

Energy control of a self-sufficient microgrid based on a combined electrical and hydrogen distribution grid



Autoren

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Sector Coupling

- three energy sectors
 - gas (H_2)
 - heat
 - electricity

- Sector Coupling

- Power-to-Gas (PtG)

- Gas-to-Power (GtP)

- three types of energy storages

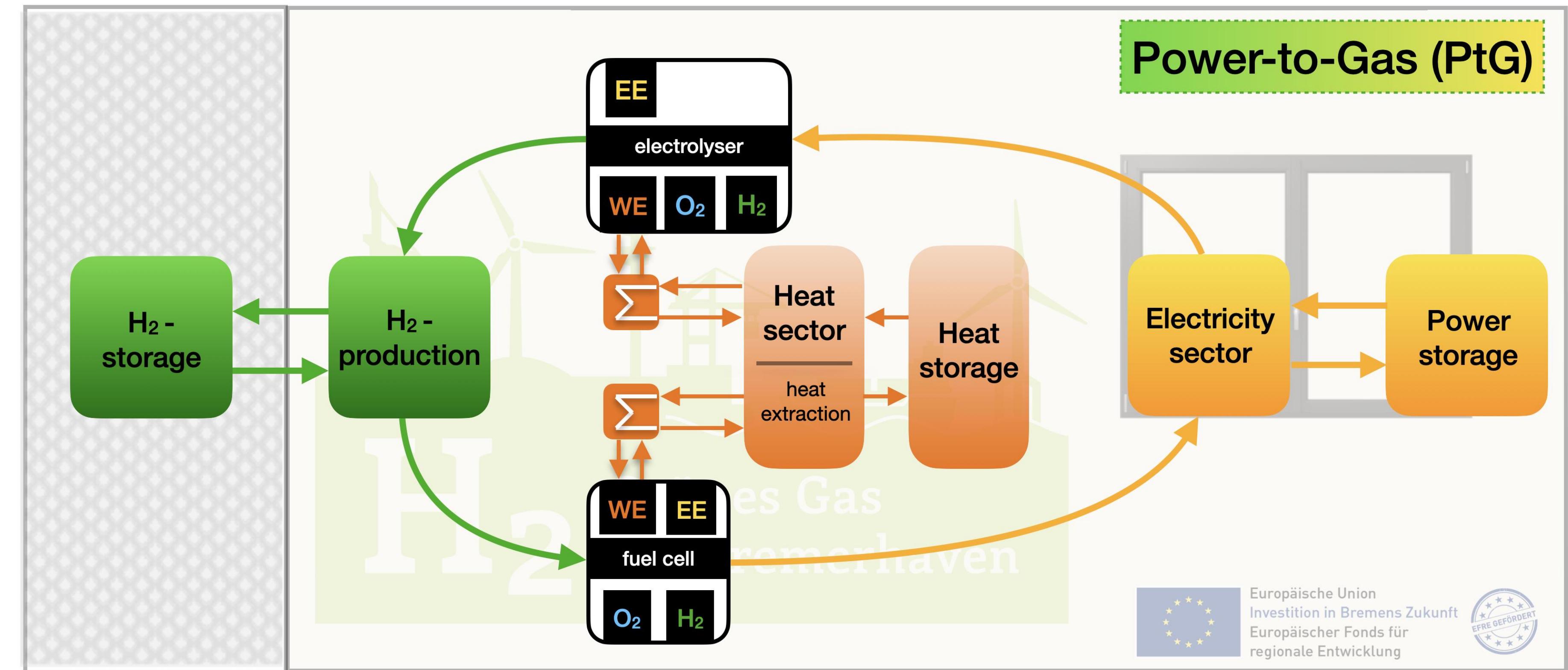


Figure 1: Sector coupling of the microgrid supply container at the Bremerhaven University of Applied Sciences

