



**THORIZON**

# Thorizon Introduction

Expert meeting Provincie Noord-Brabant  
Sander de Groot, CTO & co-founder, 14 March 2025



# Thorizon proposition

## Business model

250MWth reactor including salt storage



**THORIZON**ONE



A flexible turnkey, full-service asset with attractive economics

### Flexible asset

- 50-300 MWe flexible power, 100 MWe baseload
- 550°C heat for industrial processes

### Turnkey delivery

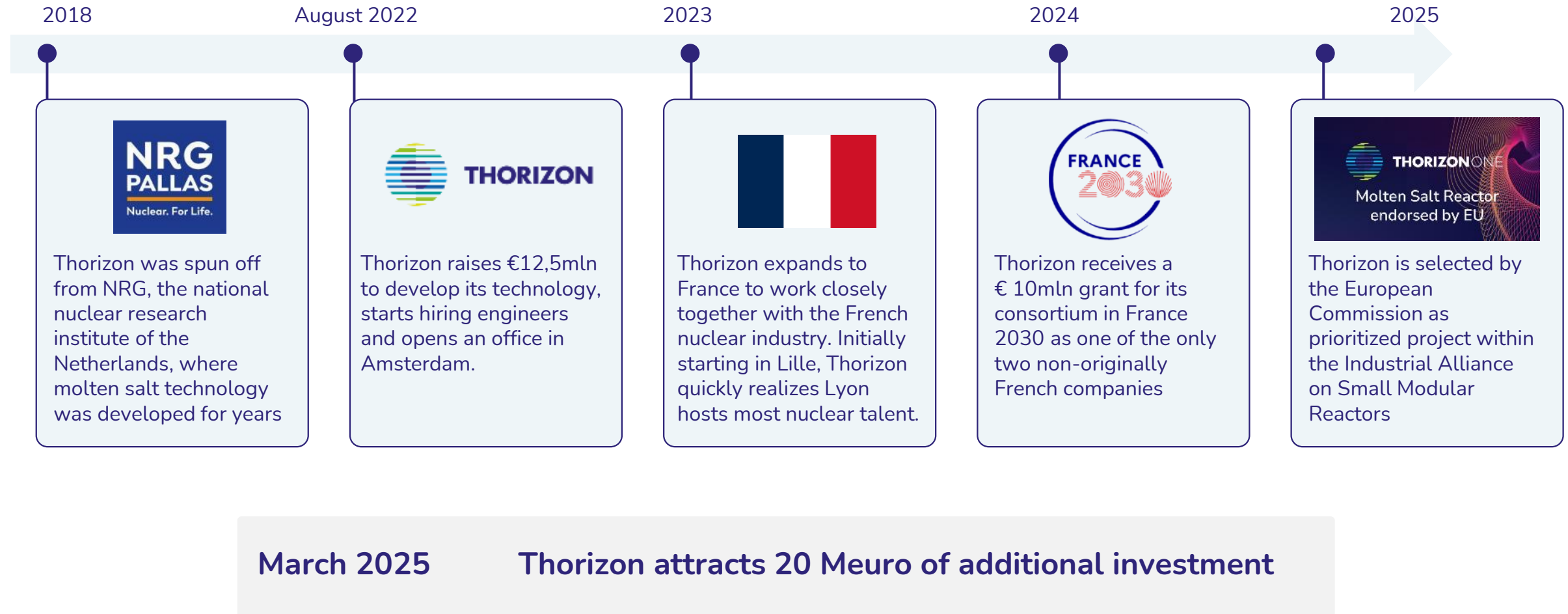
- From pre-feasibility to commissioning
- Fuel and cartridge lifecycle management
- Operators are our customers

### Attractive economics

- Targeting LCOE of € 60 per MWh
- Industrialized cartridge production in series offsite

# Thorizon was founded as spin-off nuclear research institute NRG Pallas

## History of Thorizon



# We rapidly onboarded a team of 45 engineers across NL and FR

Thorizon team

## Our management team



**Sander de Groot**  
CTO & Co-founder  
25yr nuclear R&D and projects



**Kiki Lauwers**  
CEO  
15yr tech scale-up and management



**Alexander v/d Touw**  
CFO  
25yr of deep-tech & scale-up finance



**Laure Claquin**  
COO & director France  
15yr nuclear projects & management



**Margriet Hooghiemstra**  
Chief of Staff  
10yr strategy, M&A and business building



- Fast pace hiring and onboarding
- Strong team building across offices and disciplines
- ~30% women
- >10 nationalities



