

The core of the system

The SWITCH prototype system comprises two Large Stack Modules (LSMs) that represent the core of the system.

These LSMs can operate in fuel cell mode (SOFC-mode) or in electrolysis mode (SOE-mode) thanks to their special Solid Oxide Cells and reversible operation features.

In SOFC mode, the modules simultaneously generate electric power and hydrogen via steam reforming of methane-rich fuels, whereas in SOE mode the modules produce hydrogen (H₂) via steam electrolysis.

The prototype will demonstrate a **production capacity of 100 kg/day of H₂ once operated in SOE mode**, in addition to the **40 kg/day of H₂ plus 50 kW_{el} once operated in SOFC mode** as developed in CH2P project. ¹

The Balance of Plant (BoP) components of the system provide all the required feed streams to the LSMs at the desired conditions, and take care of the conditioning and purification of the product gases from the LSMs.

The SWITCH system consists of a cold section and a hot section.

H₂
production
capacity up to
100 kg/day
in SOE mode

HOT SECTION

The Hot section consists in all the equipment needed for fuel processing and steam generation.



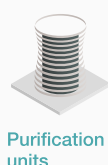
It is designed to pre-treat all the inlet and outlet streams to both SOFC/SOE modules (air and natural gas to burner, air to the LSMs, steam to mixer, EDI water to steam generation, PSA off-gas) in order to guarantee the right chemical-physical conditions to operate in SOFC/SOE modes.

COLD SECTION

The Cold section is designed to achieve the following:



- Provide the feed streams (natural gas, air, water and utilities, i.e. nitrogen, hydrogen and forming gas) at the required conditions, in terms of pressure and temperature level, and composition;
- Condition the syngas that is produced in the Hot BoP modules, by condensing the steam and compressing the gas stream at the proper pressure level for purification in the PSA (pressure swing adsorption) unit;
- Purify and recover the produced hydrogen at a required purity level.



References

¹ CH2P Project: <https://ch2p.eu/>

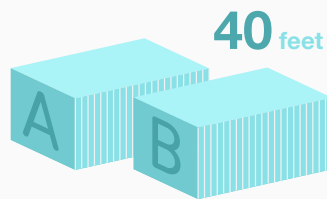


HOT SECTION

The hot section includes two gas upgrading units, each one composed by:

- 1 The SOFC/SOE modules (LSM)
- 2 The Hot BoP, which includes the following components: Burners | Electrical Heaters | External reformers | Steam/fuel mixers | Heat exchangers | Water-Gas-Shift (WGS) reactor

The steam generation is an external unit that serves the two Hot Balance of Plants.



Container A

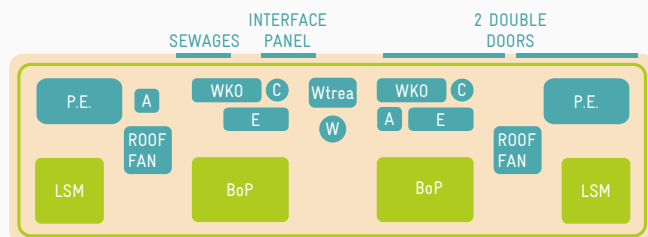
Container A accommodates the hot BoP and some elements of the cold BoP. It is dedicated to the gas upgrading section, including the steam generation units and part of the gas train (fuel, air, nitrogen and forming gas interception valves). The following components are included in this container:

- Two LSM modules
- Two Hot BoP modules
- One steam generation unit with the steam train
- Cooling and condensing system after the WGS units (steam condenser and water knock-out)
- The SPLC cabinet and the power electronics.

CONTAINER A

LSMs: Large Stack Modules (SOFC/SOE)
BoP: Balance of Plant
A: Air suction blower
Wtrea: Water treatment unit

C: Steam condenser
W: Water storage tank
WKO: water Knock-out
E: Electrical cabinet
P.E: Power Electronics



COLD SECTION

The Cold BoP has been sub-divided in the following sub-units:

- 1 Air Supply
- 2 Natural Gas Cleaning and Supply
- 3 Water Treatment and Supply
- 4 Gas Conditioning
- 5 Gas Purification
- 6 Coolant conditioning

The prototype will be arranged in two 40 feet high cube containers.

Container B

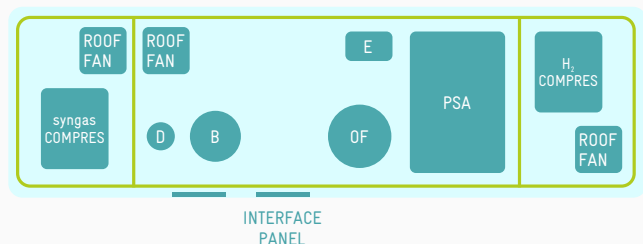
This container accommodates most of the cold BoP and contains the following components:

- The utilities gas trains
- The PSA unit
- The two compressors (for hydrogen and syngas)
- The electrical cabinets and control PLC.

CONTAINER B

PSA: Pressure Swing Absorber
E: Electrical cabinet
OF: Off gas vessel

B: Buffer vessel
D: Desulph vessel
COMPRES: syngas compressor and H₂ compressor



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