NPHyCo Webinar Technical Requirements

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NPHyCo
Nuclear Powered Hydrogen Cogeneration

Agenda

About NPHyCo project

Technical Requirements & Challenges

Questions & Answers

Concluding remarks + next events

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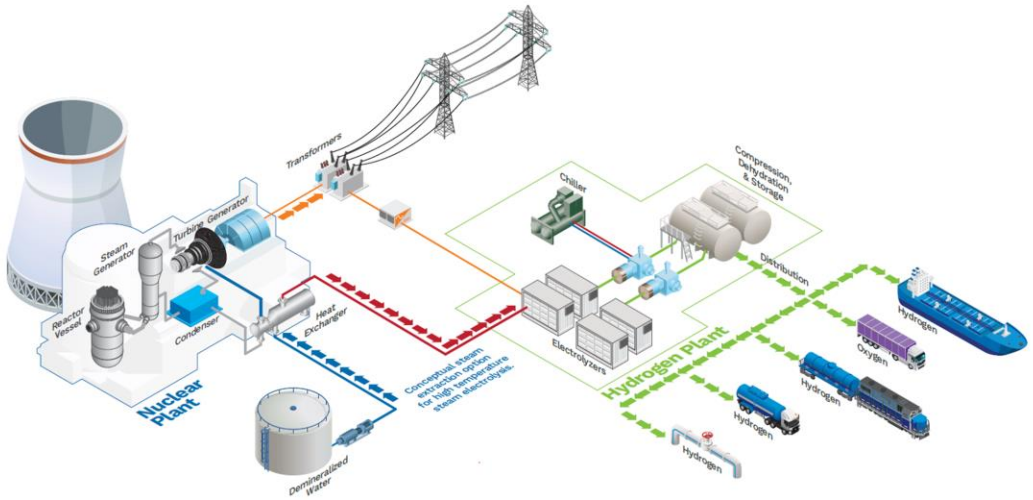
About NPHyCo

- EU research project dedicated to the production of hydrogen from nuclear power
- Funded by the EU's Euratom Research & Training programme (2021-2025) dedicated to nuclear research and innovation
- Kicked-off in the Autumn of 2022 and will run for two and a half years



The Challenge

- Full decarbonisation of the EU's economy by 2050
- Could hydrogen be part of the solution? Potentially yes BUT
  - to date most of the hydrogen produced comes from fossil fuels (e.g. Methane)
- How can Europe:
  - Ramp up production of low-carbon hydrogen?
  - Produce to meet demand?
  - Ensure it is affordable?

Project goals

- NPHyCo is focusing on the potential for developing large scale, low-carbon, hydrogen production facilities linked to nuclear power plants.
- It started by assessing the feasibility of producing hydrogen near an existing nuclear power plant as well as the added value of such project.
- It is analysing the potential offtaker (e.g. steel, iron, fertilizer and petrochemical industry) and also the transportation routes.
- It is also looking at potential locations where a pilot project could be implemented.

Project Partners

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ansaldo nucleare

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CVŘ Research Centre Řež

European Commission

covalion

GRS

ENERGY SAFETY GROUP

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NRG Nuclear. For life.

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Work Packages

WP1: Conceptualisation

This Work Package will focus on conceptualisation of the project.

WP2: Technical Roadmap

This Work Package will focus on the technical conditions related to the coupling of a hydrogen production facility to an existing NPP.

WP3: Economic Roadmap

This Work Package aims to develop a business plan for hydrogen produced from nuclear power.

WP4: Licensing Roadmap

This Work Package will focus on licensing requirements.

WP5: Implementation Roadmap

This Work Package will put forward proposals for pilot plant locations and their layout.

WP6: Communication, dissemination & public awareness

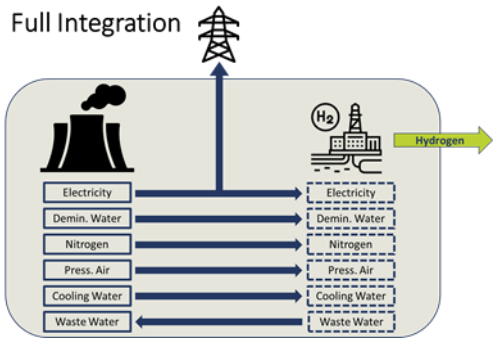
This Work Package focuses on communication around the project.

Outcome of Technical Roadmap

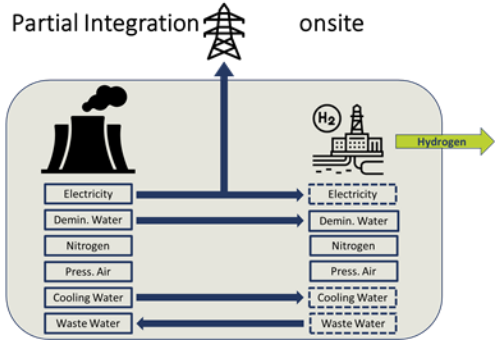
- NPHyCo identified needs of Hydrogen Production Units taking into account the three main types of electrolysers: AEL, PEM and SOEC and compared them with the resources available on existing NPP sites
- Potential coupling scenarios were derived (D2.1) and analyzed for NPP sites where there was enough information available
- The impacts of coupling were analyzed with two aspects: Safety Impacts (D2.2A) and Impacts on Flexible Load operation (D2.2B)
- Conditions in favor or against coupling were listed and described (D2.3 and D2.4) and fed into the Economic Roadmap
- The requirements and the economic result were used to build a decision matrix for the comparison of different site, scenarios, technologies based on requirements weighted according to their significance.

