

**sCO<sub>2</sub>-4-NPP**

# **Innovative sCO<sub>2</sub>-Based Heat Removal Technology for an Increased Level of Safety of Nuclear Power Plants**

**sCO<sub>2</sub>-flex  
Final Event**

**2021, June  
16<sup>th</sup>**

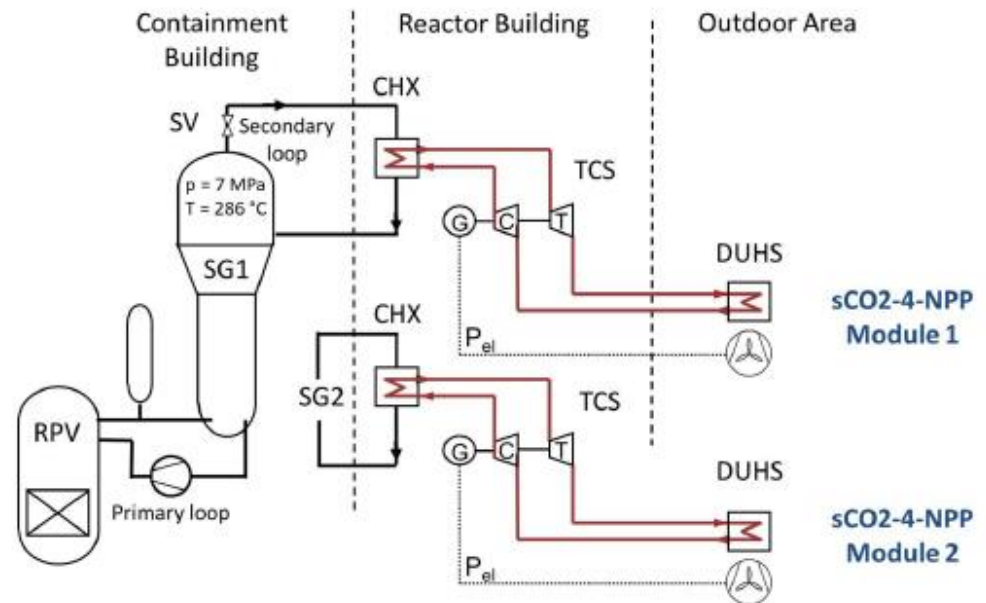
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# SCO2-HEAT REMOVAL SYSTEM

**Project Objective:** Development of an Innovative sCO<sub>2</sub>-Based Heat Removal Technology for an Increased Level of Safety of Nuclear Power Plants

## The vision: sCO<sub>2</sub>-System

- Electricity made out of decay heat
- Modular
- Self-starting
- Self-sustaining
- Retrofittable for existing PWR, BWR, ...
- Innovative power conversion system for SMR, GEN IV...



