

ELEKTRA

ADVANCED ELECTRIFICATION OF KEY INDUSTRIAL REACTIONS

Electrification of Industrial Reformers

Functional safety when process heat becomes electrical

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Based on work conducted by SYPOX in collaboration with the University of Padua and the Technical University of Munich and published in *Chemical Engineering Transactions* in 2025.



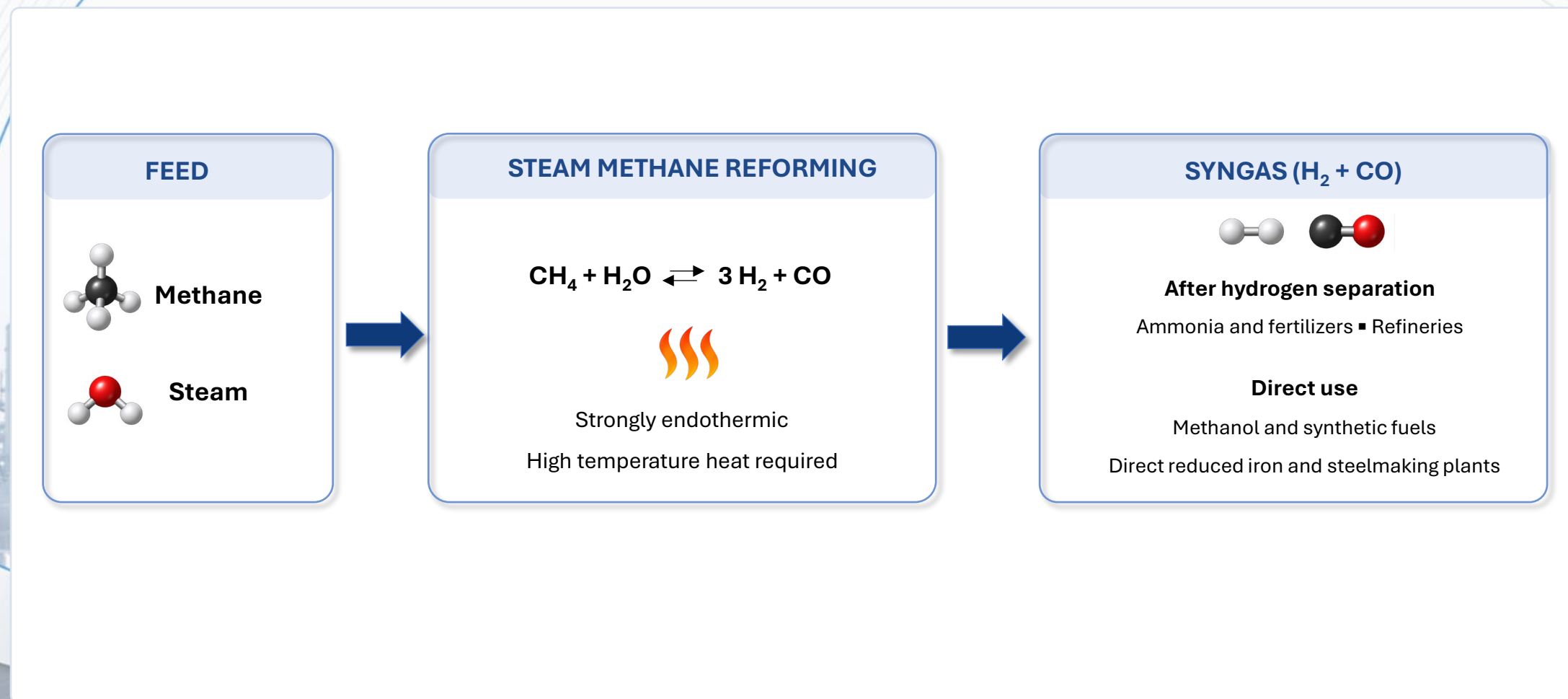
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Steam Methane Reforming