Possibilities of Integration

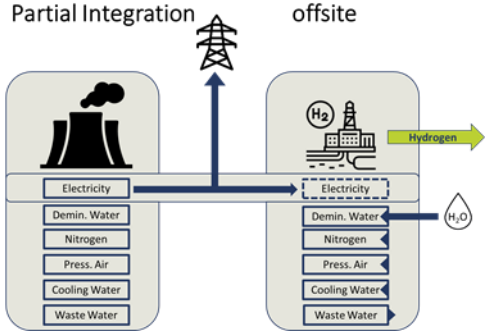
With respect to the needs of hydrogen production via electrolysis of water (AEL, PEM, SOEC) coupling to a NPP may be performed at different levels of Integration



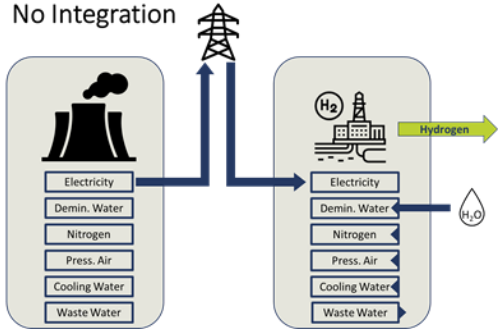
All Inputs to HPP
provided by facilities of NPP



Some Inputs to HPP
provided by facilities of NPP
e.g. electricity, water or cooling
Other Input is produced within the HPP
HPP located onsite of NPP



Some Inputs to HPP
provided by facilities of NPP
e.g. direct line for supply of electricity
Other Input is produced within the HPP
HPP located offsite of NPP



No Inputs to HPP are provided by facilities of NPP
HPP within the same location and framework as NPP to be used as a benchmark for uncoupled H2 production

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Preset of Integration Scenarios

The following 7 pre-sets of Integration Scenarios have been investigated in NPHyCo for sites where sufficient information was available

Onsite Solutions

1. Onsite solution with full integration except chilled water with electricity at normal price (grid)
2. Onsite solution with full integration except chilled water with electricity at reduced price (home need)
3. Onsite solution with integration of electricity and cooling water only normal price
4. Onsite solution with integration of electricity and cooling water only reduced price

Offsite Solutions

(3 km distance as a starting point)

1. Offsite solution with integration of electricity and cooling water (elaboration of break-even distance for cooling water integration) with electricity at normal price (grid)
2. Offsite solution with integration of electricity and cooling water (elaboration of break-even distance for cooling water integration) with electricity at reduced price (home need)
3. Offsite solution with integration of electricity only at normal price
4. Offsite solution with integration of electricity only at reduced price

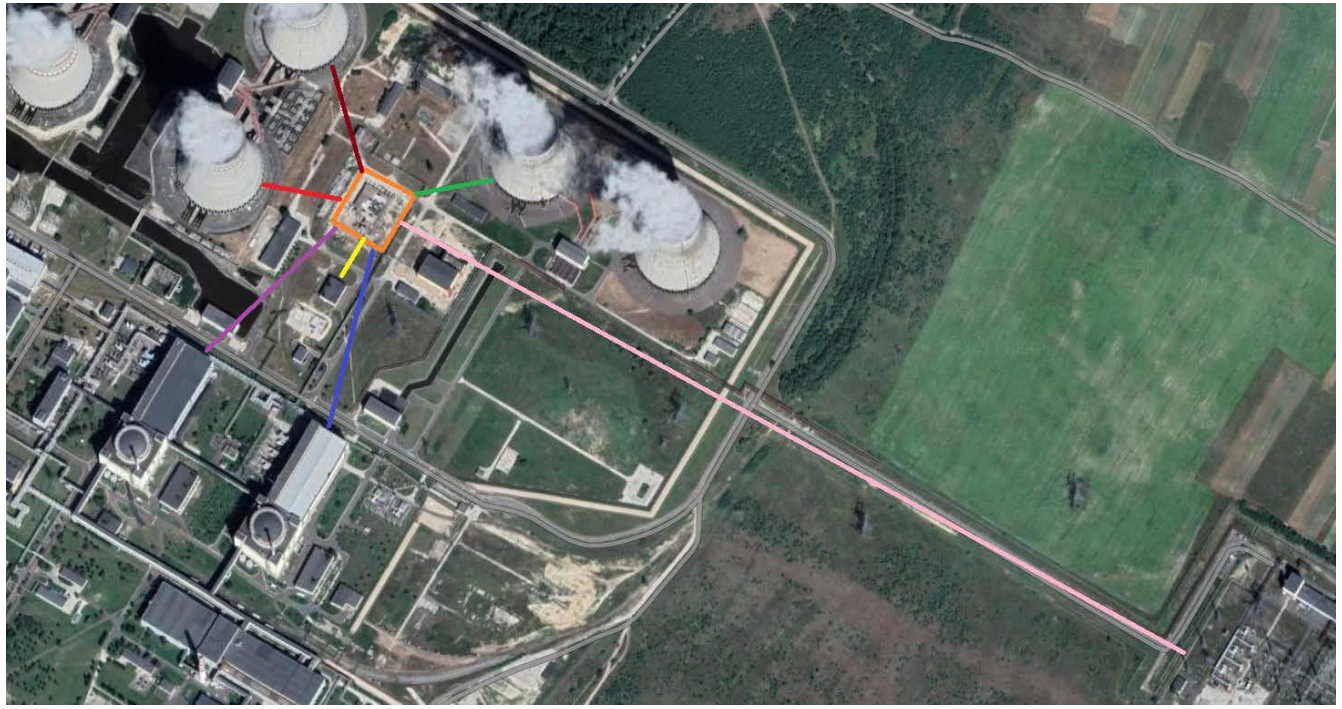
Offsite solution with zero integration as benchmark i.e. normal price (grid)

