Energy Efficiency in Thermal Utilities in Refinery

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Involve…Innovate…Deliver

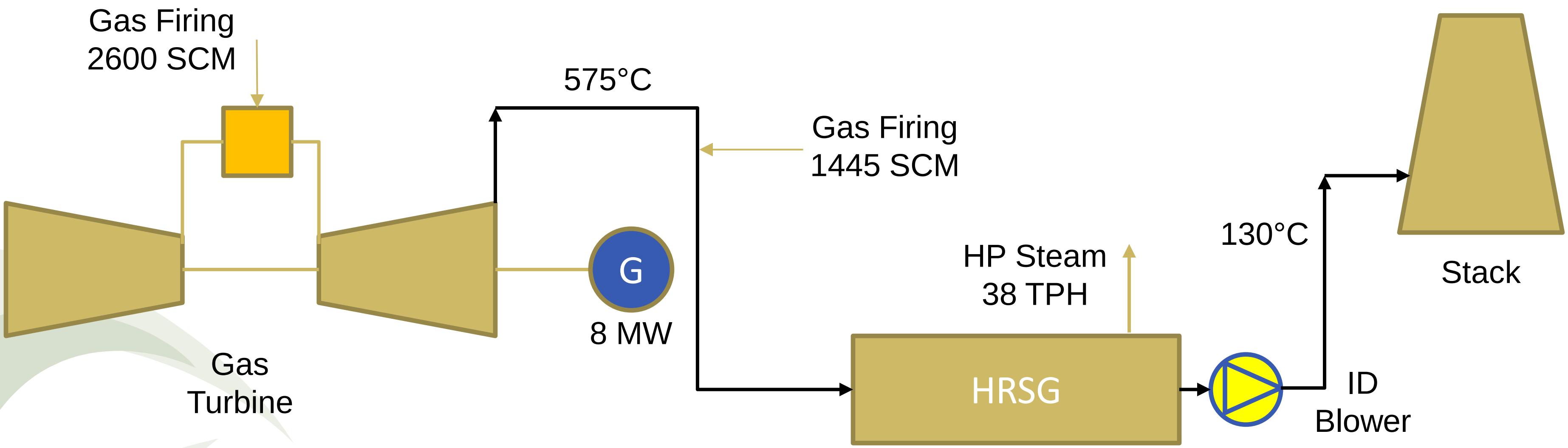
WHAT NEXT?

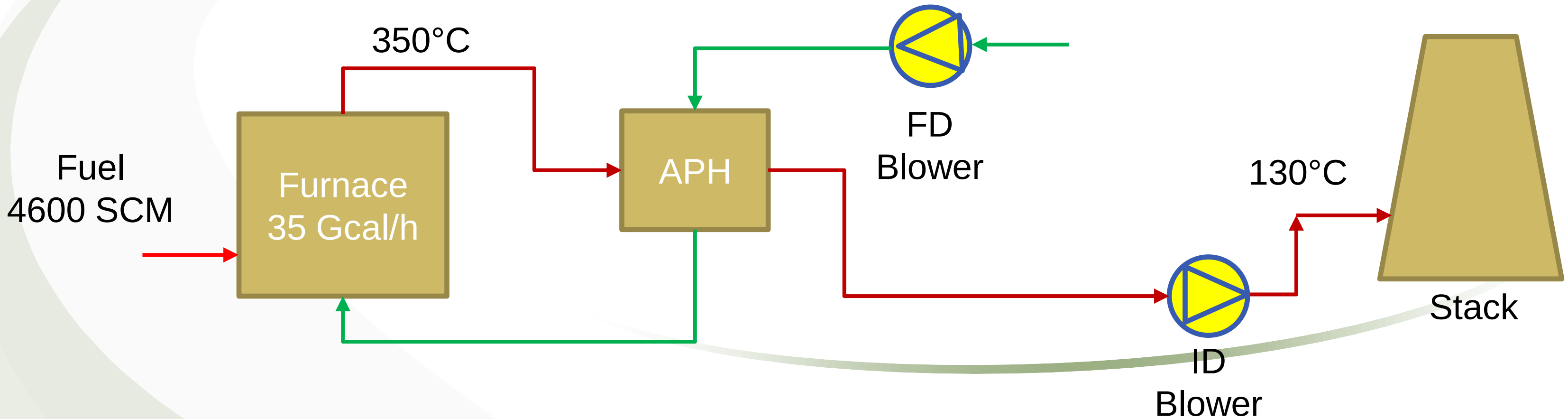
- The energy use is optimized by most of the refineries by co-generation and heat integration
- Heat integration aims at process to process heat transfer reducing demand of secondary energy i.e. steam, electricity, cooling water etc.
- Co-generation optimizes primary energy utilization by striking balance in various forms of secondary energy.
- Further optimization in energy is now possible through applications of improved availability of energy, Exergy maximization. Simply put, Exergy means the highest form of energy used to meet highest level of demand

WHAT NEXT?

