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# **ADVANCED REACTOR TECHNOLOGY IRRADIATION PROGRAMS AT NRG- PETTEN REACTOR**

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NRC Advanced Reactor Materials Workshop

Uazir Bezerra de Oliveira

9 December 2019

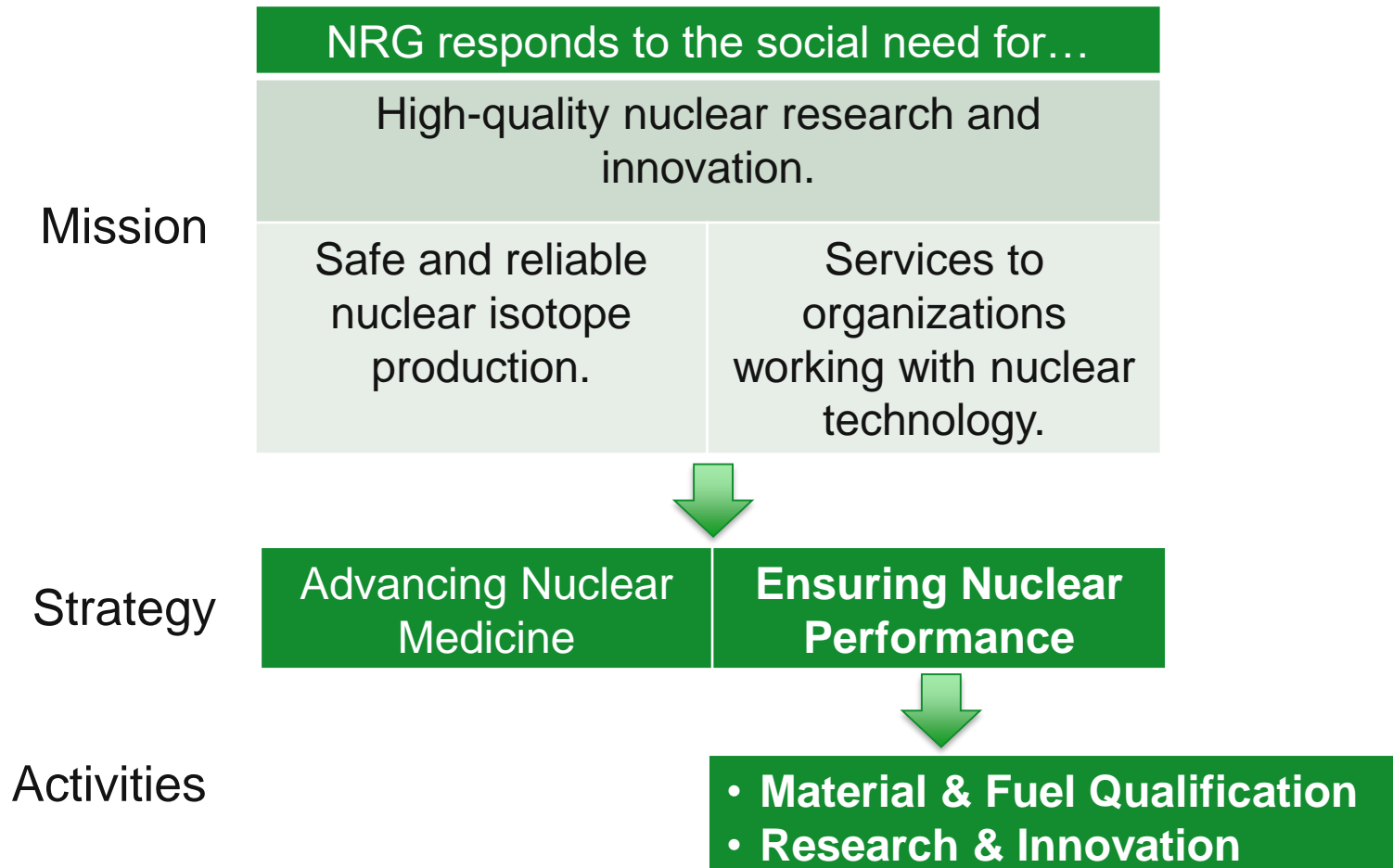


# OUTLINE

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- Introduction to NRG
- Infrastructure
- Ensuring Nuclear Performance
  - Life extension of AGR reactors
  - HTR PM Qualification
  - The Dutch Molten Salt Program
- Take away message