# TEST CAMPAIGN

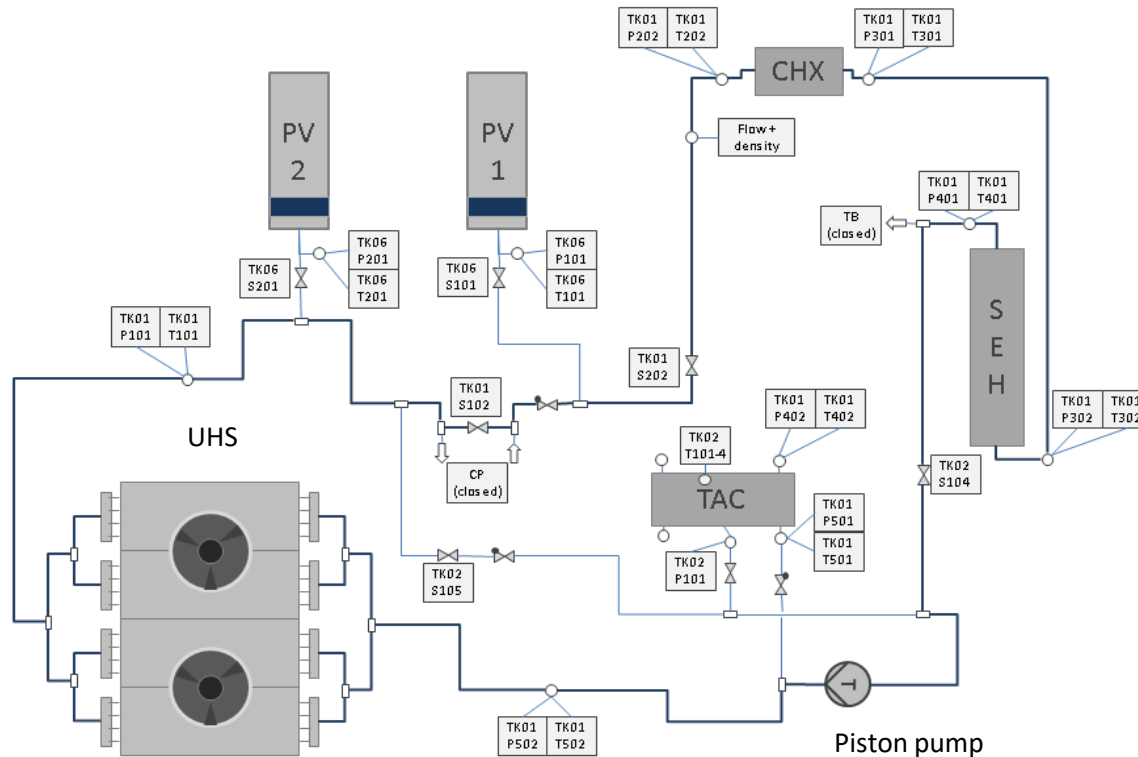
## Essen sCO<sub>2</sub> Loop tests

- Objectives:
  - Run tests and provide measurements starting with test cases of low complexity
  - Increase the number of involved components to increase complexity
- Results:
  - Improve knowledge and understanding of sCO<sub>2</sub> cycle behavior
  - Provide the required data for the loop modelling