System structure

- renewable energy sources

- small wind turbine
- photovoltaic system

- electrolyser

- hydrogen distribution grid

- low pressure level 20 bar
- high pressure stage 200 bar

- fuel cell

- power distribution grid

- direct current network
 - 24 Volt
 - 48 Volt
 - 220 Volt

- three-phase grid

- DC/AC conversion

- three-phase inverter
- rotating converter

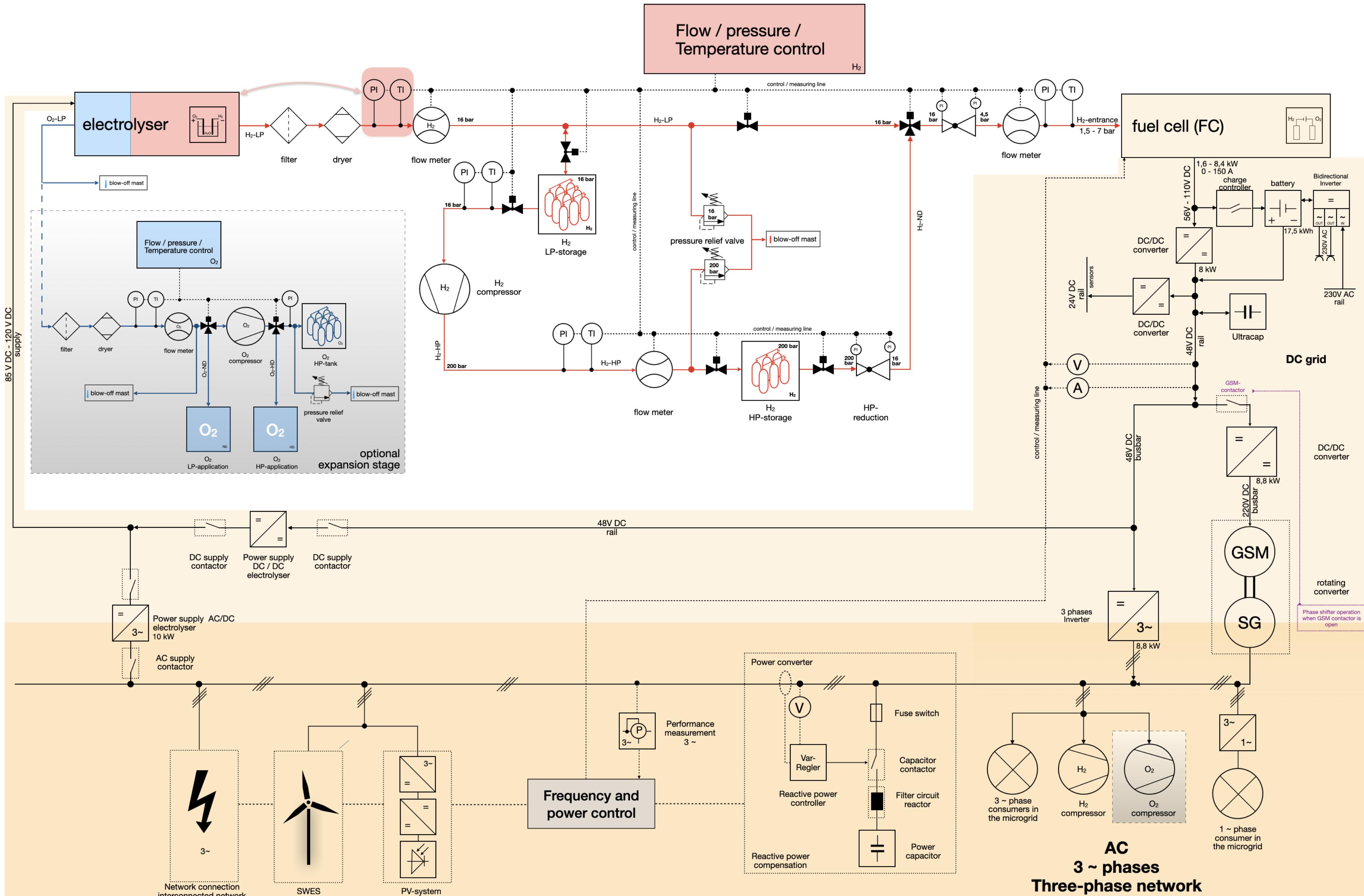


Figure 2: schematics of the whole system structure

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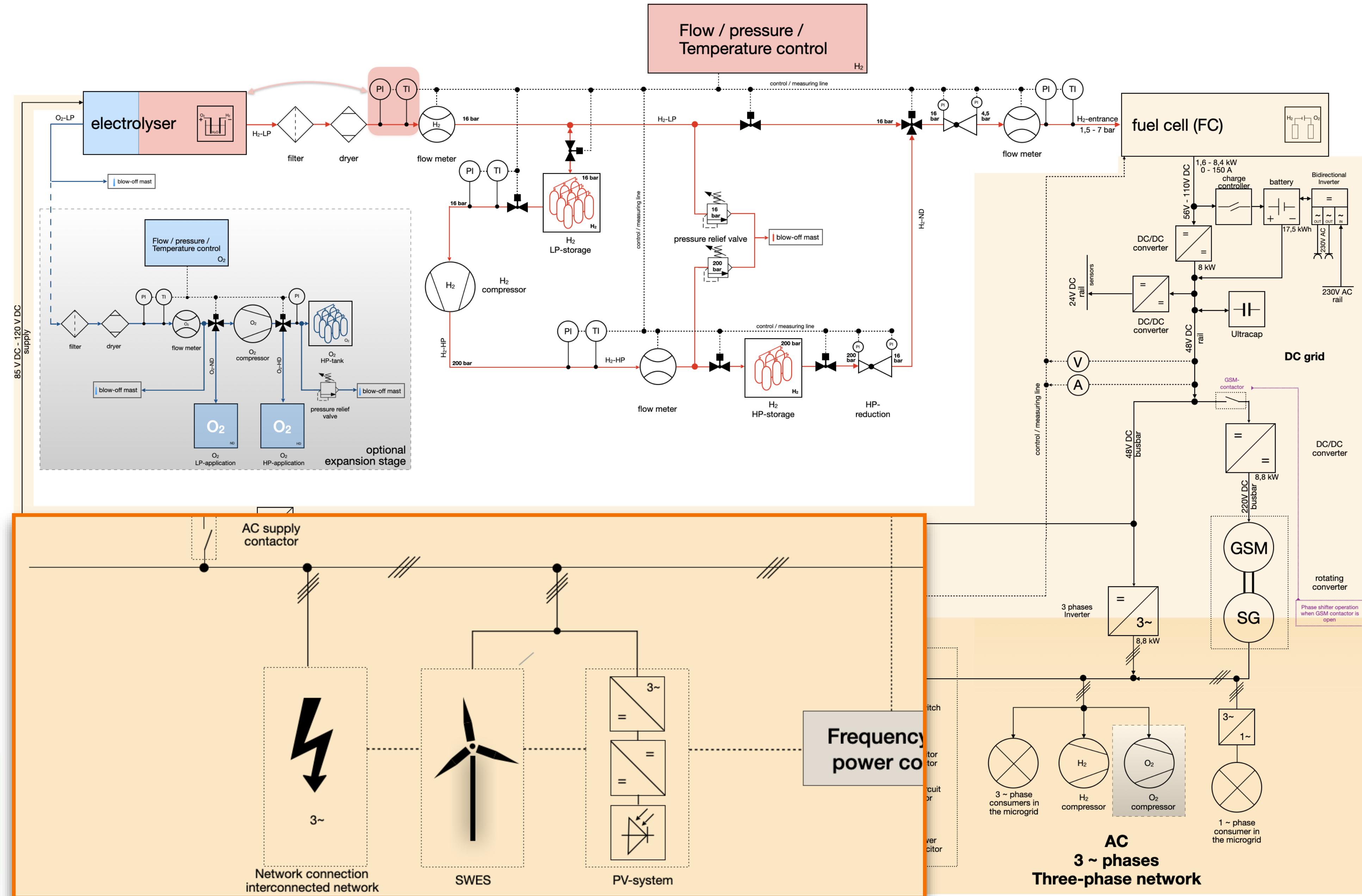


