

Background & Objective

Background
Growing electricity demand in Saudi Arabia. Need for reliable low-carbon power generation. SMRs provide enhanced safety and modular construction.

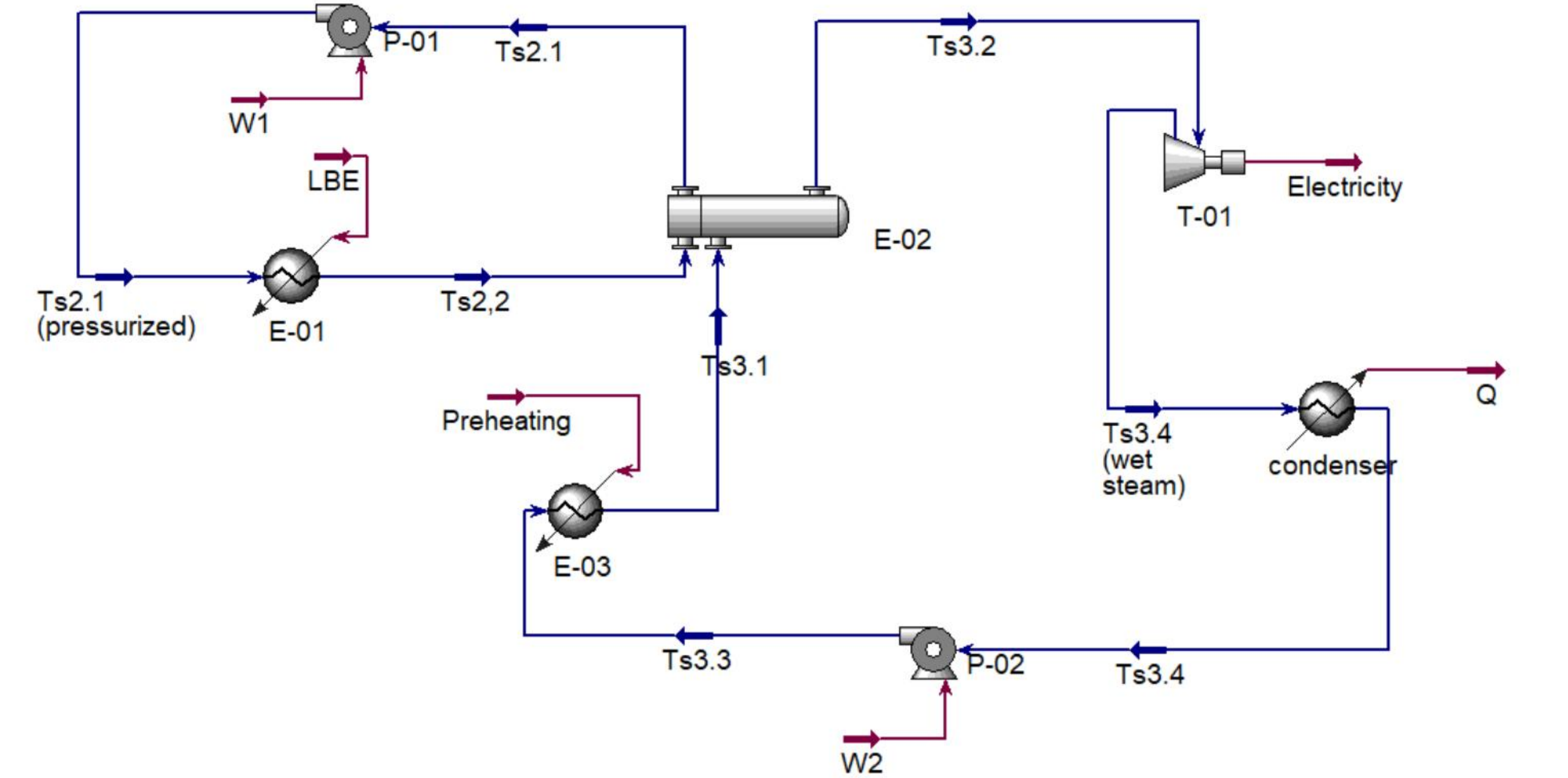
Objective
Design an LBE-cooled SMR capable of producing approximately 80 MW of electricity while maintaining high safety and environmental performance.