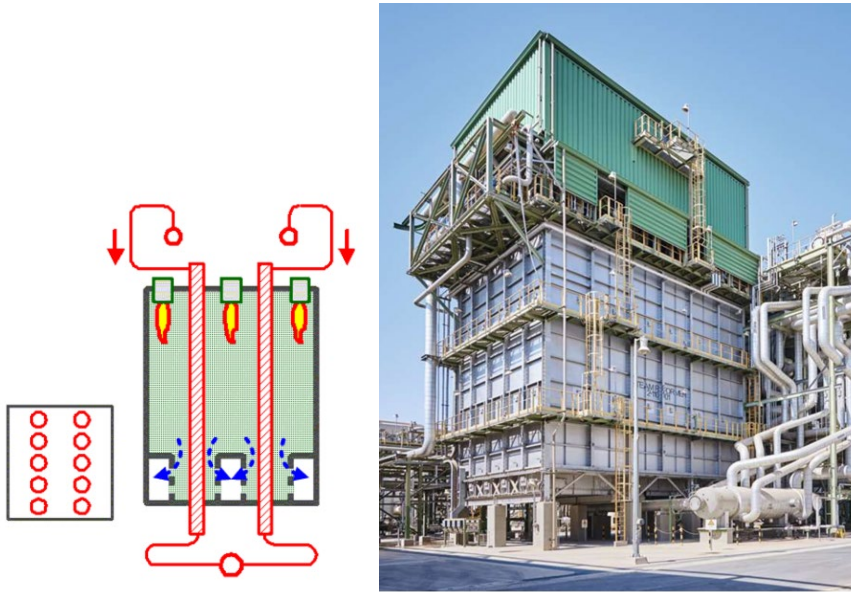


Electrification of Steam Methane Reforming

Conventional Reformer

Heat supplied by **fuel combustion**:

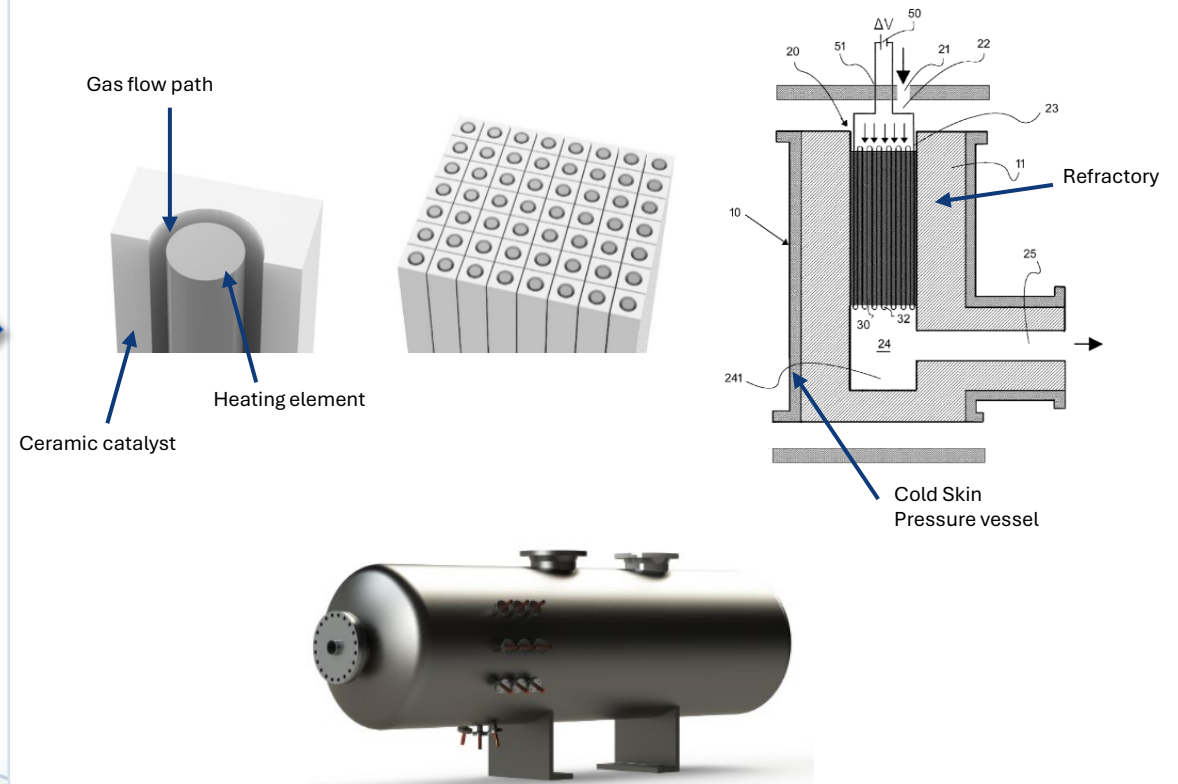
Burners heat catalyst-filled tubes



Electrified Reformer

Heat supplied by **electricity**

SYPOX: Resistive heating integrated into a structured ceramic catalyst



Hazard assessment

COMMON PROCESS-RELATED HAZARDS

- High temperature
- High pressure
- Loss of containment
- Flammable gas release

HEATING-SPECIFIC HAZARD

Conventional SMR

- Fuel-gas leakage
- Flame instability
- Incorrect fuel-to-air ratio

e-SMR

- Electrical arcing
- Loss of insulation resistance
- Shortcircuit

Risk evaluation for each scenario

Basic Process Control System sufficient for risk reduction

Safety system to be activated to bring process to a safe state
→ reformer emergency shutdown

How can the heat source be shut down in a safe and reliable way for each case?