## Our growing team of experts

Safety	Neutronics	Thermal Hydraulics	Mechanical Engineering	Systems Engineering & Prototyping	Chemistry	Program

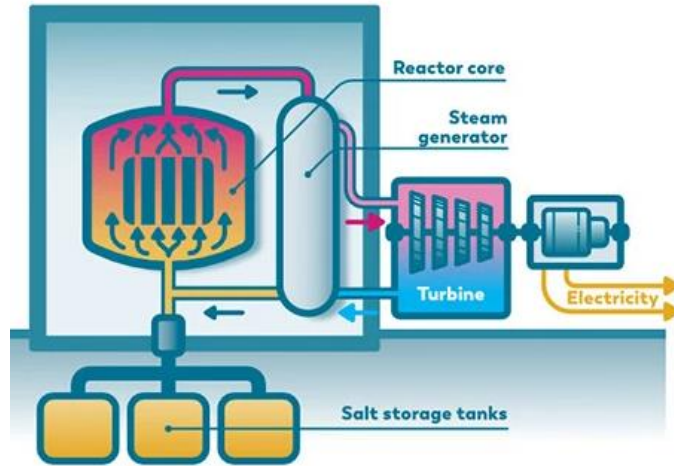
## Our technical advisory board

 Emmanuelle Galichet le cnam	 Rudy Konings TU Delft	 Bertrand Morel orano	 Hans Priem WDL	 Sylvain Takenouti EDF	 Arjan Vreeling NRG
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# What are molten salt reactors?

The concept and benefits of molten salt reactors

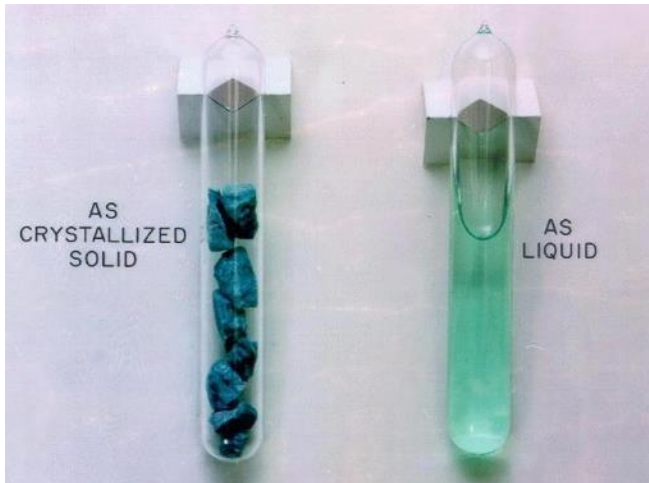


## Concept

- Innovative nuclear fission technology “Generation IV”
- “Molten salt” acts as both the coolant and the fuel
- Liquid salt mixture at high temperature and low pressure
- Fission energy heats up the molten salt

## Benefits

- Inherent safety – low pressure & self-correcting
- Improved waste profile – reduction of long-lived elements
- Improved use of scarce nuclear resources – U & alternatives
- Competitive costs – high temperature & low pressure
- High outlet temperatures – industrial heat applications



# If Molten Salt Reactors are such a great idea, where are they?

Obstacles in Molten Salt Reactor development



## The problems to be solved

### 1 Material Integrity

Impossible to find and license **reactor materials** for a lifetime of >60 years due to effects of corrosion, heat, and irradiation.

### 2 Fuel Management

Large volume of salt is needed for operations and salt is **difficult to transport** and handle after use.

# Thorizon solved the two main issues in molten salt reactor realization

Innovative cartridge based-core

## The solution

1

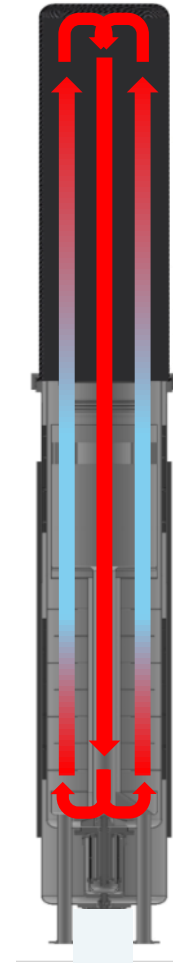
### Material Integrity

- Salt is contained in cartridges that are **replaced** every 5 to 10 years.
- Containment materials are already **qualified** for nuclear use.

2

### Fuel Management

- Fuel volume is **compartmented** in modular cartridges.
- Cartridges **allow for transport** and handling of fuel.