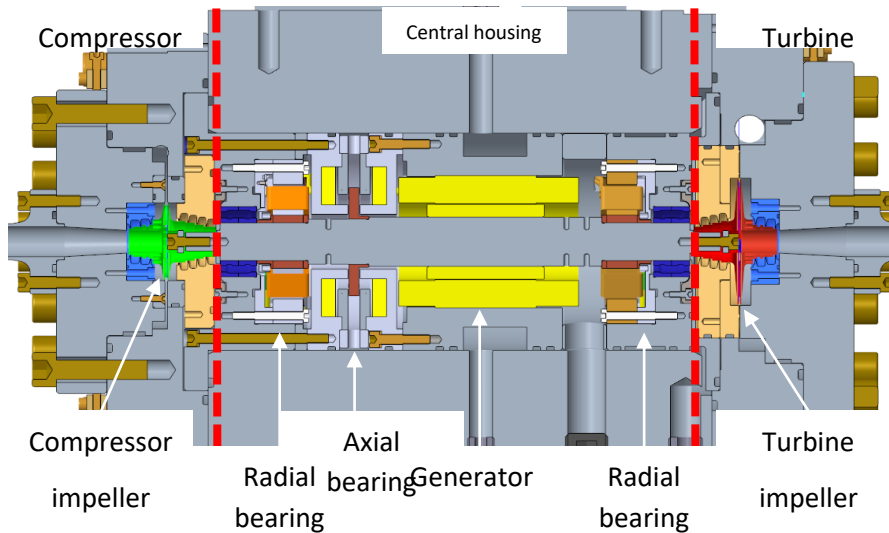
# sCO<sub>2</sub> LOOP MODELLING

- Loop modelling in 3 thermohydraulic codes



- Results: Comparison between tests data and models in ATHLET, CATHARE, MODELICA

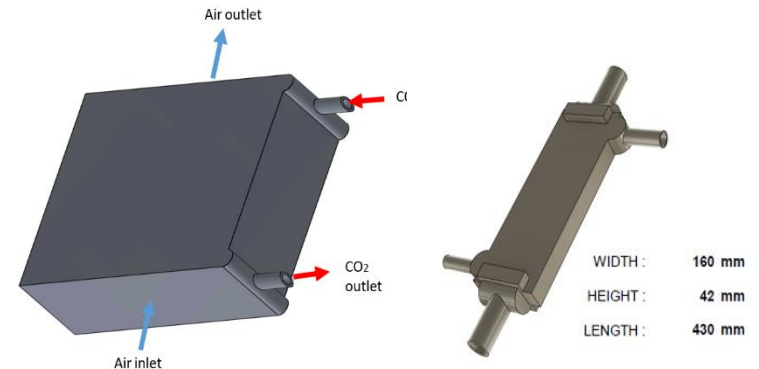
## Turbocompressor



### ■ Results:

- New bearings tests (magnetic, hydrostatic gas)
- New design

## Heat Exchangers

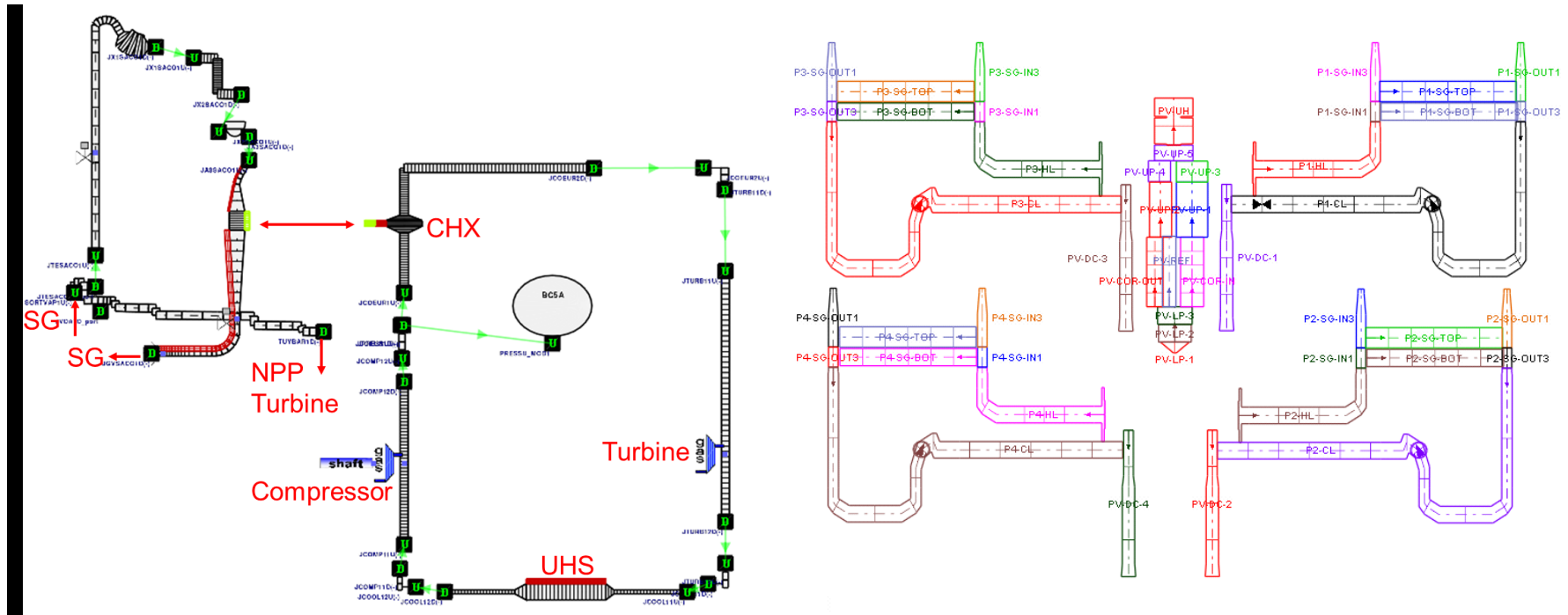


### ■ Results:

- New designs
- Patent

# SCO2 SYSTEM COUPLING

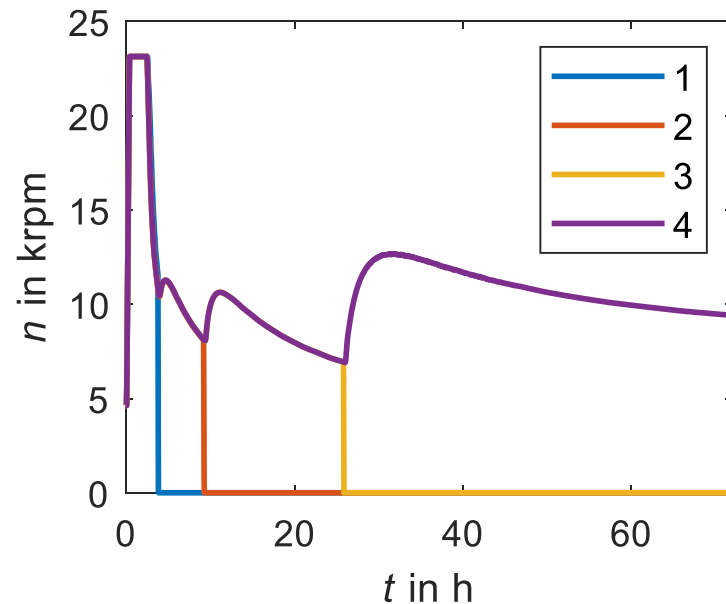