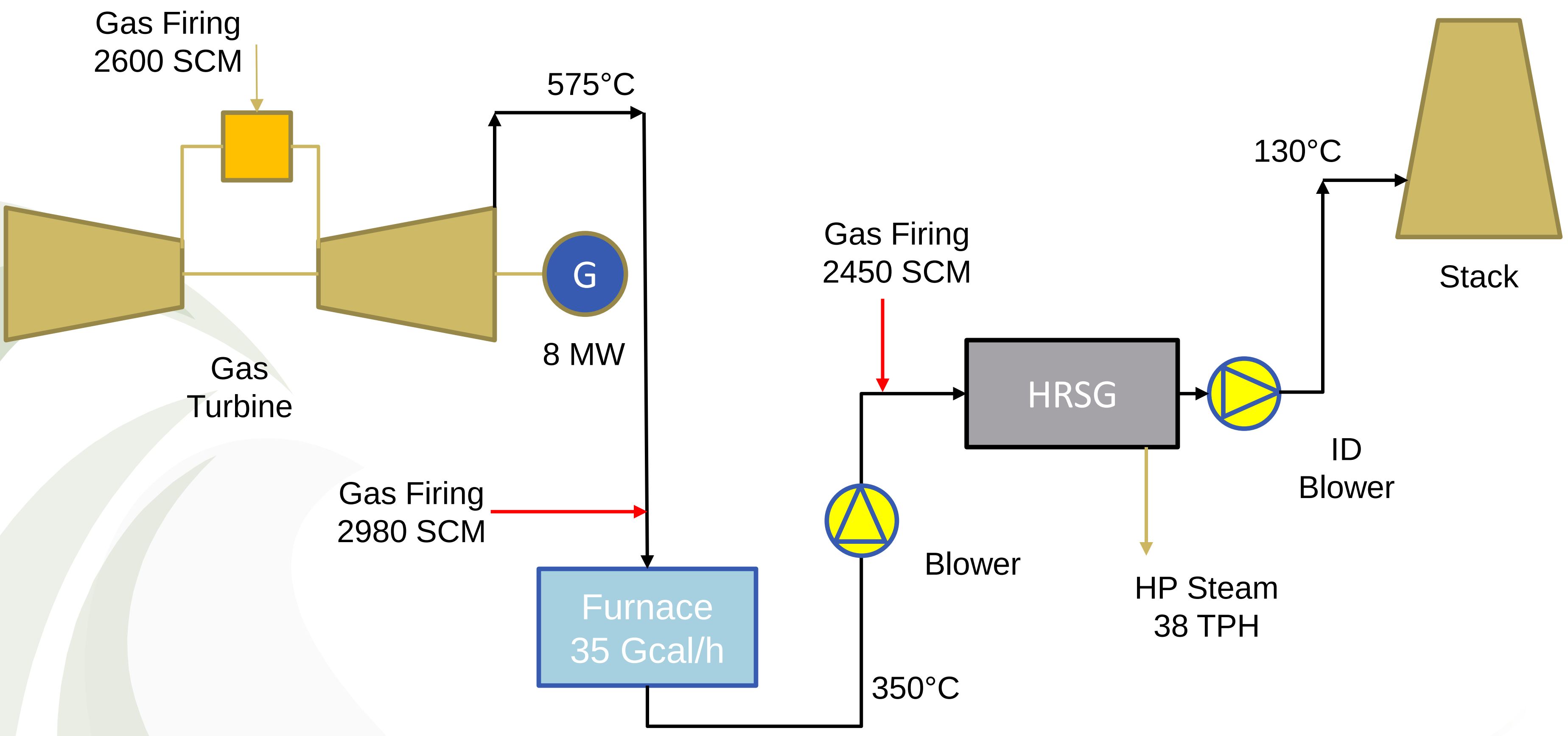
- It is possible to achieve energy optimization by:
  - Integrating process and electricity generation
  - Upgrading low temperature energy for different applications
  - Process interventions for substituting cooling demand by secondary energy generation