Conventional SMR: safe shutdown of the heat source

Shutdown of heat source

=

Isolate the fuel supplied to the burners

In a reliable and safe way

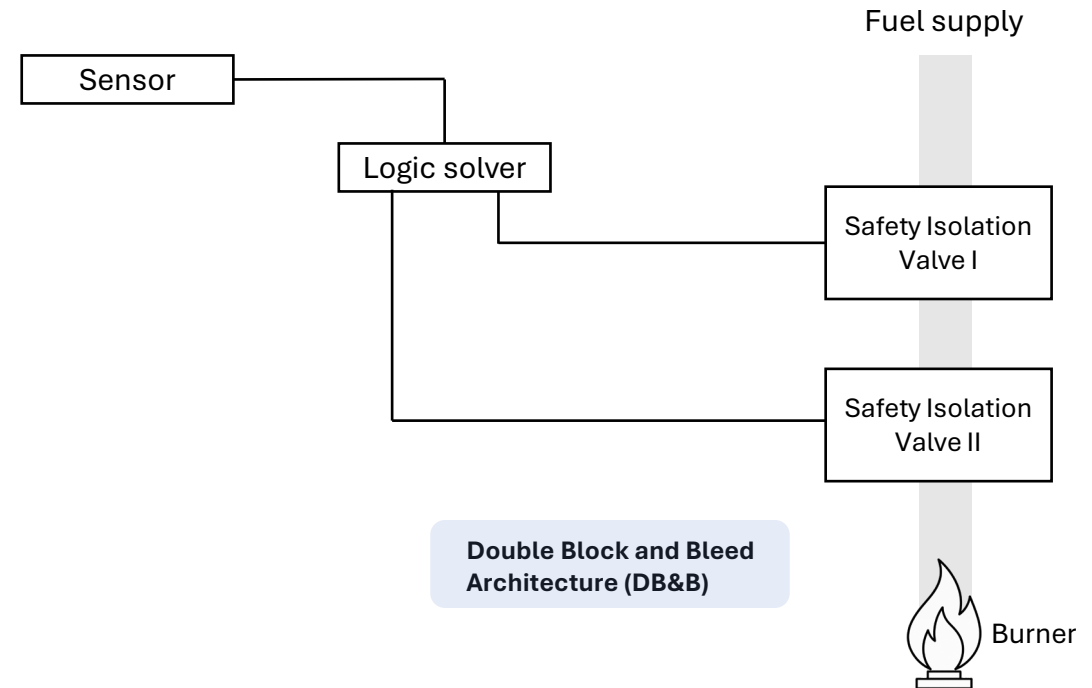
→ Combustion Safety Interlock

A mature safety solution covered in detail by standards and industry guidelines

- Redundant actuators
- Fail-safe valves with position feedback
- Defined installation location

Combustion Safety interlock

Managed by the BMS “Burner Management System”
(Safety system independent from BPCS)



e-SMR: safe shutdown of the heat source

Shutdown of heat source

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Interruption of electrical power to the reformer