Outcome of Technical Roadmap

- Integration of hydrogen production unit is generally feasible even with an existing nuclear power plant.
- All necessary modifications and related impacts need to be described and entered into the safety assessment of the NPP. This is more or less laborious and costly depending on the level of integration but can be rationalized.
- Conditions in favor or against are **highly site-specific** and detailed analysis needs to be carried out case by case for any specific site in question.
  Examples:
  Availability of resources, Availability of a suitable location for HPP, Safety of (civil) structures of the NPP
- Very site specific as well is the respective local hydrogen market and the potential offtakers. This defines the needs for storage and way of transportation of the co-generated hydrogen which has significant impact to the technical solution.
  Example:
  Hydrogen Storage tanks are more difficult to locate than the production unit due to the larger amount of hydrogen in place, Piping connection can reduce the size of storage tanks

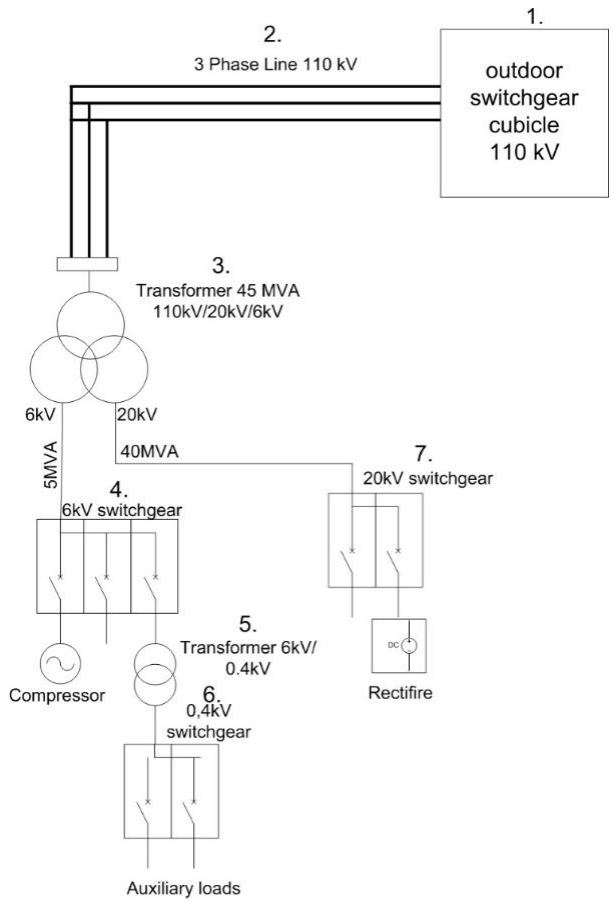
Steps to find the possible integration scenario

- Key step is to find the location on the NPP site
- Find the possible consumer and the way of transport of hydrogen to him
- Identify the resources which is possible to use from NPP
- Identify the connection points for selected resources
- Create the possible modifications of the affected systems
- Identify the safety impact of the modifications



Example of the possible scenario

- HPP site is located in sanitary zone of the NPP
- NPP with more that 2 units with lifetime more than 10 years
- Chosen technology – PEM electrolyzer
- Electricity from NPP with special low price and with minor modification
- Demiwater from NPP with necessary additional treatment at the HPP site
- Cooling water from NPP with minor modifications
- Chilled water – autonomus chiller at HPP site
- Nitrogen – using replaceable cylinders filled at NPP
- Tap water and waste water used from NPP with minor modificafions
- Compressed air – at the HPP site
- Steam is not possible to use from the NPP
- Hydrogen storage (2 day production)
- Hydrogen consumer is within 100 km of the NPP



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UPCOMING EVENTS

Webinar Series

In order to present the results of the NPHyCo Project, three webinars are foreseen

- **Licensing & Safety Aspects:** December 2024 (date TBC)
- **Economics & the Business Case:** January 2025 (date TBC)

Conference

Brussels (Belgium): early February 2025.

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