Innovative sCO2-Based Heat Removal Technology for an Increased Level of Safety of Nuclear Power Plants

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Project Coordinator

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Presentation structure

- Project Summary
- Objectives & expected impact
- Scope
- Main results/outcomes
- Options for exploitation/collaboration/follow-up activities

Project summary

Funding source	EU-funded EURATOM project
Budget	2,786,971€
Duration	36 months (Sept. 2019 – Aug. 2022)
Start TRL	TRL3
End TRL	TRL5

Partners

EDF

Jožef Stefan Institute
Ljubljana, Slovenia

ÚJV NUCLEAR RESEARCH INSTITUTE

fives

Das Simulatorzentrum
KSG | GfS

CVŘ Research Centre Řež

Baker Hughes

UNIVERSITÄT DUISBURG ESSEN
Open-Minded

ARTTIC
a PNO international management services company

University of Stuttgart
Germany

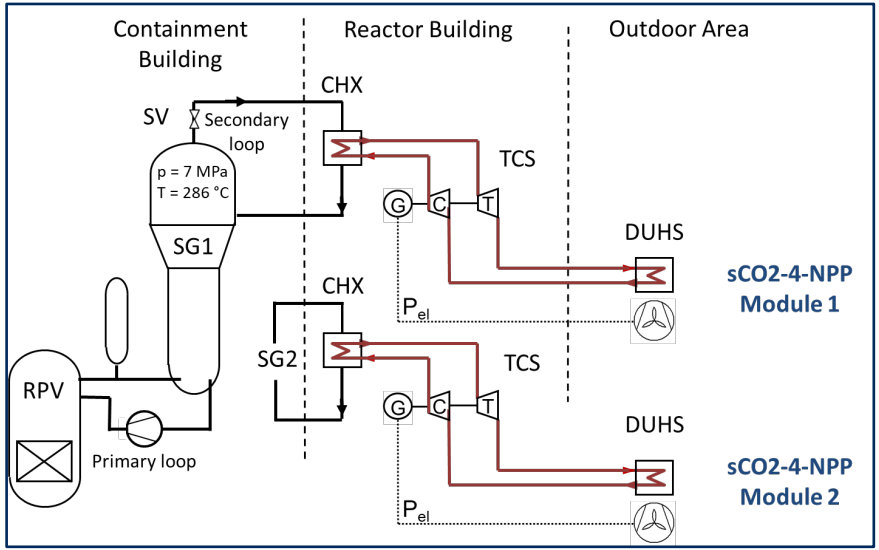
sCO2-4-NPP

Objectives & expected impact

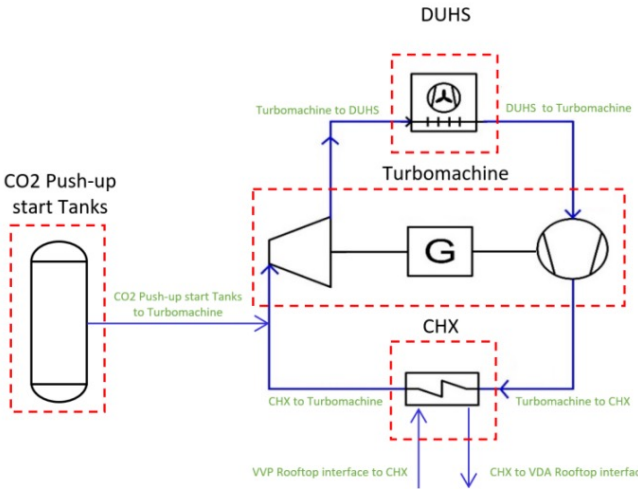
Development of an Innovative sCO2-Based Heat Removal Technology for an Increased Level of Safety of Nuclear Power Plants

The vision: sCO2-System

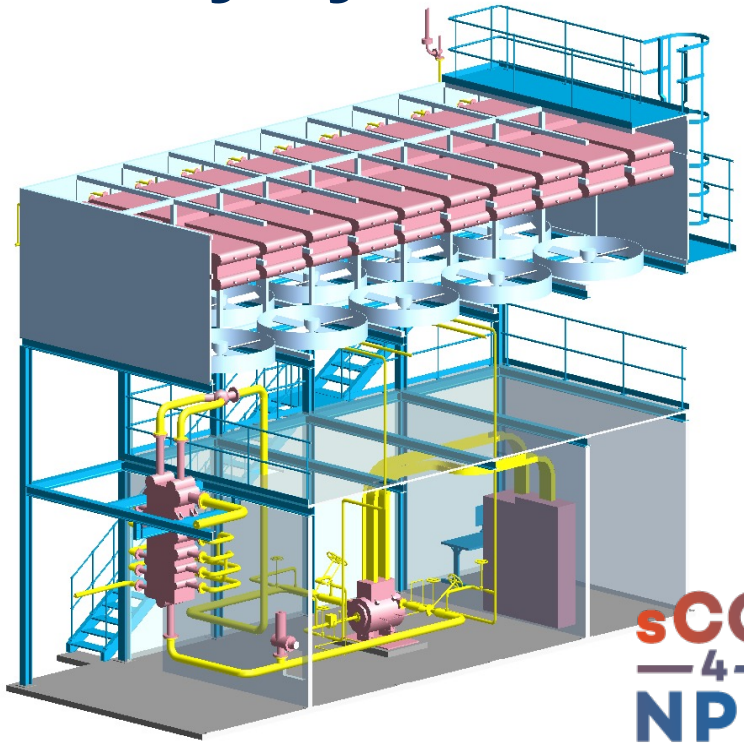
- Electricity made out of decay heat
- Modular
- Self-starting
- Self-sustaining
- Retrofittable for existing PWR, BWR, etc.
- Innovative power conversion system for SMR, GEN IV, etc.