Gas Turbine: Present Scenario





Gas Turbine: Proposed Scenario



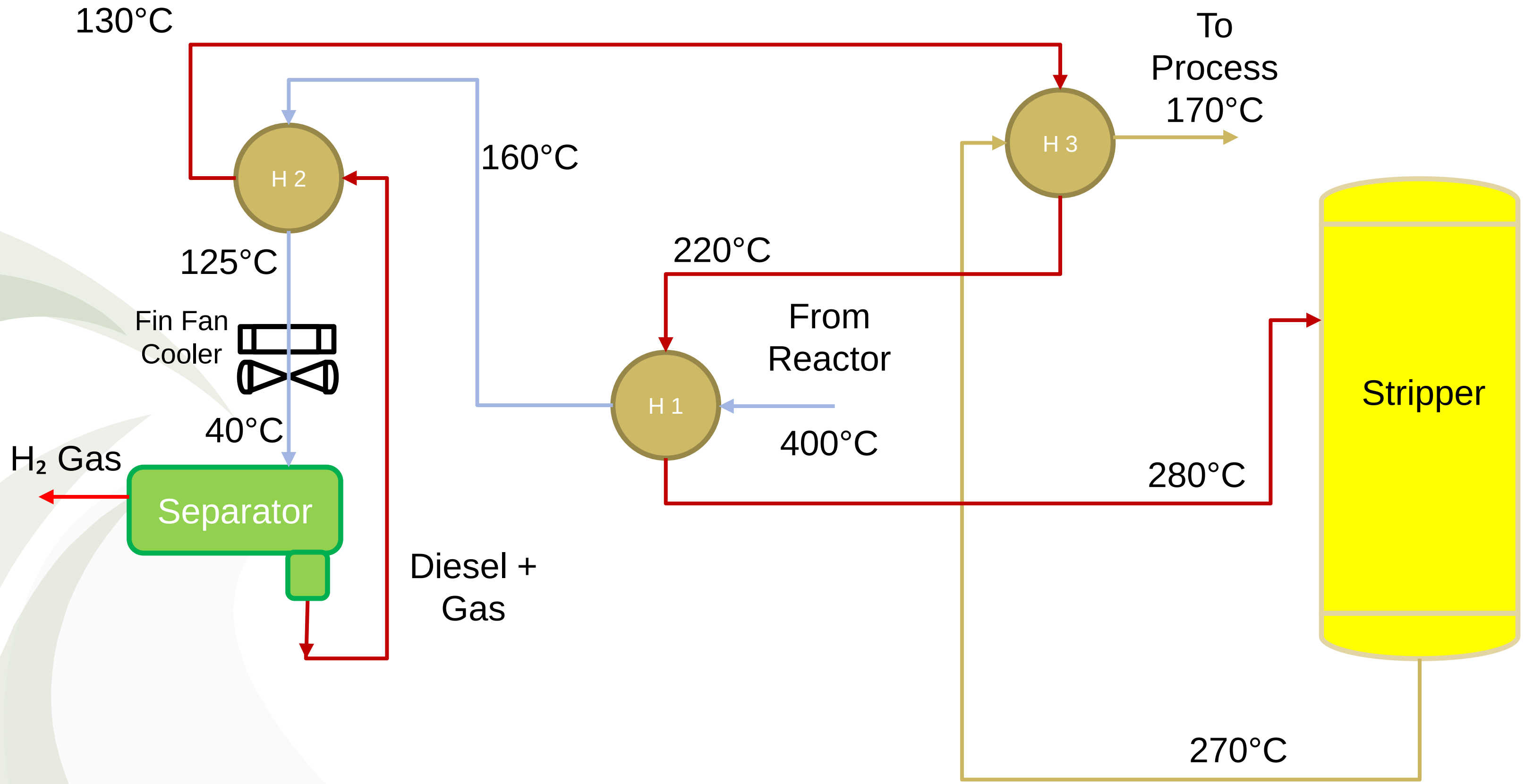
Gas Turbine: Summary

Details	Unit	Present Scenario	Proposed Scenario
Gas Firing	SCM/ H	8645	8030
Power Generation	MW	8	8
HP Steam Generation	TPH	38	38
Blower Power	kW	650	500