Coolant Selection

Coolant	Score (%)
LBE	73.5
Sodium	72.0
Lead	64.5

- LBE selected because of:
- ☐ High boiling temperature
 - ☐ Low operating pressure
 - ☐ Excellent passive safety
 - ☐ Good neutronic performance

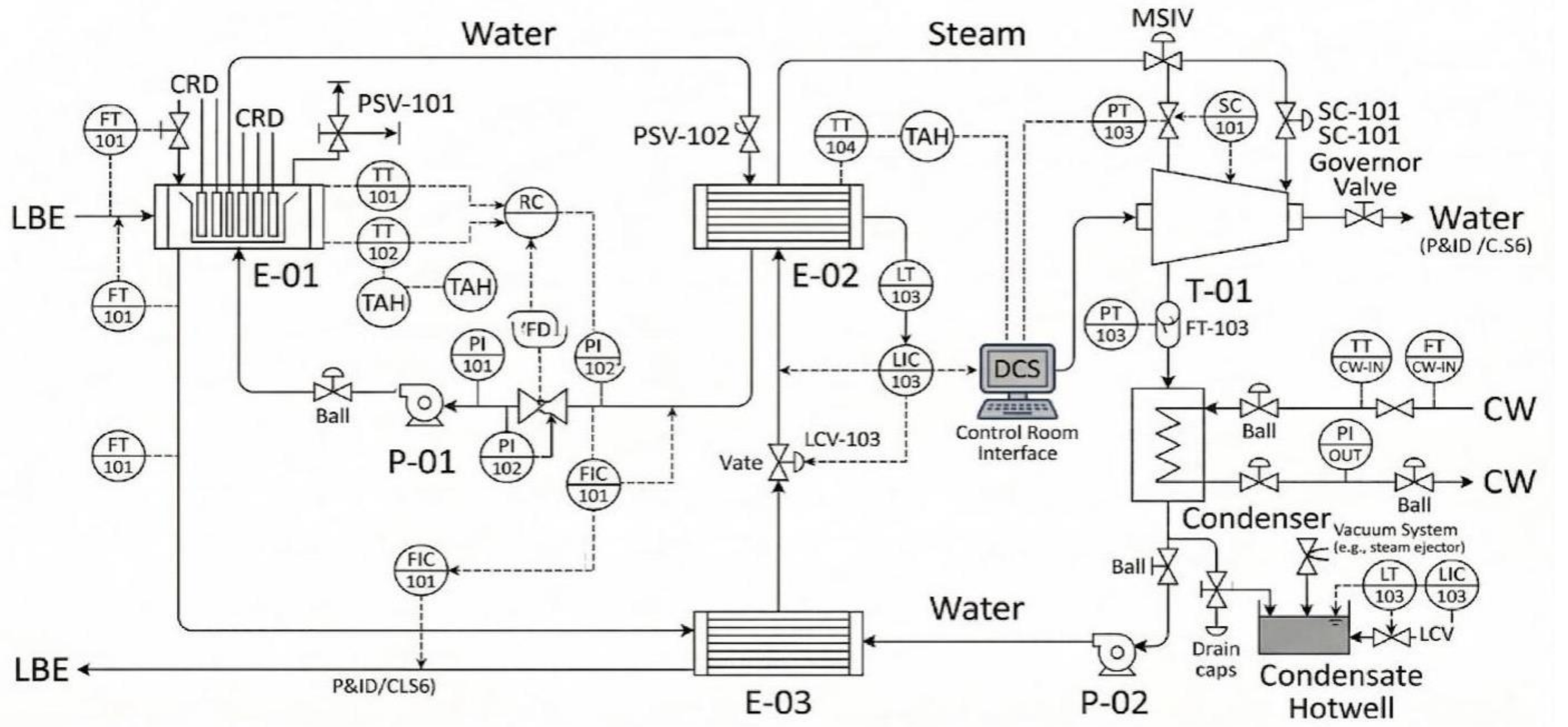
Process Flow Diagram



Safety Analysis

Deviation	Safeguard
No Flow	Passive Cooling
High Temp	Reactor Scram
LBE Freezing	Trace Heating
O ₂ Loss	Oxygen Control

Flowchart



Aspen HYSYS Validation

Parameter	Error (%)
E-01 Duty	4.8
E-02 Duty	3.4
Turbine Power	3.8
Pump Power	2.0

Simulation results agreed well with manual calculations.