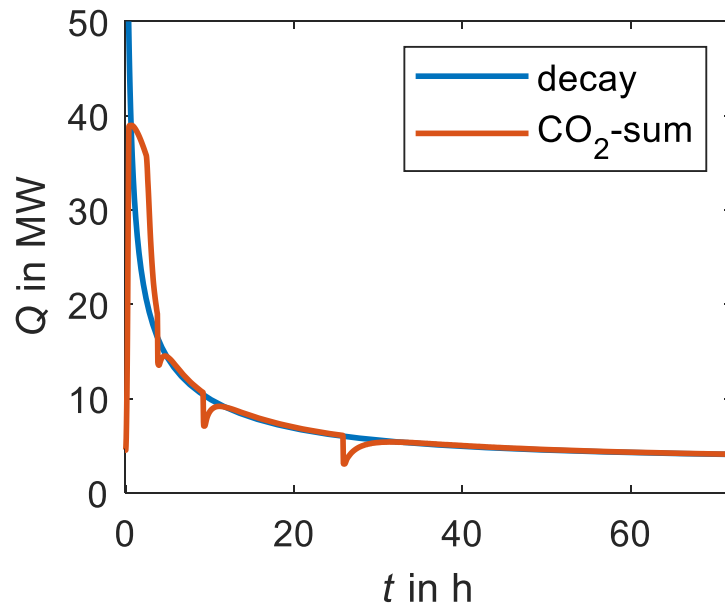
- Objective: In thermohydraulic codes: Coupling of the 10MW sCO<sub>2</sub> system to NPP and simulation of accidental situation



- Results: Preliminary assessment of the actual effect of the system on heat recovery

# FIRST PWR SIMULATIONS WITH ATHLET

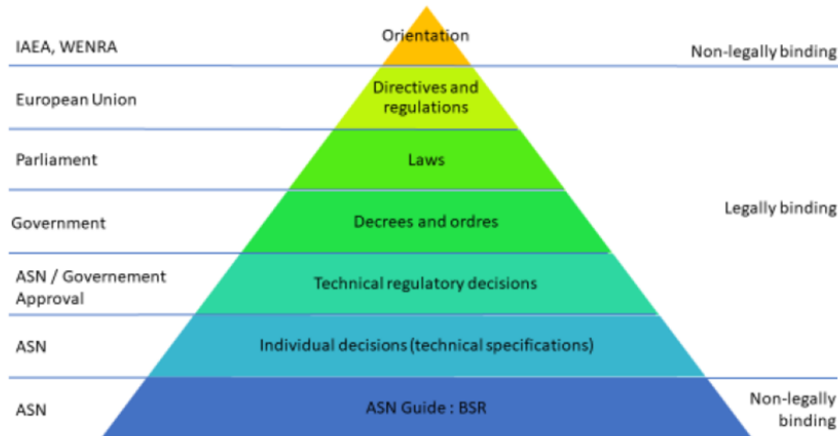
- 4 systems (with adaption to decay heat curve)
- Control of turbomachinery speed and subsequent shutdown
- Systems can run for more than 72 h
- Excess power always higher than zero