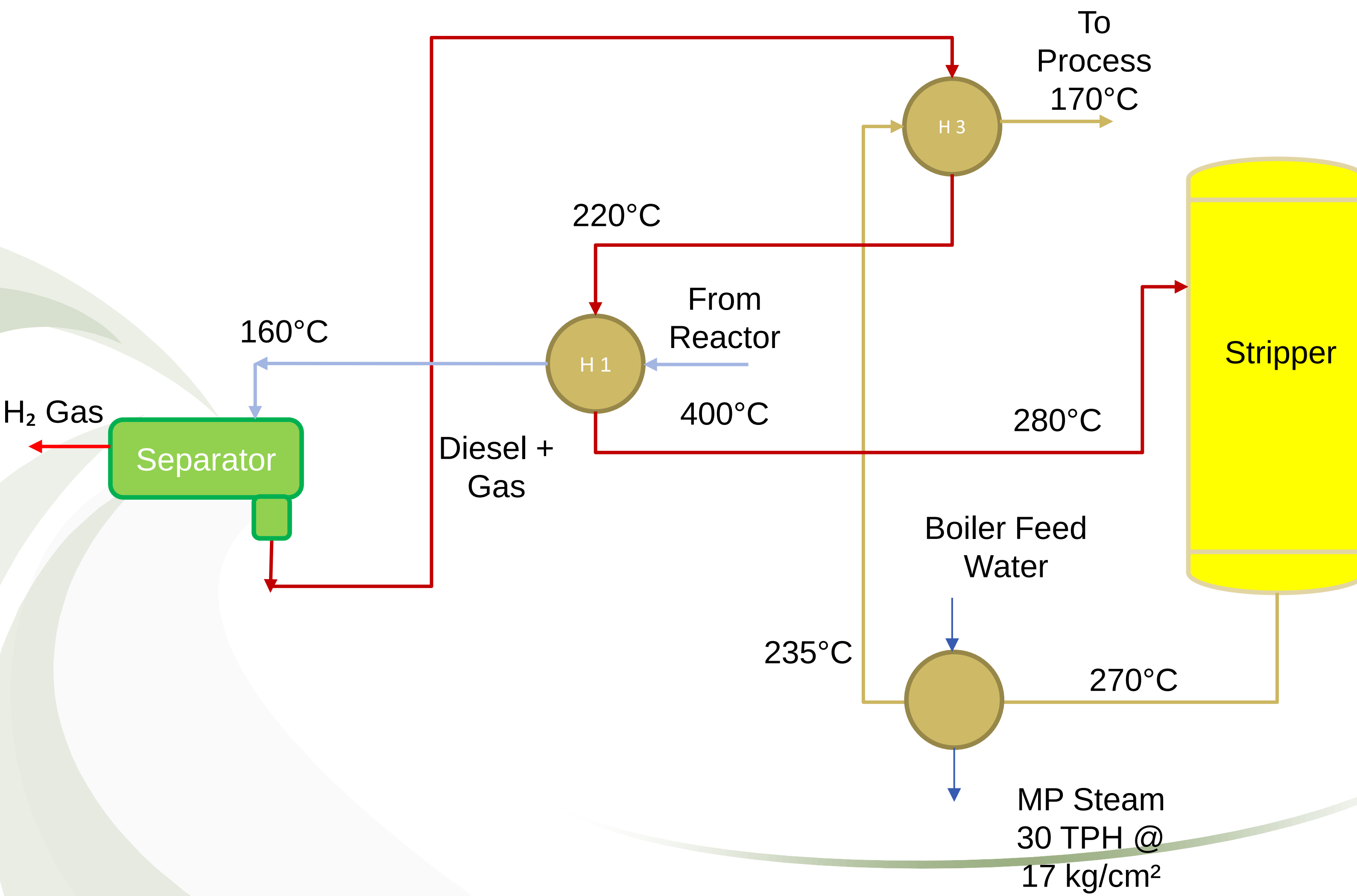
Process Intervention

- In one of the processes, high temperature fluid from reactor is cooled in series of heat exchangers and then by fin fan cooler near to ambient temperature
- In separator, hydrogen gas is separated and diesel + gases are sent to stripper for further separation
- Enroute to stripper, the fluid is preheated by hot stream from reactor
- The technology is changing and new technology of separation at high temperature is worked out by licensor
- Thus, instead of cooling the reactor stream to ambient temperature and reheating the stream, the stream is cooled to higher temperature.
- The energy used for reheating the steam is saved and it can be used for MP steam generation