Scope : sCO2 Heat recovery system



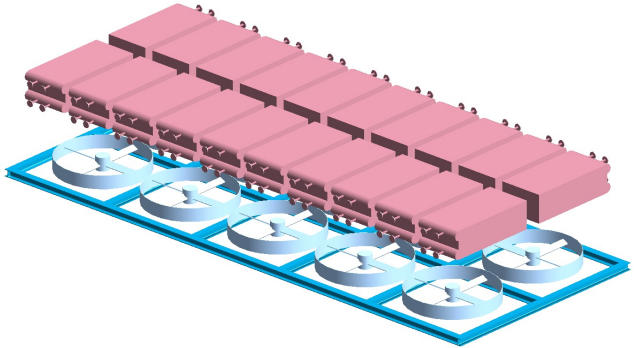
	P [bar]	T [°C]
Compressor inlet	126.3	55.0
Compressor outlet	214.7	80.8
CHX inlet	213.4	80.86
CHX outlet	213.4	280.51
Turbine inlet	211.7	286.6
Turbine outlet	127.5	243.2
UHS inlet	122.2	149.92
UHS outlet	122.2	55.01



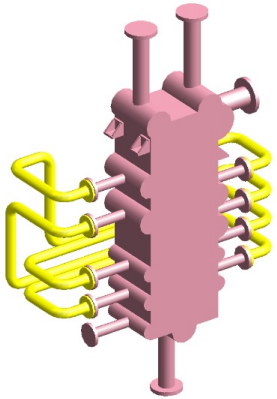
Scope : sCO2 Heat recovery system

Small-scale equipment developed and tested

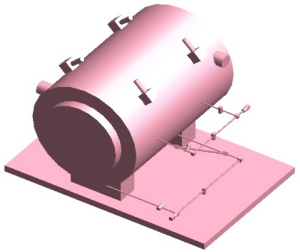
DUHS Exchangers with fin-fan coolers



CHX Exchanger



Turbomachine



- Several sCO2 loops for tests (2 in Germany, 1 in Czech Republic)
- Integration in a NPP simulator

Main results/outcomes 1/2

1: Validation of sCO2 models in thermal-hydraulic system codes on lab scale

- ✓ Simulations of sCO2 test loop in ATHLET, CATHARE and ATHLET/MODELICA

2: Specification of an upscaled system, boundary conditions & simulations for sCO2-4-NPP loop implementation in a full-scale NPP (PWR)

- ✓ Specification of accident simulation
- ✓ Simulations of upscaled sCO2 system

3: Preparation of a licensing roadmap of the sCO2-4-NPP system to ensure compliance with applicable regulation

- ✓ Licensing and construction requirements
- ✓ Roadmap

4: Design of components for the sCO2-4-NPP loop in the context of licensing requirements

- ✓ Design of upscaled Heat Exchangers
- ✓ Design of upscaled Turbocompressor

Main results/outcomes 2/2

5: Final design of the system architecture of sCO2-4-NPP integrated in a full-scale NPP

- ✓ Drawings of scale design of sCO2-4-NPP modules integrated in PWR and safe heat removal of the designed system validated by ATHLET and CATHARE simulations.

6: Validation of sCO2-4-NPP loop in a virtual “relevant nuclear environment” PWR

- ✓ Operation of sCO2-4-NPP integrated into the KONVOI NPP simulator without negatively interfering with the existing safety and operational systems

7: Prepare technical, regulatory, financial and organisational roadmaps to bring sCO2-4-NPP to market

- ✓ Detailed technical, regulatory, financial and organisational roadmaps for bringing sCO2-4-NPP to market.

Options for exploitation/ collaboration/ follow-up activities

- Instruction of a follow-up project
  - Integration of new start-up and operating procedures (via thermal-hydraulic modelling and simulator)
  - Performance improvements of main equipment
    - Prototypes on a larger scale
    - Quantification and reduction of modelling uncertainties
  - Continued work on regulation
- Open the system to other applications
  - Industrial heat recovery, ...
  - Flexibility and performance improvements in addition to reliability

Contacts

- Coordinator: albannie.cagnac-1@edf.fr
- Project website: www.sco2-4-npp.eu (public deliverables on website)