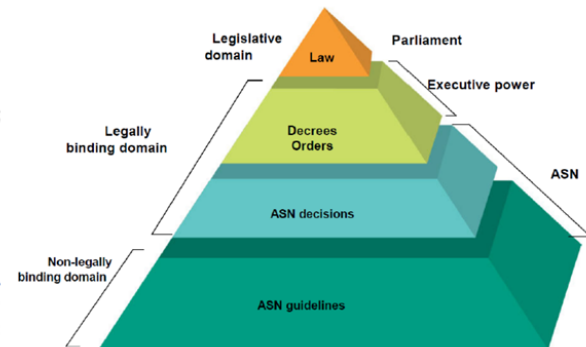
# REGULATORY WORK

- Objective: To prepare licensing and regulatory work for industrialisation

## Levels of regulation: 7 levels



## Regulation process: 4 levels

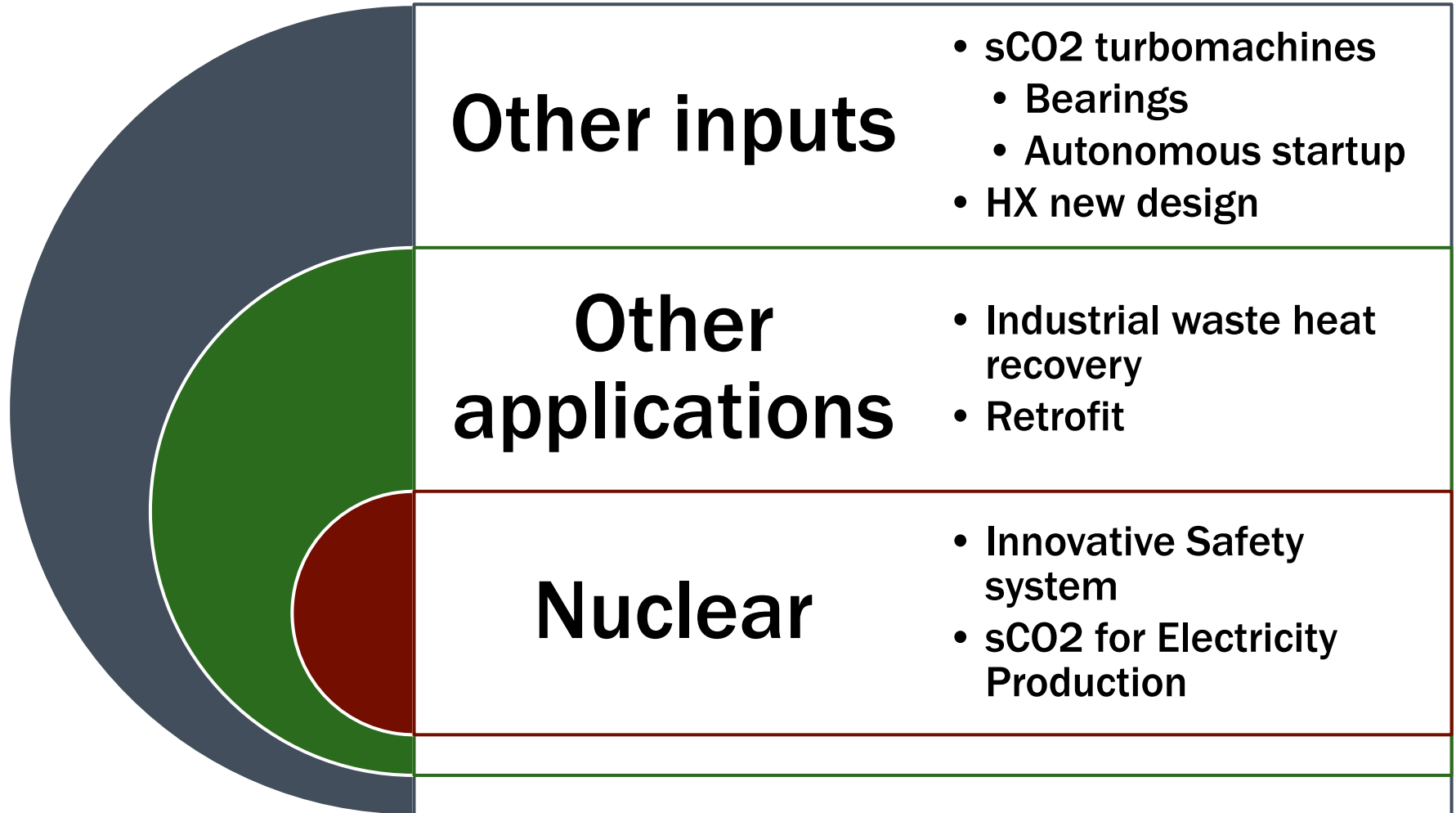


- Results:
  - Identification of all regulations and standards related to nuclear safety systems and sCO<sub>2</sub> systems
  - Identification of standards to be followed for the development of components

## NEXT STEPS

- Optimized 10 Mwe module design
  - Ultra compact architecture
  - Final design of main components
- Improved efficiency of the sCO<sub>2</sub> system
  - Autonomous system start-up
  - Efficiency improvements of main components
- Simulation of sCO<sub>2</sub> system behaviour
  - Test on an NPP simulator
  - Optimisation of NPP-sCO<sub>2</sub> system couplings in nuclear codes
- Preparation of development roadmaps
  - Technology roadmap
  - Regulatory roadmap

# SCO2-4-NPP IN SCO2 LANDSCAPE



# THANK YOU



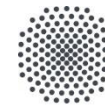
Das Simulatorzentrum

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