M P Steam : Present Scenario



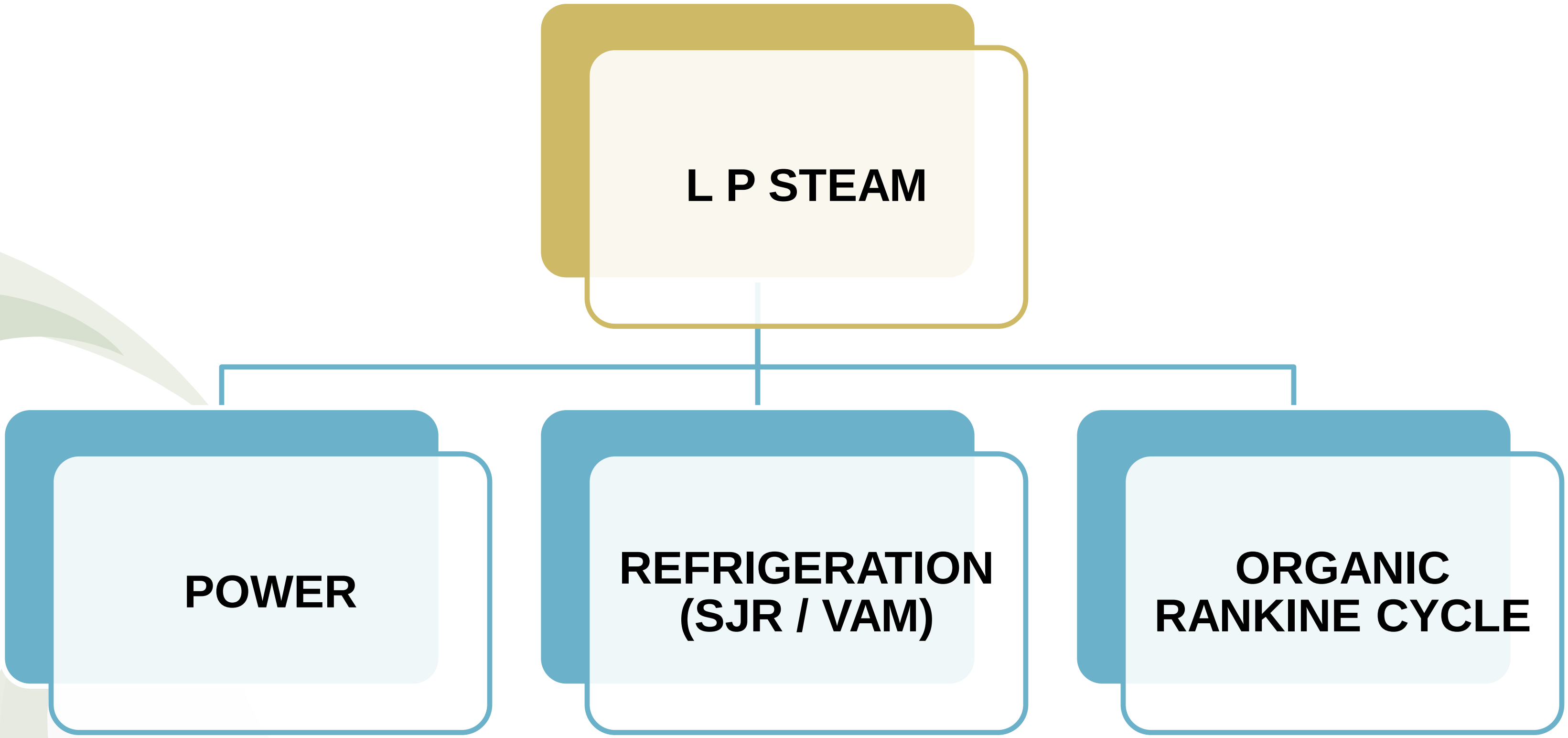
M P Steam : Proposed Scenario



M P Steam : Summary

Details	Unit	Present Scenario	Proposed Scenario
∆T across H 1 Heat Exchanger	°C	60	60
∆T across H 2 Heat Exchanger	°C	90	-
∆T across H 3 Heat Exchanger	°C	90	60
MP Steam Generation	MT/h	-	31