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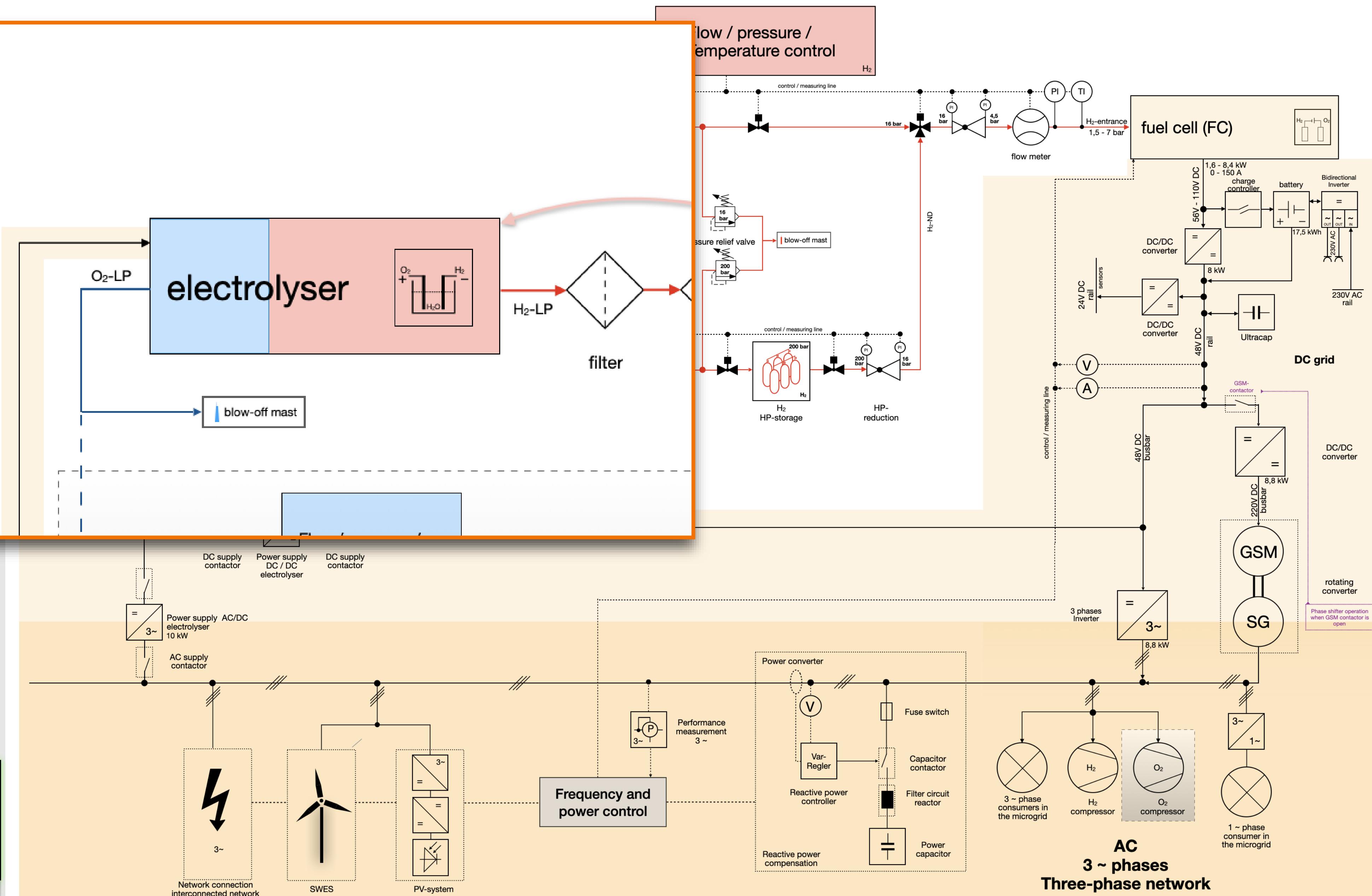


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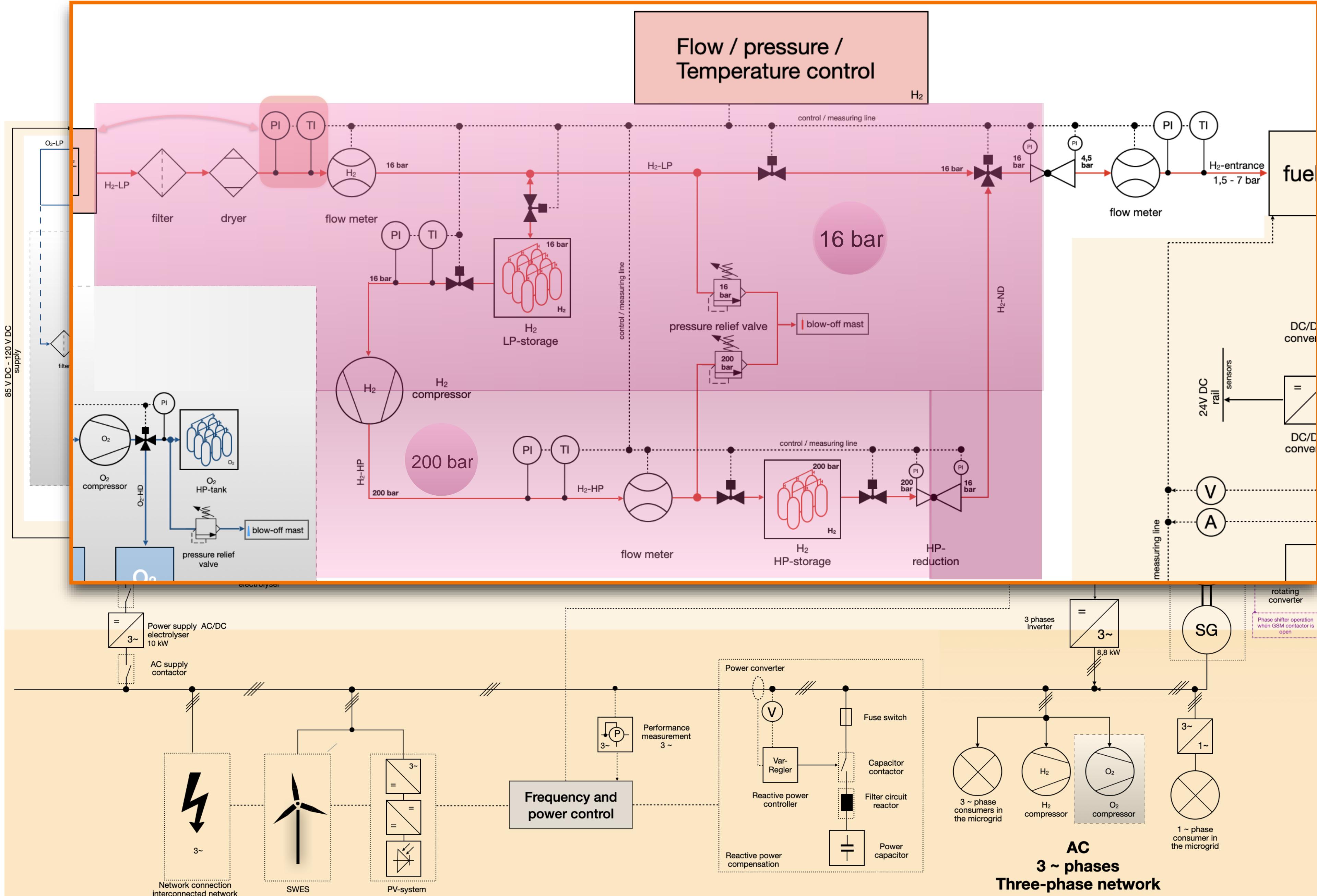