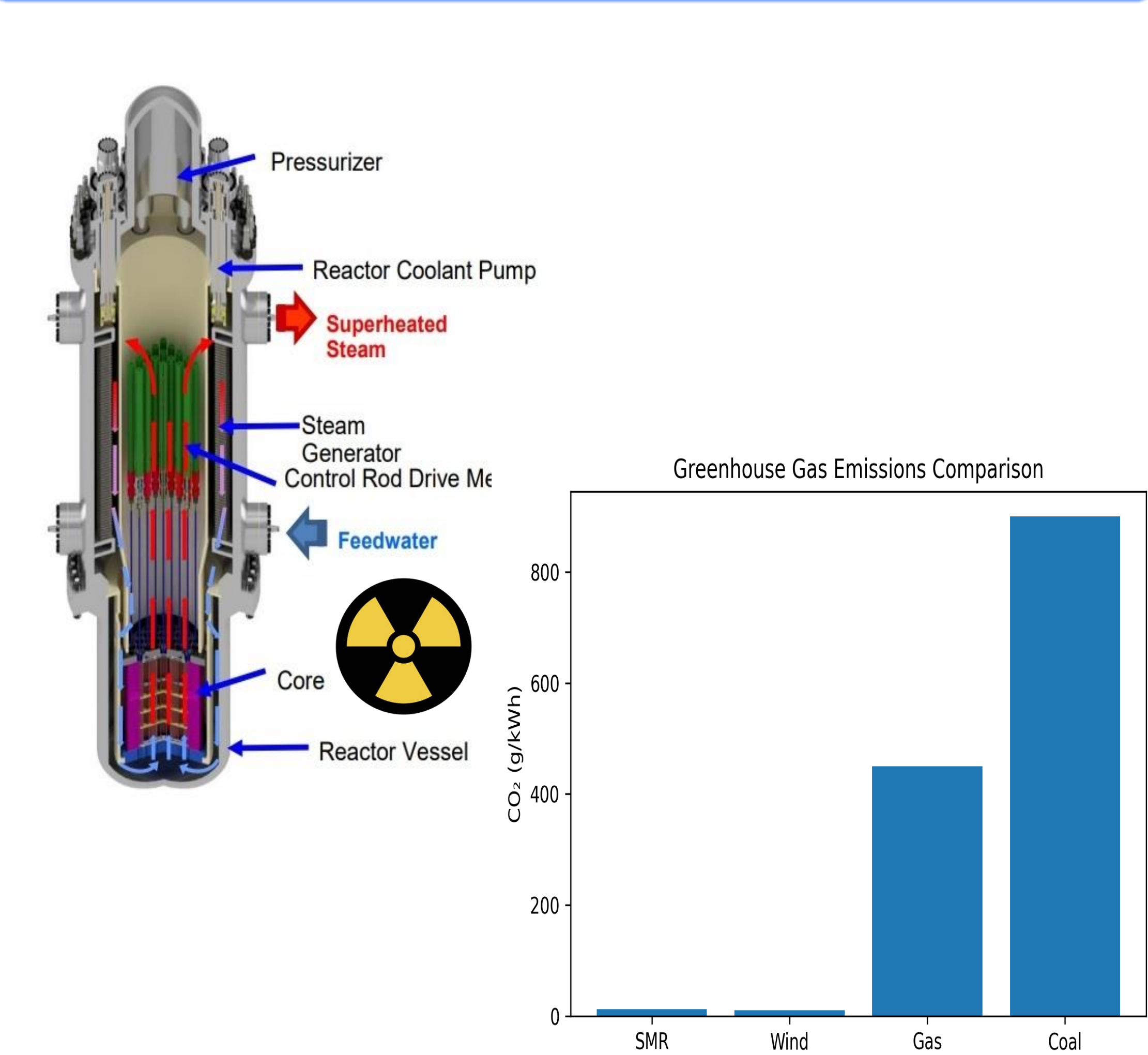
Equipment Design

Unit	Area (m ²)
E-01	18.1.5
E-02	6509
E-03	3.8

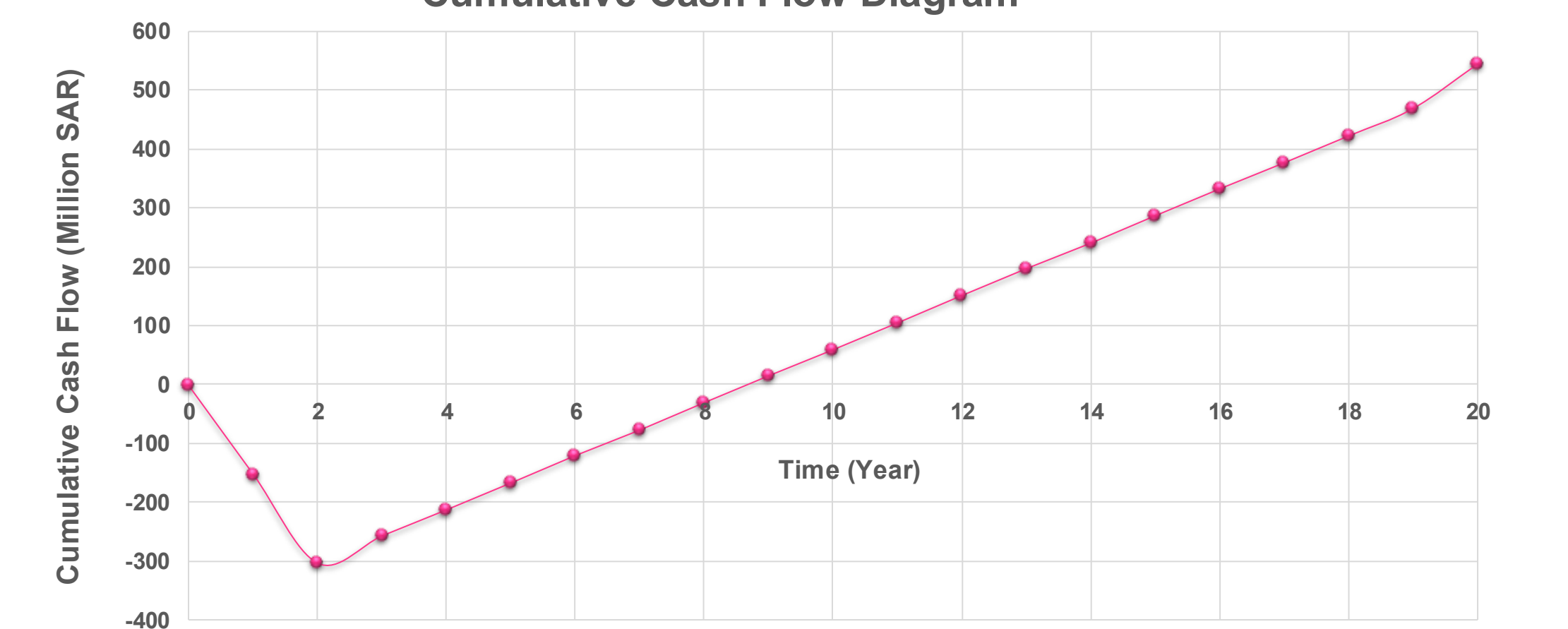
Performance Table

Parameter	Value
Thermal Power	275 MWth
Turbine Output	81.07 MWe
Net Output	80.59 MWe
Steam Flow	104.9 kg/s

Environment Performance



Economic Analysis



Conclusions

- ☐ Net electrical output of 80.59 MWe achieved.
- ☐ Aspen HYSYS successfully validated the design.
- ☐ Passive safety features reduced operational risks.
- ☐ Near-zero operational carbon emissions.
- ☐ Positive economic performance with acceptable payback.
- ☐ Suitable for future desalination and hydrogen production applications.