Thorizon's patented concept:

Exchangeable molten salt cartridges that together form a critical reactor core

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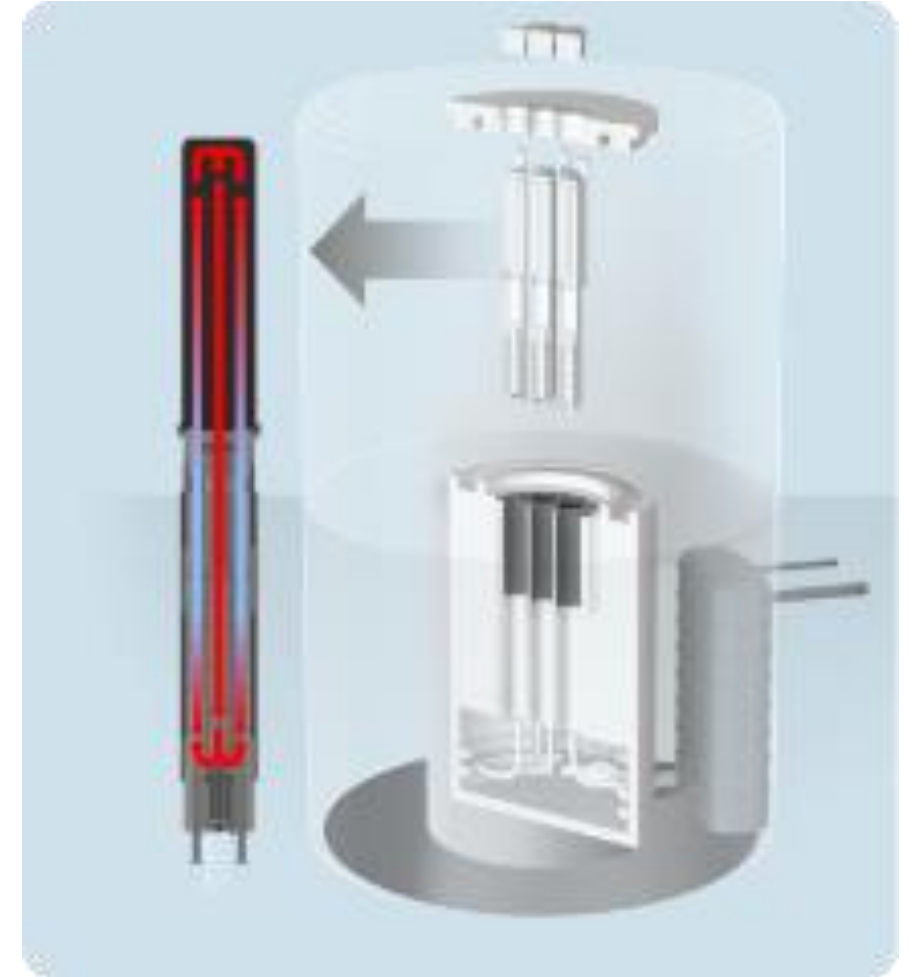
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# These cartridges have many advantages

## Advantages of the modular cartridge system



### Additional safety

- Without active pumping, the core becomes subcritical
- Closed system with two containment barriers
- Control rod systems not in salt



### Optimized path to market

- Using existing technology, materials and components
- Demonstrator with one or more cartridges



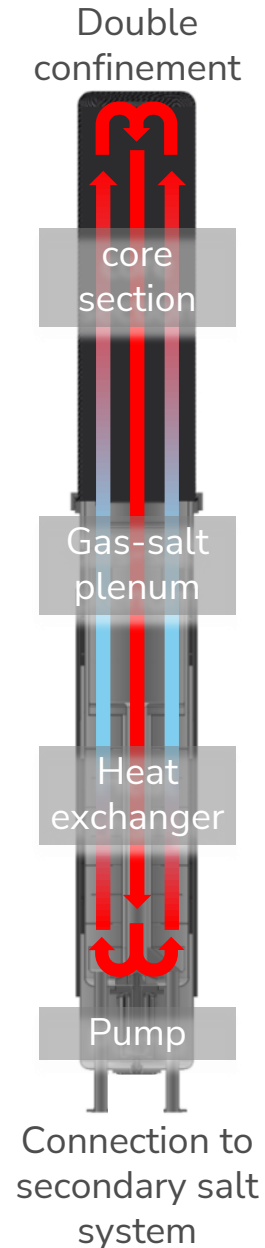
### Additional flexibility

- Different fuels in different parts of the core
- Reactor spectrum adjustable
- Continuous improvement and innovation with each core load