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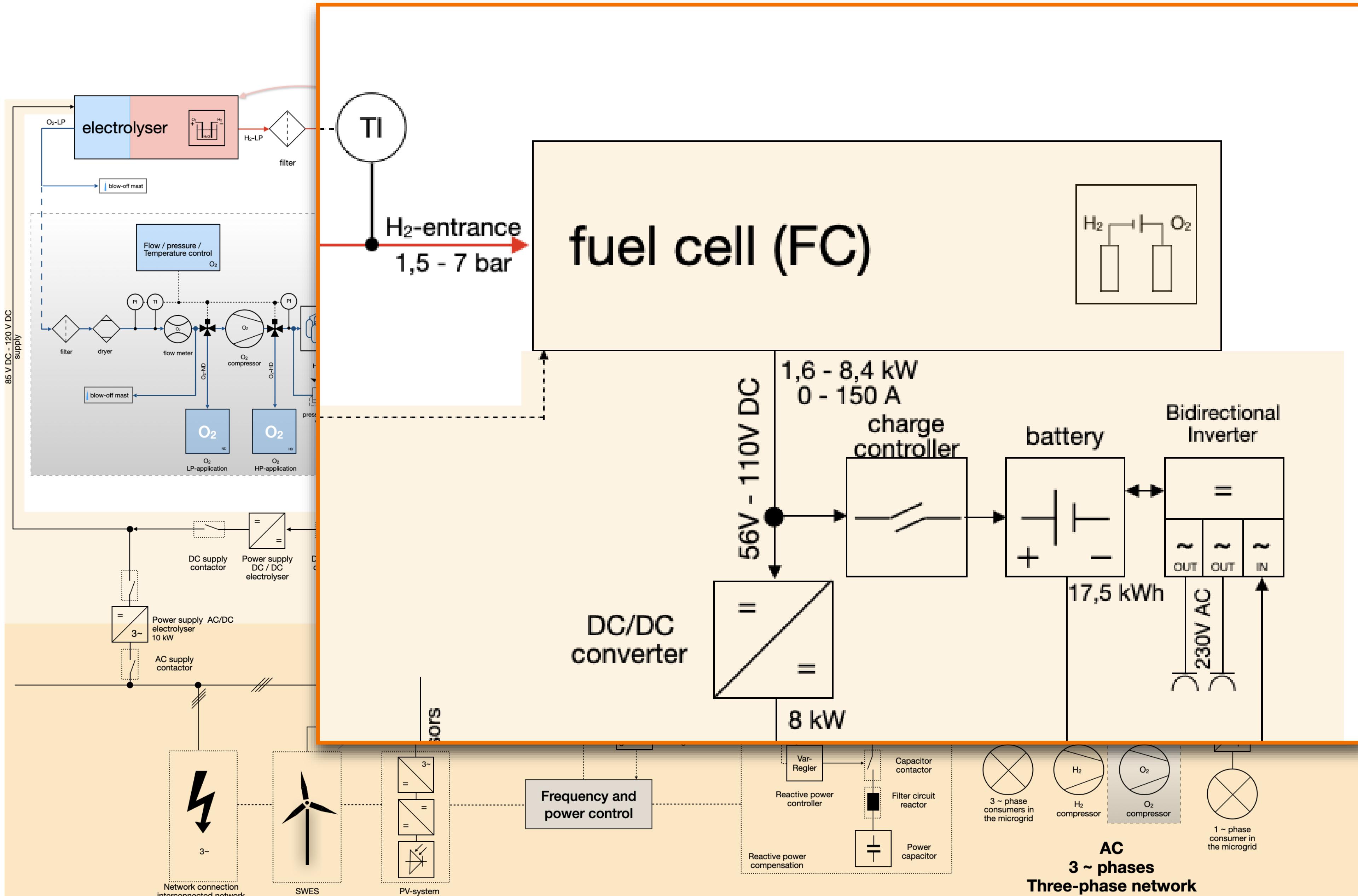