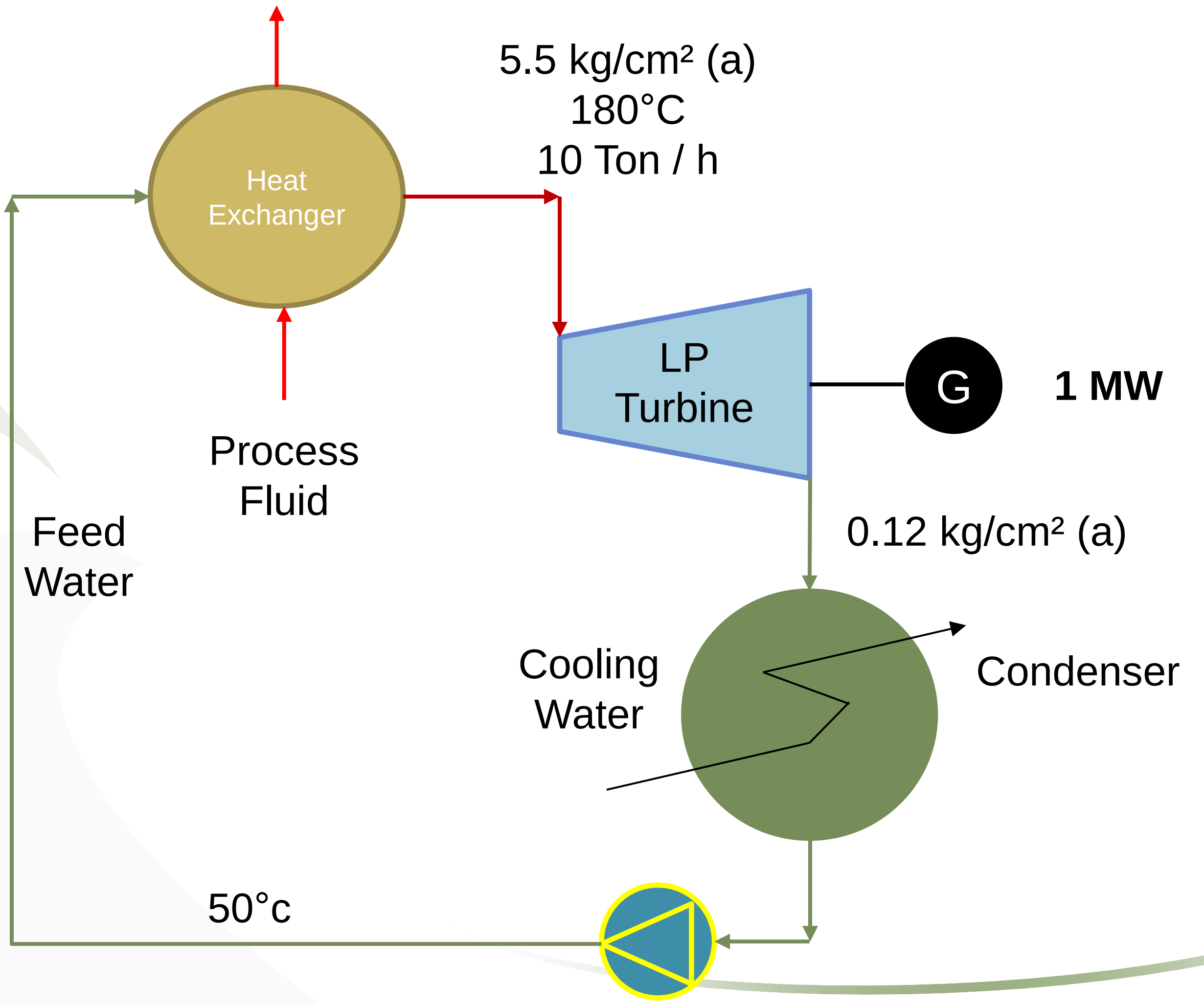
Usage of LP Steam



LP Steam for Power Generation

- LP superheated steam can be generated from any waste heat source of 200°C or equivalent
- The LP steam generated in heat exchanger is passed through turbine, specifically designed to generated power