In a reliable and safe way

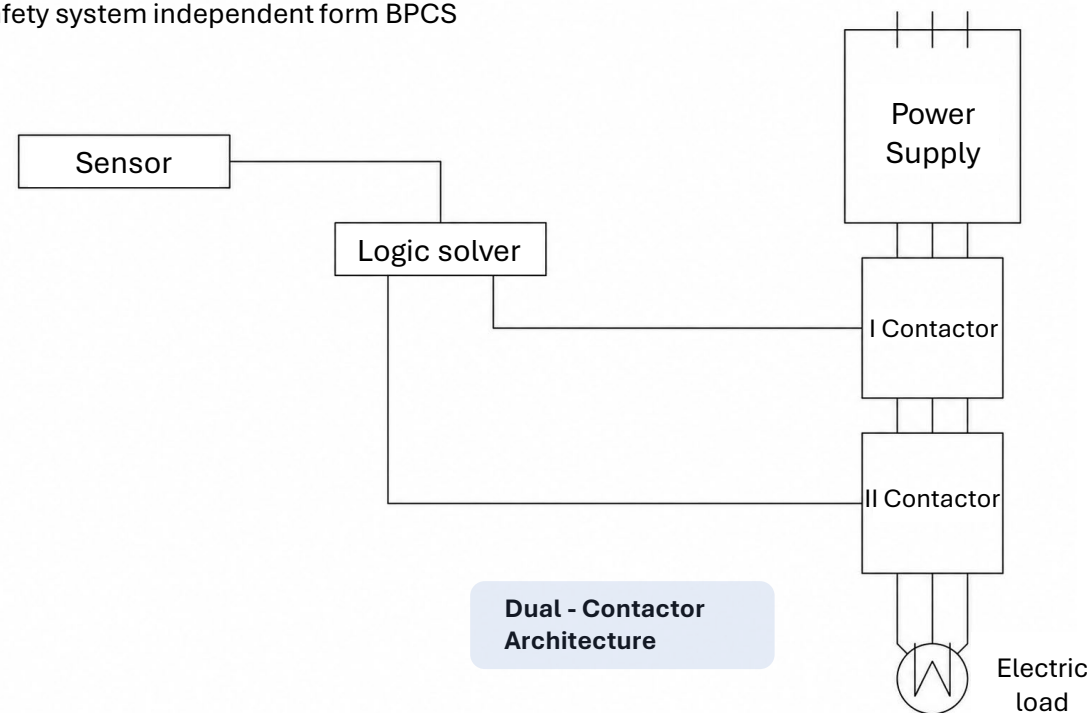
→ Safety interlock for an electric load

An established safety solution for safely disconnect power to an electric load

- Redundant contactors
- Both contactors are opened upon a safety trip
- Contact position monitored through feedback contacts

Safety interlock for an electric load

Safety system independent from BPCS



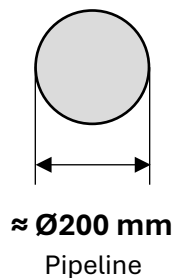
Stopping 100 MW: molecules versus electrons

Industrial scale reformers
100 MW duty

What does shutting down the heat source mean physically?

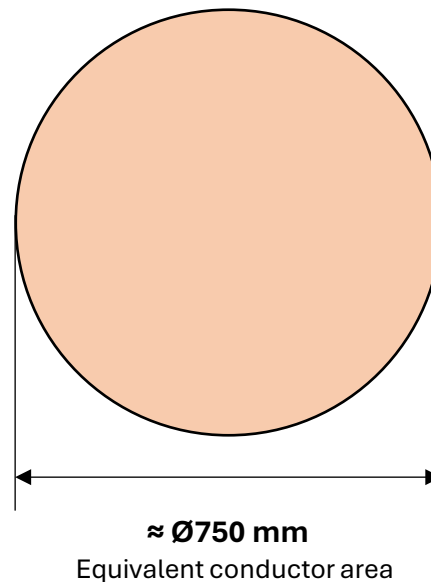
FUEL GAS

Closing valves



ELECTRICITY

Opening a circuit



Dual channel architecture: physically challenging

Limited regulatory guidance and industrial experience for safely switching off electrical heating loads at this scale.



Learnings from electric motors

Electric motors

Development of electronics of power supplies

→ Integrated safety function that prevent torque generation without opening the main power circuit



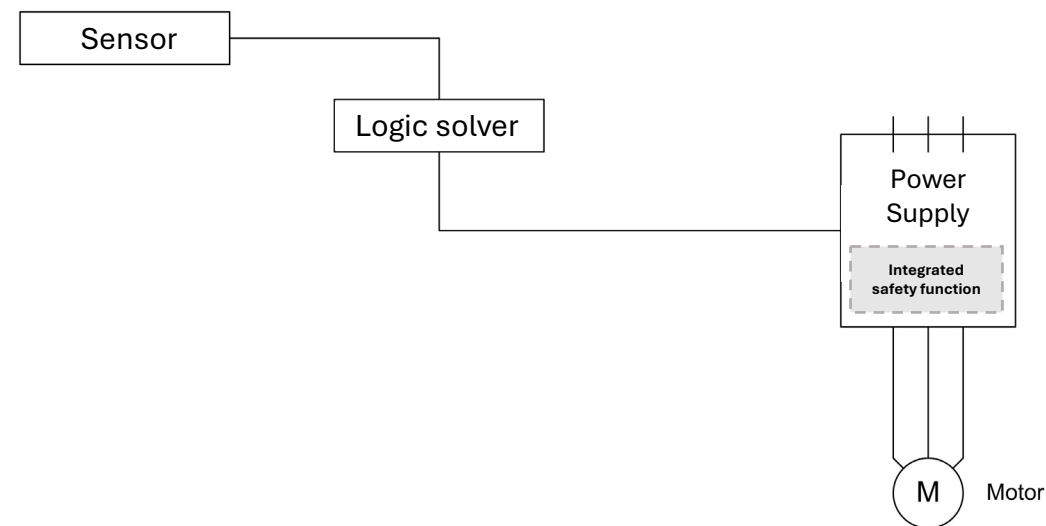
Potential direction for electric heating at large scale

→ Development of power supplies that prevent further heat generation without interrupting the main power circuit

Further progress will require development by power-supply providers and updated guidance from safety standards bodies

Integrated Motor Safety Function

Safety system independent form BPCS



Thank you



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