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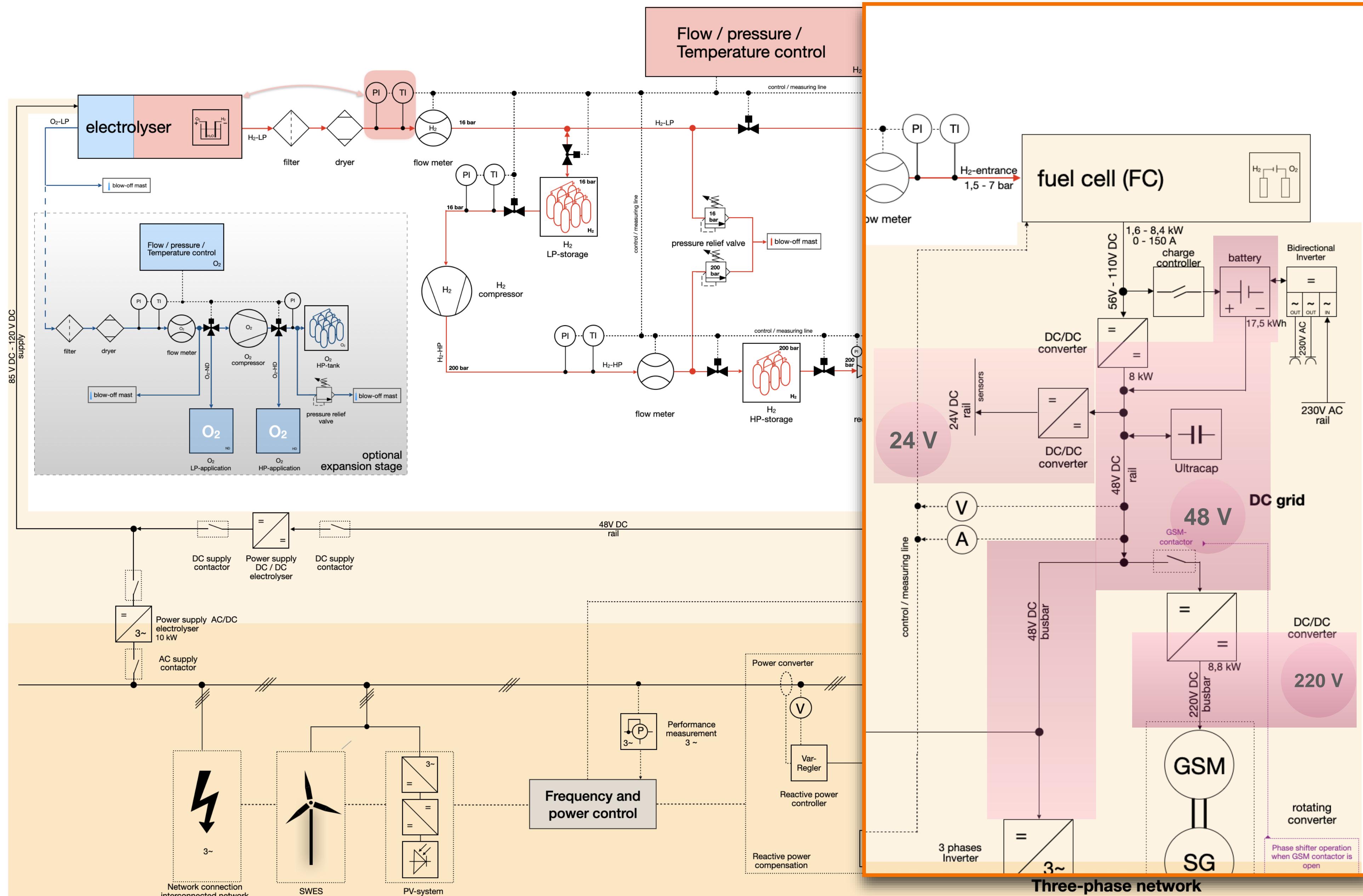