### Series production

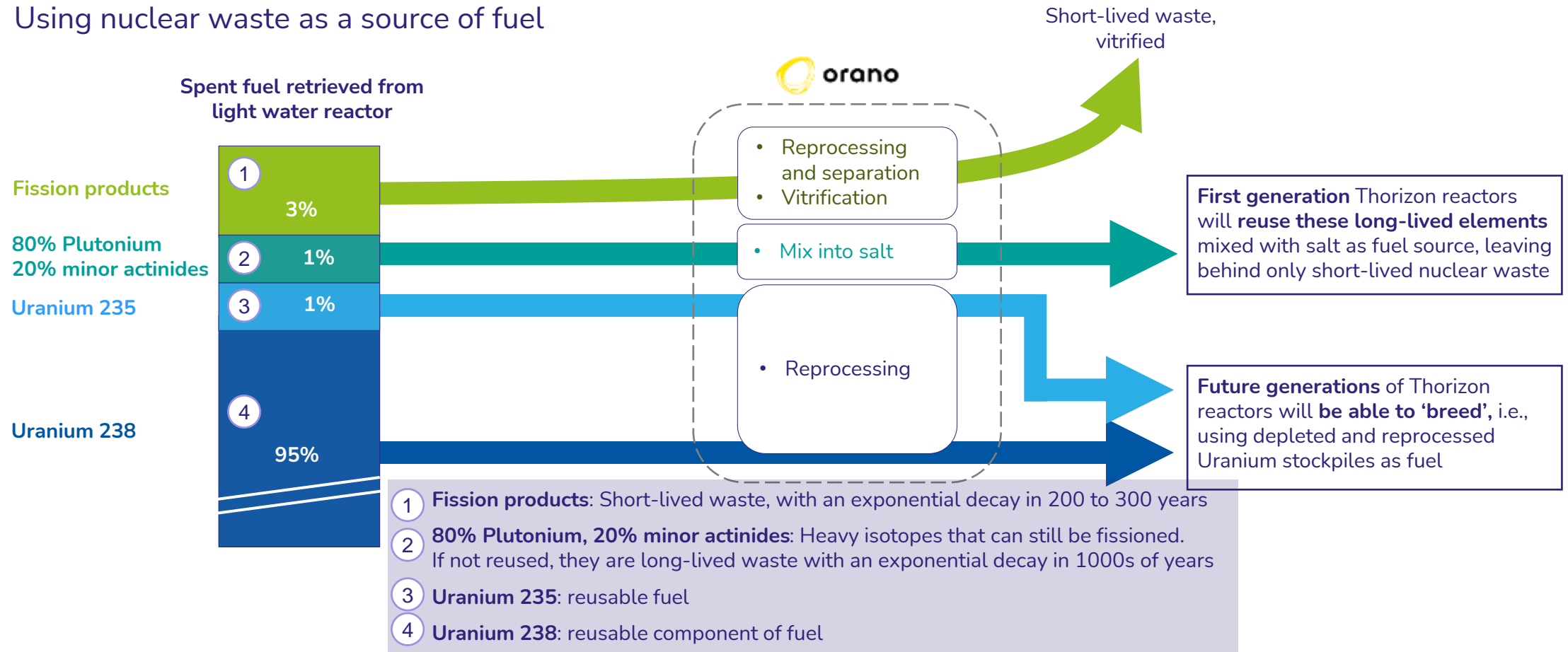
- Reduced on site building
- Series production of primary circuit off-site
- Connects to facilities for (repetitive) reprocessing





# CIRCULAR: Thorizon uses spent nuclear waste as fuel and reduce the volume of long-lived nuclear waste

Using nuclear waste as a source of fuel



These types of reactors will make it possible to recycle not only the plutonium contained in the used fuel from current reactors, but also "minor actinides" which, to date, are not recycled and are conditioned as vitrified waste. The recycling of these materials in MSR's would make it possible to go even further in terms of nuclear safety, the recovery of materials, and reducing the quantity and lifetime of nuclear waste (to around 300 years).

# Where are we today?

Licensing:  
Joint preparatory review starting

wnn

world nuclear news


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HOME / REGULATION & SAFETY / JOINT PREPARATORY REVIEW FOR THORIZON ONE REACTOR

Joint preparatory review for Thorizon One reactor

Wednesday, 4 September 2024

Thorizon of the Netherlands has announced that the Dutch and French nuclear regulators are to collaborate on a preparatory review of its Thorizon One molten salt reactor to streamline the pre-license applications expected next year.