LP Steam: Power Generation



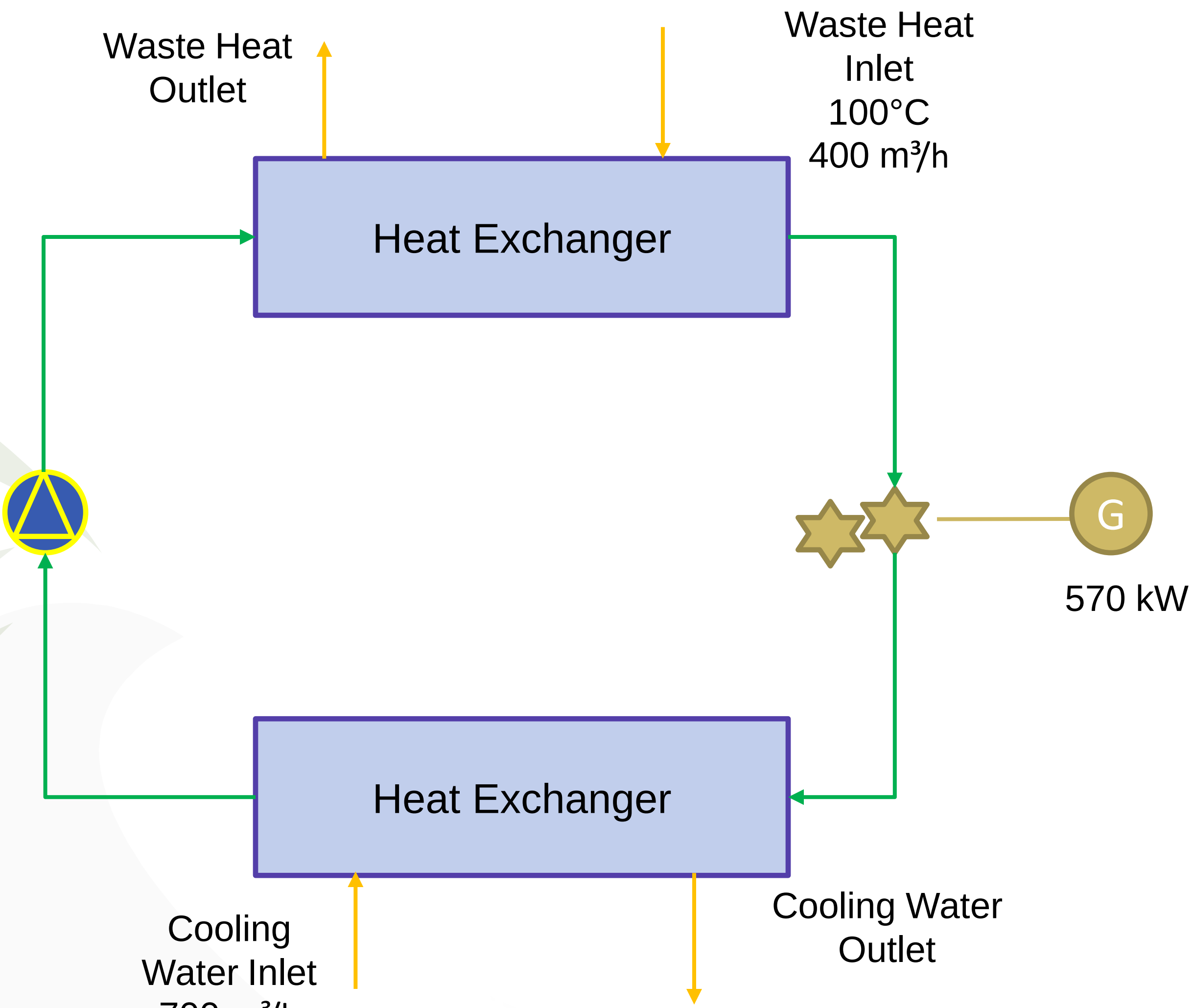
LP Steam for Refrigeration

- Exhaust steam is condensed and cooling water is used as condensing media. The condensing pressure is 0.1 kg/cm^2 (a)
- Normal cooling water inlet temperature is 32°C and outlet temperature is 40°C
- In such scenario, use of steam jet refrigeration (SJR) system shall enable reducing condensing pressure thereby increasing power generation from existing turbine
- Also, DM grade water shall be available which is require in refinery as make up water for boiler
- SJR shall use motive steam to generate low temperature cooling water which shall be circulated in condenser of turbine
- The motive steam and evaporated water shall be condensed in surface condenser which shall generate additional potable water
- LP steam generation will require 8 kg of steam per ton of refrigeration

WHR: Organic Rankine Cycle

- The low temperature energy can be captured from process and heat is transferred to fluid at constant pressure, vaporizing the fluid
- The fluid is expanded into turbine to generate electricity
- The refrigerant cycle is closed loop system
- All refrigerants / hydrocarbons (isobutane, pentane, propane) can be used as working fluids in the cycle