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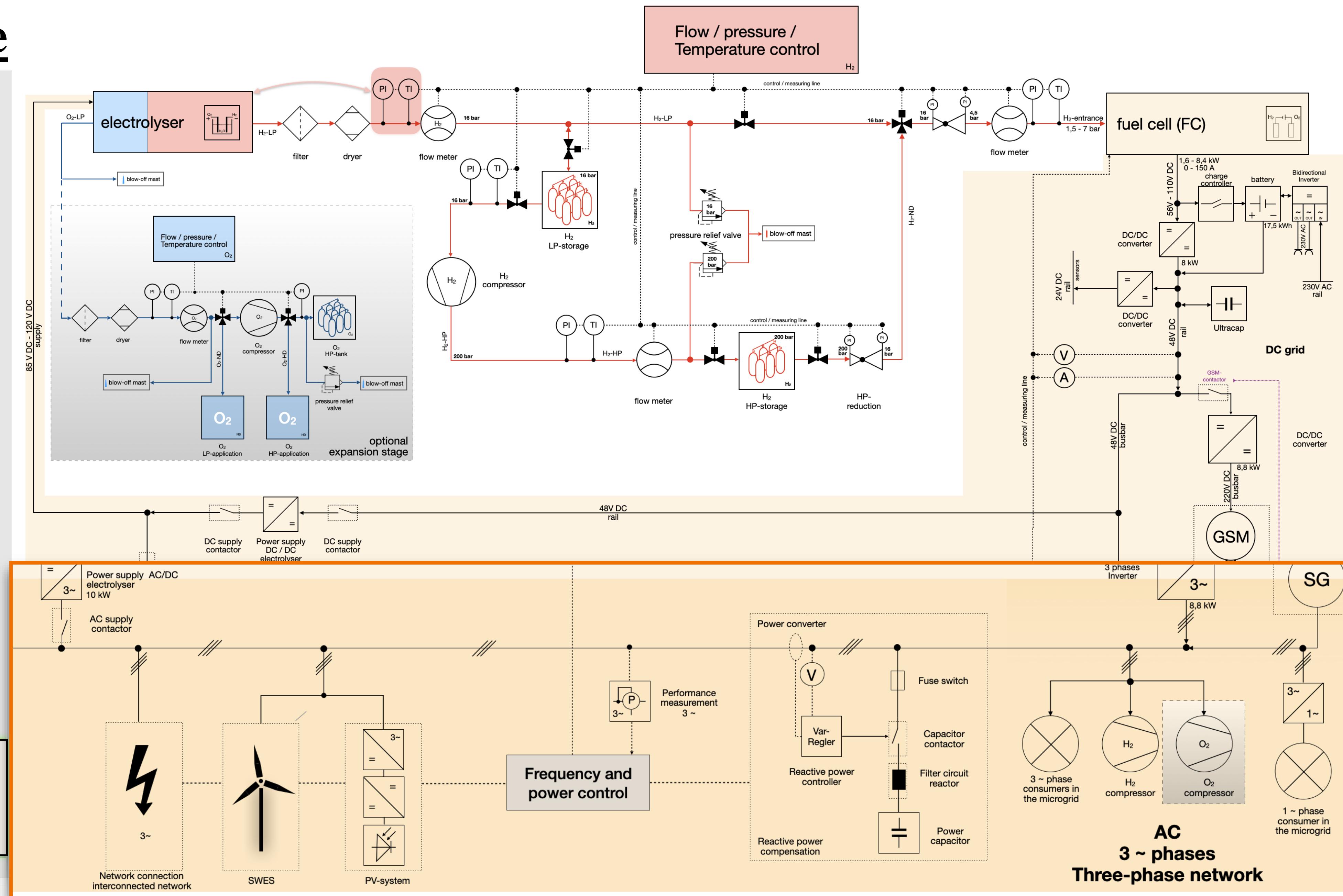
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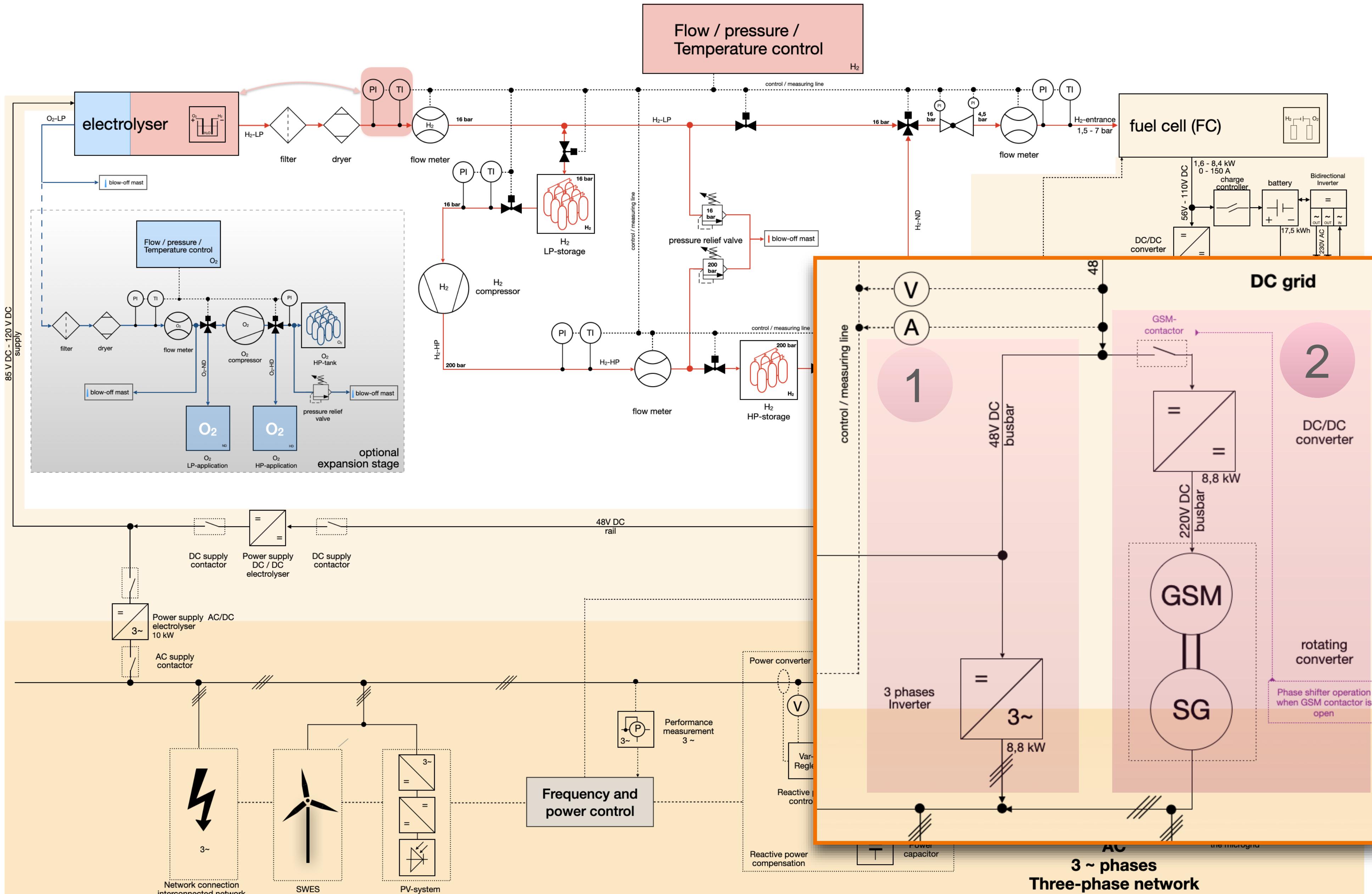
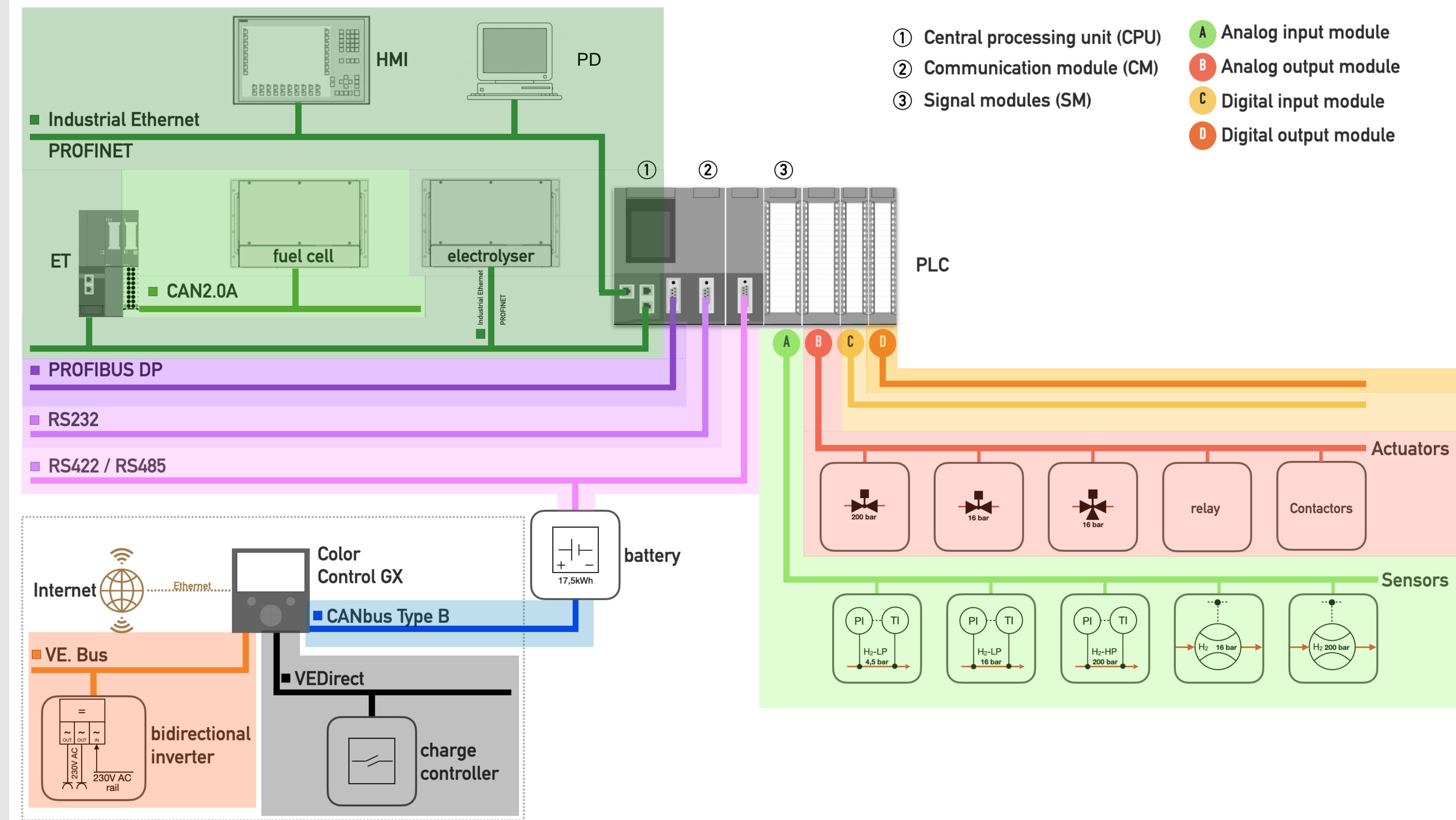