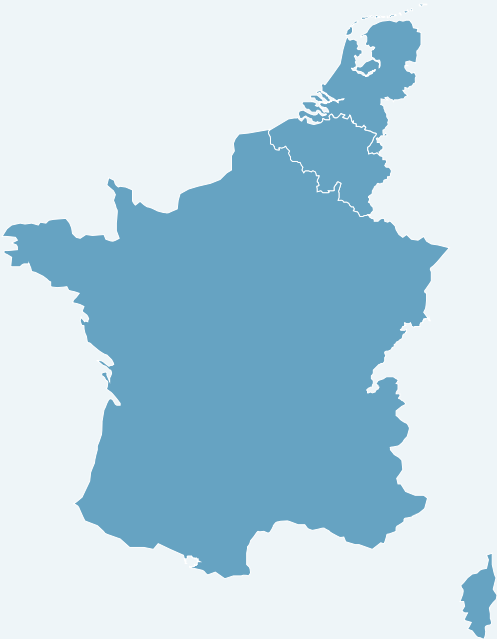
Prototyping & validation:  
Own loops + external validation



Design:  
Concept ready, basic design phase



First of a kind location:  
3 pre-feasibility studies ongoing



# Prototyping: In the Promosa project Thorizon can accelerate the development of component prototypes in the next 2 years

1

## Primary containment manufacturability

- Manufacturability studies
- Manufacturing & testing of components
- Welding procedure developments
- Prototype assembly

2

## Heat exchanger development

- Conceptual design
- Manufacturability studies
- Detailed design
- Prototype manufacturing

3

## Salt production & purification

- Conceptual design
- Detailed design
- Realization & tests
- Pilot production

4

## Heat exchanger testing loop

- Conceptual design
- Detailed design
- Realization and tests
- Loop operation

} Location in Noord-Brabant

**THORIZON****DEMCON****DIFFER**

*Nuclear innovation coalition in Brabant – granted € 4mln subsidy in shared project*

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# Questions?





# Validation: Examples

## Nuclear tests

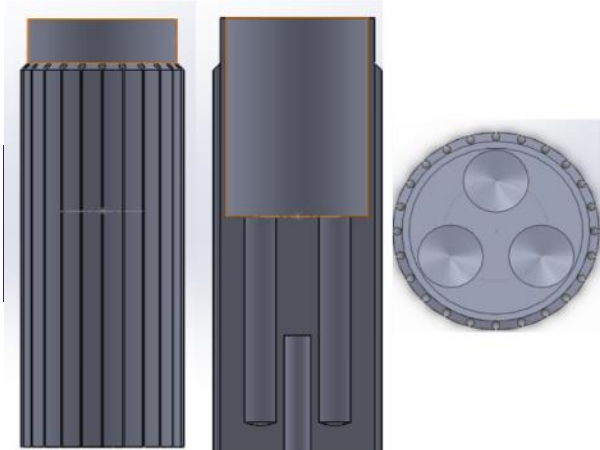


Opening of the DICE facility by Noord-Brabant deputy Martijn van Gruijthuijsen, who also has reserved support funds for Thorizon

- DICE experiment at DIFFER initiated:
  - accelerator irradiation of thin samples in contact with flowing salt
  - simulating high dose irradiation damage and impact on chemical interaction



DICE facility, with right the molten salt chamber and beam target, and left the DIFFER accelerator



- MOCHA irradiation facility for neutron irradiation of molten salt in the HFR Petten is ongoing
  - Orano, Thorizon and Stellaria salts will be irradiated in molten state ( $> 500$  C) in the HFR core.



HFR Petten

# Prototyping: In a short timeframe developed 2 non-nuclear prototypes

## Prototyping progress

### Plexiglass Loop:

- A transparent proof-of-principle model of Thorizon's core cartridge
- Demonstration of gas relocation feature (under patent)
- Designed to optimize molten salt flow within the core

### Molten Salt Miniloop:

- Small-scale test setup to study molten salt behavior and its interaction with selected containment materials
- Forced flow in operation, unique in the world

### Other benefits:

- Fast design iterations based on low-cost prototypes
- Hands-on experience with operations and procedures
- Initiating supply chain



# Developing a new reactor technology is not something we can do alone

Network of partners

## GOVERNMENT



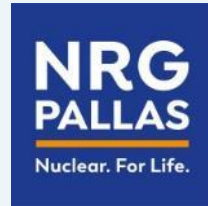
Autoriteit Nucleaire Veiligheid en Stralingsbescherming



INVESTNL  
bpi**france**



## RESEARCH INSTITUTES



sck cen



Université de Lille



## INDUSTRY



THORIZON



orano



edf



DEMCON TRACTEBEL



assystem



OAKRIDGE



SCHELDE EXOTECH



framatome

