	Two Stage	Sulphur Scrubber	Optional (from CO2)	
CO2 Compression	From Atmospheric	From Atmospheric	From 10 bar	100 bar export
Power Generation	Gas plus Steam Turbine	Steam Turbine	Fired Expander plus Steam Turbine	
Stack	Yes	No	No	
“Standard” Unit Size	c550 MW	c500 MW	300-500 MW	

New Power Plant Options with CCS - 2

	Pre-Combustion IGCC	Post Combustion Oxyfuel		Flue Gas Scrubbing not Considered
		CO_2 Recycle	IGSC Water Recycle	
Available	Now	Burner development In hand	Fired Expander development in hand	
Suitability for Retrofit	Only if Shift already fitted	Any Steam Turbine	Any Steam Turbine	
Capture Capability	90%	Near 100%	Near 100%	
CO2 Purity	97%	90%	92%	Impurities mainly argon and nitrogen
Water Consumption	Loss up Stack	Blowdowns and FGD Discharge loss	Blowdowns Only	Oxyfuel and IGSC retain water from fuel hydrogen
Intrinsic By-Products	Sulphur	Sulphur Compounds	None	
Possible By-Products	Hydrogen	Gypsum	Sulphur Compounds	
Solid Effluent	Non-Leaching Slag	Ash	Non-Leaching Slag	
Liquid Effluent	Quench, Boiler blowdowns	Boiler blowdown, Acid Condensate	Quench, Boiler blowdowns	Oxyfuel and IGSC Retain Water from Fuel Hydrogen
Gaseous Effluent	SOx & NOx in Gas Turbine Exhaust	None	None	

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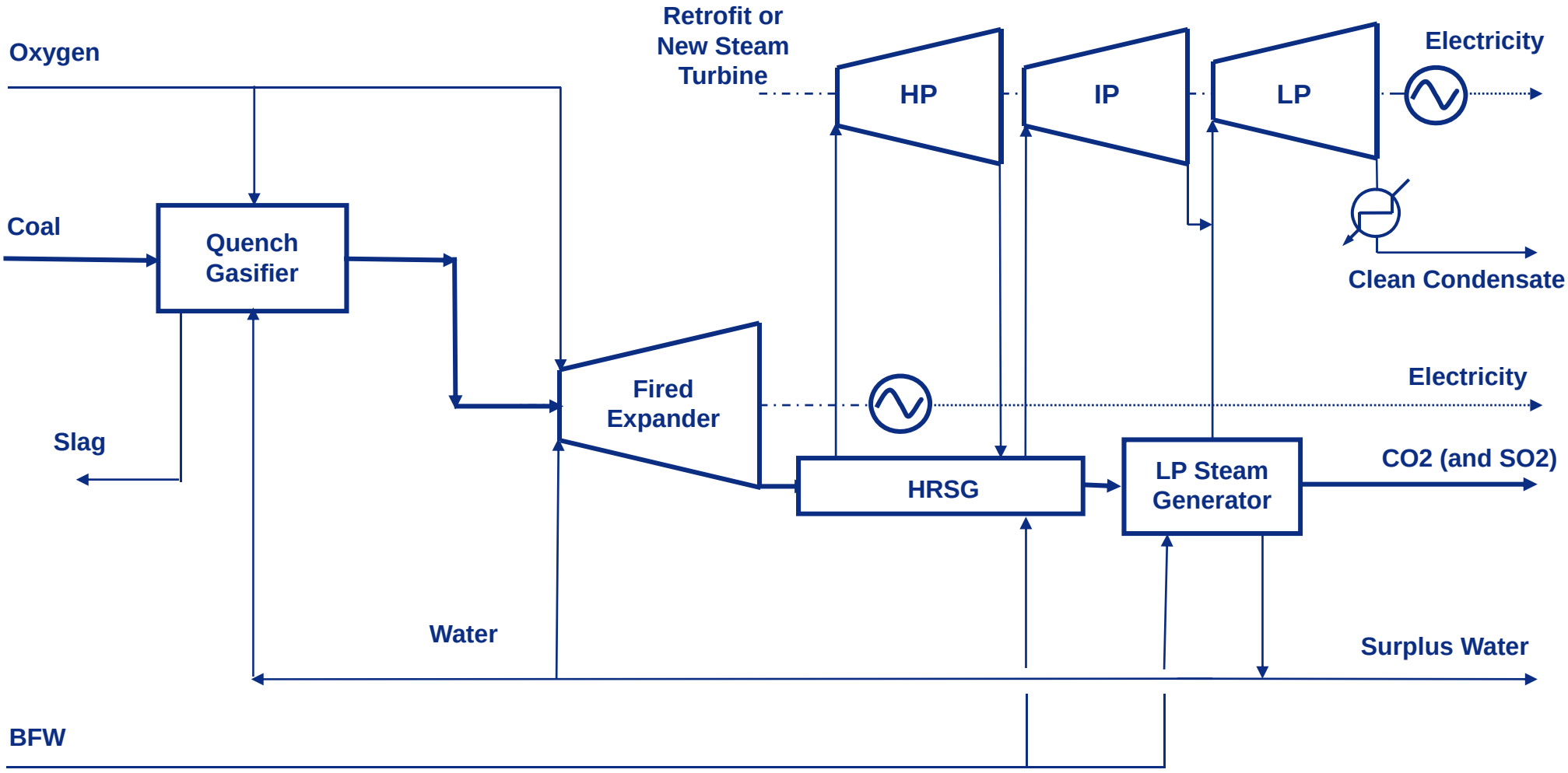
IGSC – Generic Flowscheme



Cycle Advantages

- ALL COMMERCIALLY PROVEN EQUIMENT WITH THE EXCEPTION OF THE FIRED EXPANDER
- SUITABLE FOR RETROFITING EXISTING SINGLE CYCLE POWER STATIONS
- ROBUST AND STABLE OPERATION
- NO MAINSTREAM SULPHUR REMOVAL (SO_2 CAN BE REMOVED FROM PRODUCT CO_2)
- EASY START-UP AND SHUT-DOWN USING NATURAL GAS
- SIGNIFICANT PRODUCTION OF SURPLUS WATER
- DEMONSTRATION UNIT BEING PLANNED FOR HATFIELD IGCC SITE

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