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Control microgrid

- communication ports/ protocols

- PROFINET
- PROFIBUS DP
- RS232
- RS422/485
- analog inputs/outputs
 - Sensors
 - Actuators
- digital inputs
- digital outputs
- CAN2.0A
- VE. Bus
- CANbus Type B
- VEDirect



HMI interface

- Clear structuring

- display

- measurements

- controll

- faults

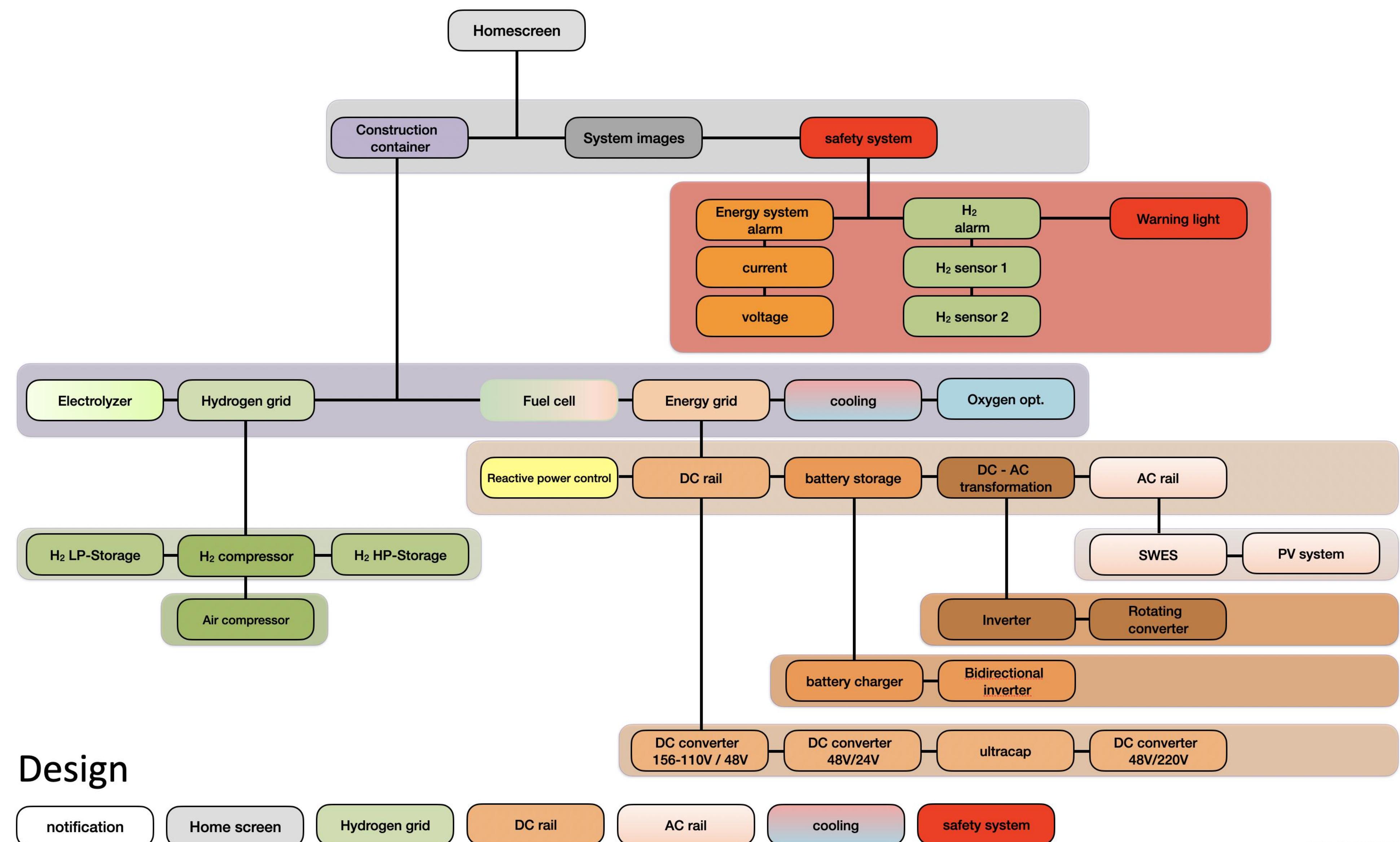
- malfunctions

- coloring

- uniform

- self-explanatory

- obvious



Design

source: David Stephan

Figure 6: Operation draft of Human Machine Interface (HMI)

