Notes on Cycle Tempo models

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## Boundary conditions

* Fuel inlet at dedicated fuel storage temperature
* Air and water inflow at ambient pressure and 25 °C
* Heat sinks are added for heat regeneration purposes. One is added for hot water at 90 °C and one for saturated steam at 180 °C. After the sinks for all models the exhaust temperature is 100°C. For some models some of the remaining heat is used to heat up the fuel.

## Nominal operational conditions of SOFC stack

* Inlet temperatures: 680 °C
* Average fuel cell temperature: 720 °C
* Outlet temperatures: 760 °C
* Fuel utilization: 80%
* Cell potential: 0.8 V
* Stack areas: 31.76 m2
* Cell Resistance: 4.3234e-05 Ωm2

## Operational constrains of SOFC stack

It is made sure the following constrains are met in all models:

* Anode pressure: 1.015 - 1.108 bar
* Cathode pressure: 1.013 – 1.083 bar
* Pressure difference anode cathode: max 0.025 bar
* Oxygen utilization: max 30%
* 2 < S/C < 2.3
* Limits for flows:
  + H2 as fuel: 128-480 sl.min-1
  + CH4 as fuel: 32-120 sl.min-1

## Ammonia model

* Cycle tempo does not support heating of liquid ammonia, so an extra block is added to compensate for the required heat.

## Diesel model

* Cycle tempo could not handle diesel in a pump well. For this reason, the fuel pump is added separately to be able to include the required power for the pump.
* The exhaust gas after the reformer is such low that no saturated steam can be produced. This is the case because a lot of energy is required for the reforming process.

## Hydrogen model

* The exhaust gas is such low that no saturated steam can be produced.
* Since the oxygen utilisation is low, the airflow is quite large. This large amount of air needs to be heated to the SOFC temperature which brings thermal management challenges.

## Methane model

* The 20% pre-reformer is modelled with a full-reformer and a 80% bypass.

## Methanol model

* The exhaust gas after the reformer is such low that no saturated steam can be produced.