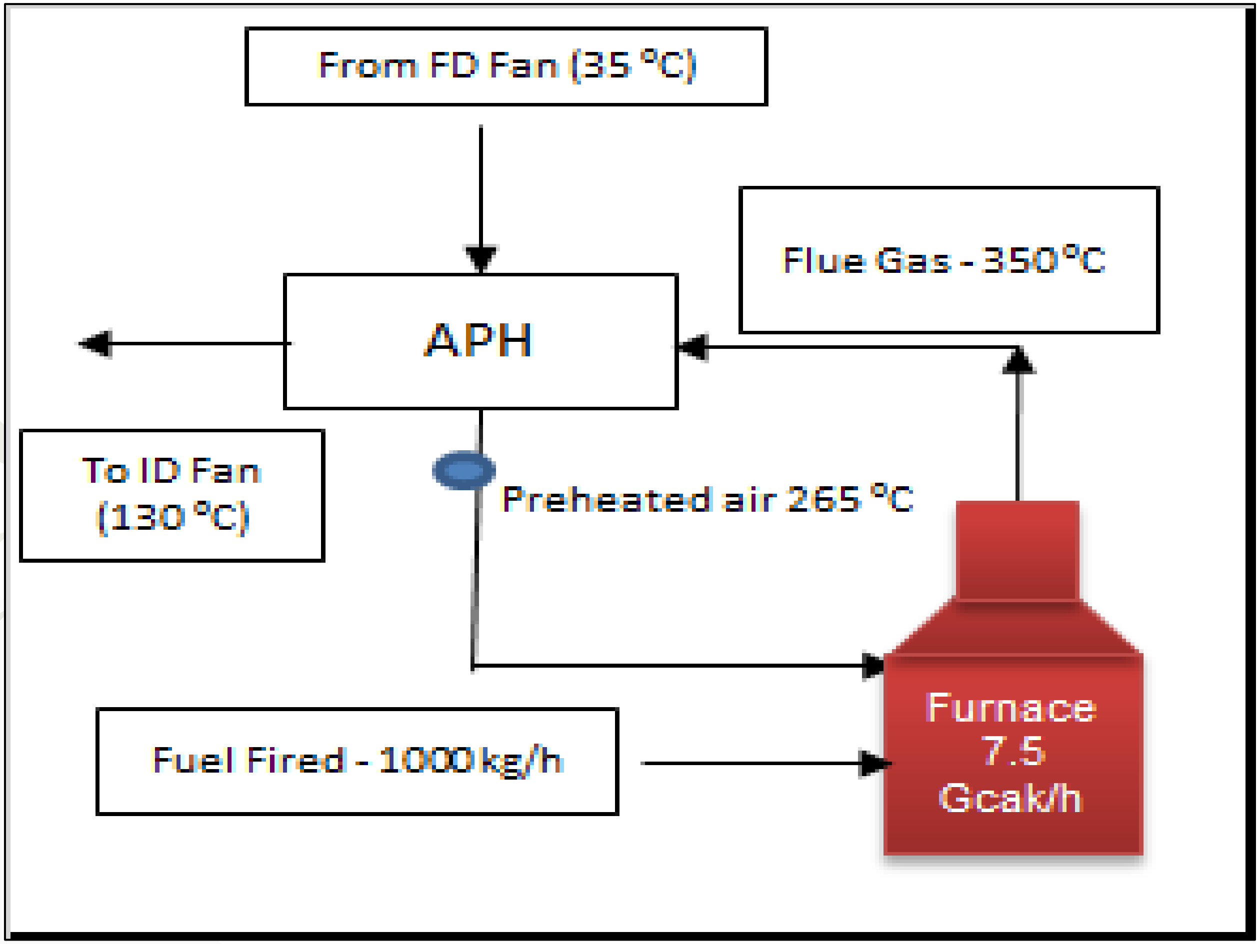
WHR: Organic Rankine Cycle



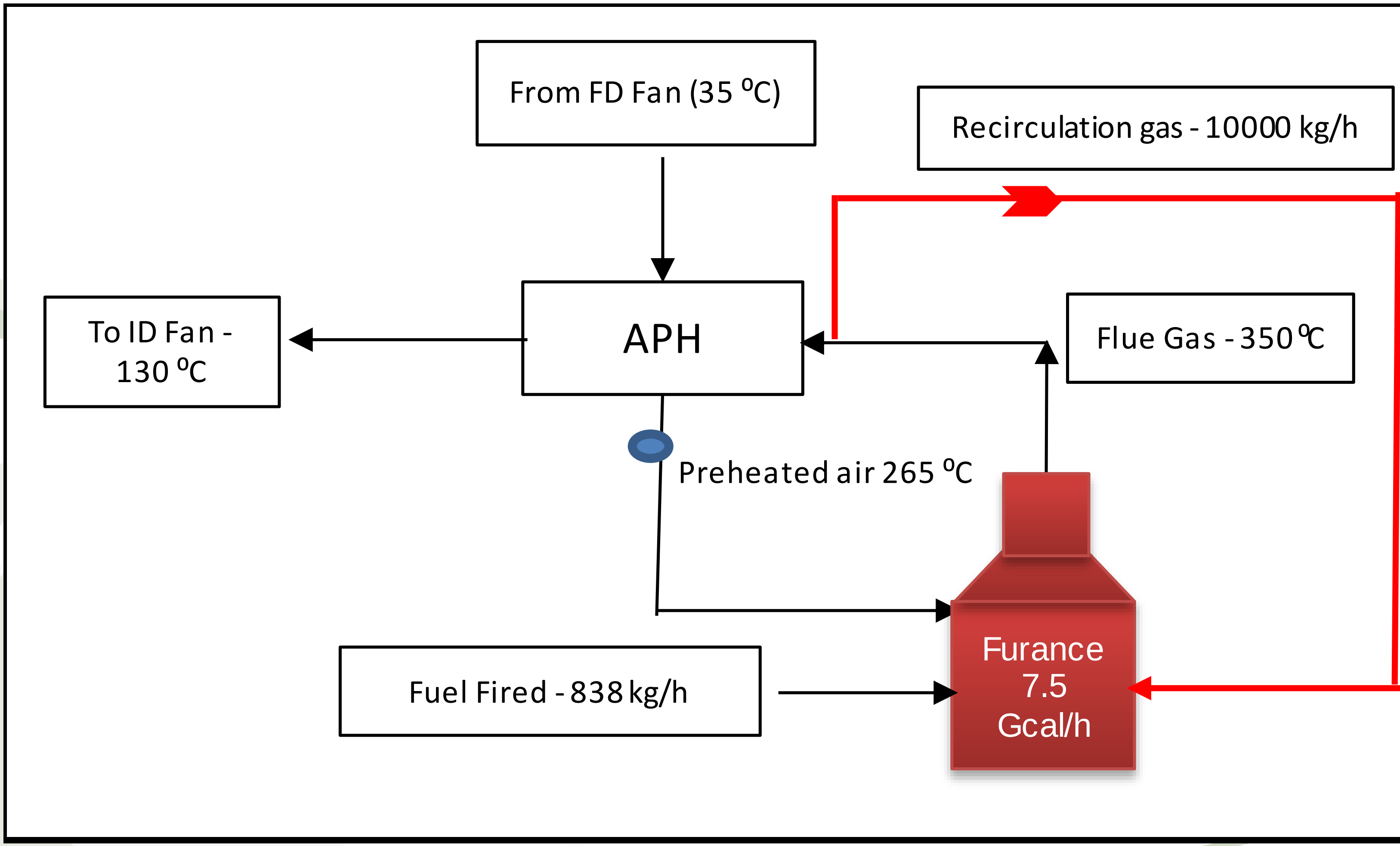
WHR: Furnace

- Furnaces operate at very high temperature, typically between 900-1200°C
- To control tube wall temperature, higher air to fuel ratio is required resulting in higher %O_2
- It is possible to recirculate part of exhaust gas (from furnace exhaust) back to furnace as a diluting medium which allows controlling tube wall temperature at optimum %O_2
- This technology is particularly useful when furnaces are operating near to rated throughput condition. Possibilities of failure of fluid or cracking of fluid substantially increase when higher firing is done to increase throughput. This results in higher tube wall temperature

Furnace: WHR – Present System



Furnace: WHR – Proposed System



Furnace: WHR Summary

Details	Unit	Present Scenario	Proposed Scenario
Fuel Firing	Kg/h	1000	838
$\%O_2$	%	10	3
Flue Gas Outlet Temperature	°C	130	130
Combustion Air	Kg/h	25300	15300
Recirculation Gas	Kg/h	-	10000

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Thank You !