Energy management

DC/AC conversion

- active power control
 - three-phase inverter
 - rotating converter
- reactive power control
 - rotating converter
 - excitation of SG
(synchronous generator)

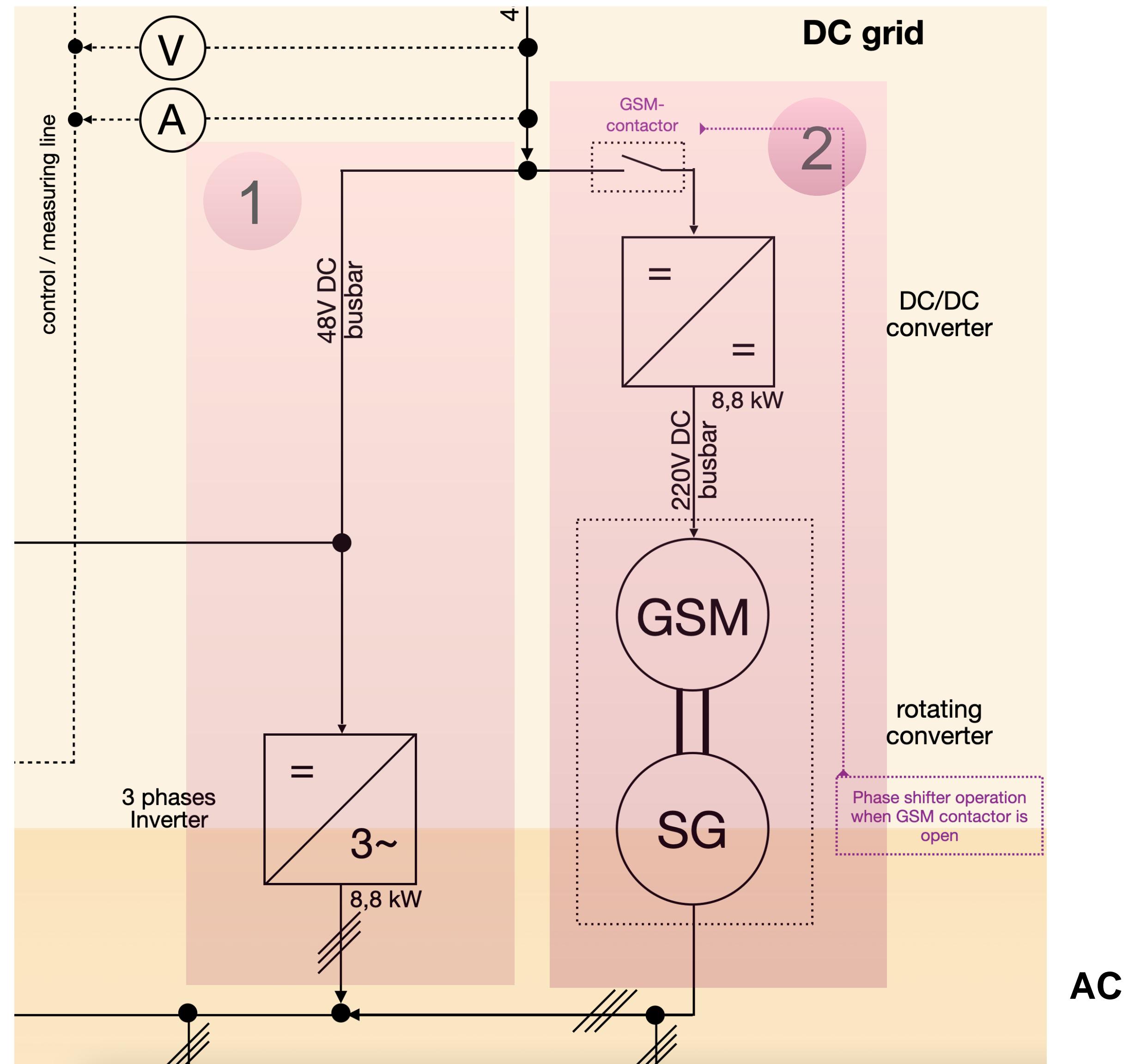


Figure 7: Options for the 400 volt supply of the AC voltage busbar

References

- [1] Werner, U.; Fichter, C.: „A Comparison of Future Alternative Fuels (LNG, Hydrogen) Utilizing in Maritime Passenger Ships for Heating, Electric Power Supply and Ship Propulsion“. 6th International Cruise Conference ICC – Bremerhaven 2019
- [2] Stephan, D., Werner U., Fichter C., „Projektierung und Modellierung eines Microgrids zur autarken Energieversorgung auf Basis eines kombinierten elektrischen Verteilernetzes und einem Wasserstoffnetz“. VDE-ETG-Kongressbeitrag 2021
- [3] Stephan, D., Werner U., Fichter C. (2022): „Electrical and Hydrogen Microgrid“. In: Industrie 4.0 Management (2022), Heft 1, S.49-52.

Founding notice



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Links:

- <https://wind-wasserstoff-bremerhaven.de/microgrids/>
- <https://www.youtube.com/watch?v=45mZC-MQPAE>
- <https://www.hs-bremerhaven.de/forschung/forschungsprojekte/wasserstoff-gruenes-gas-fuer-bremerhaven/>