# MISSION & STRATEGY

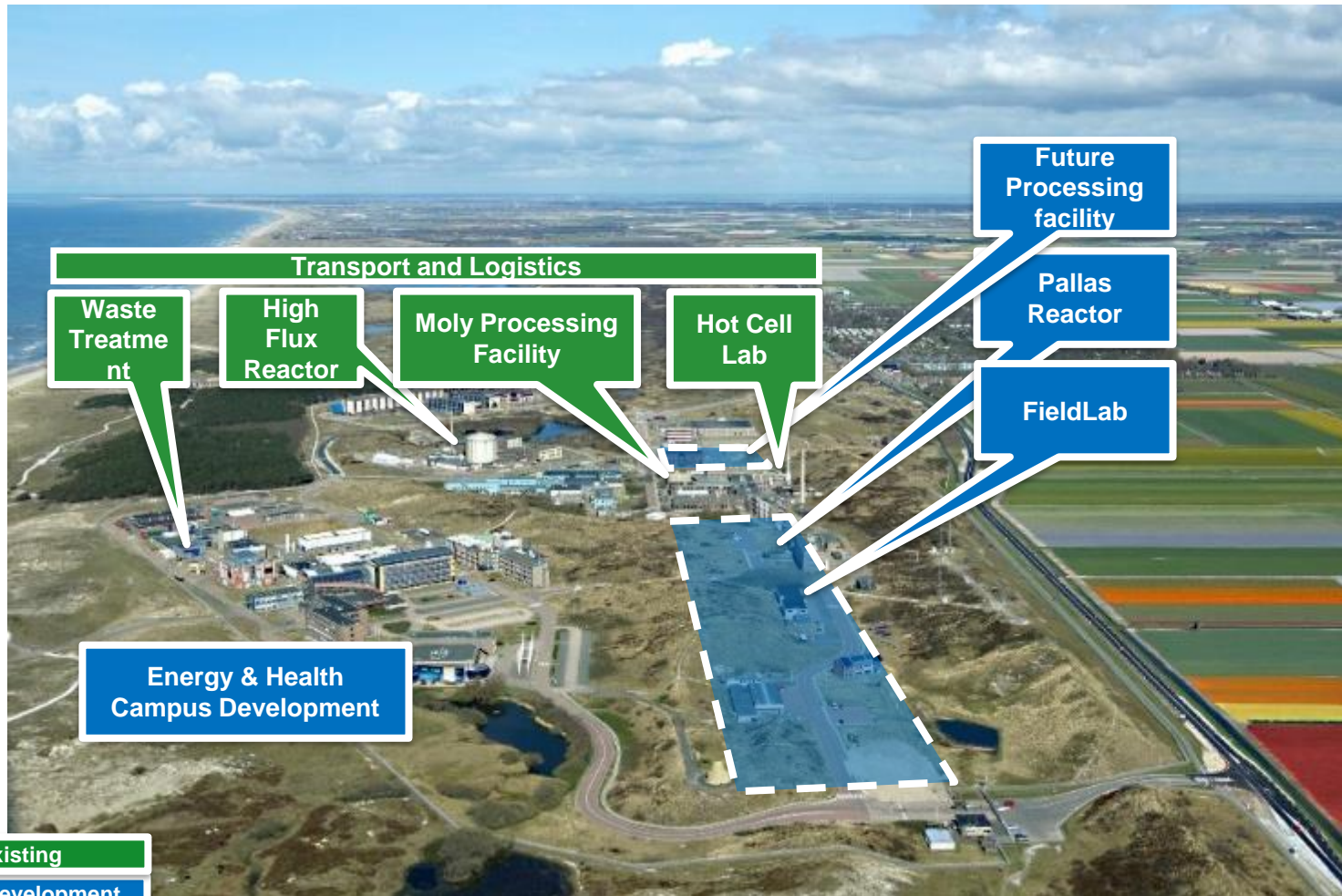


# WHERE ARE WE?

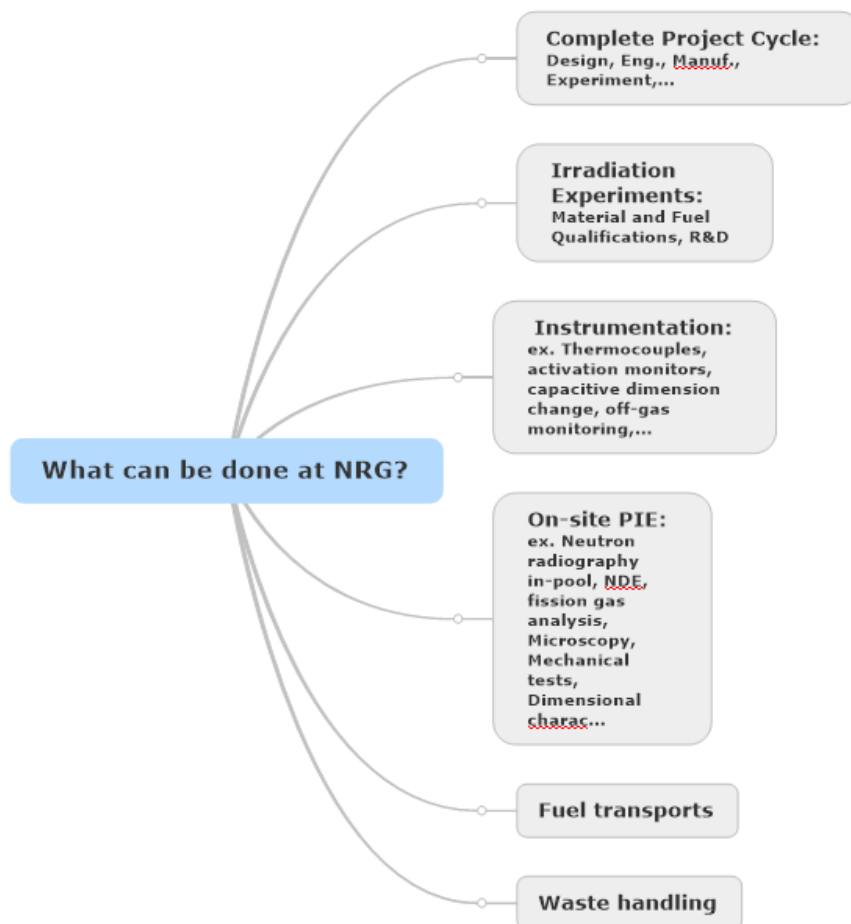




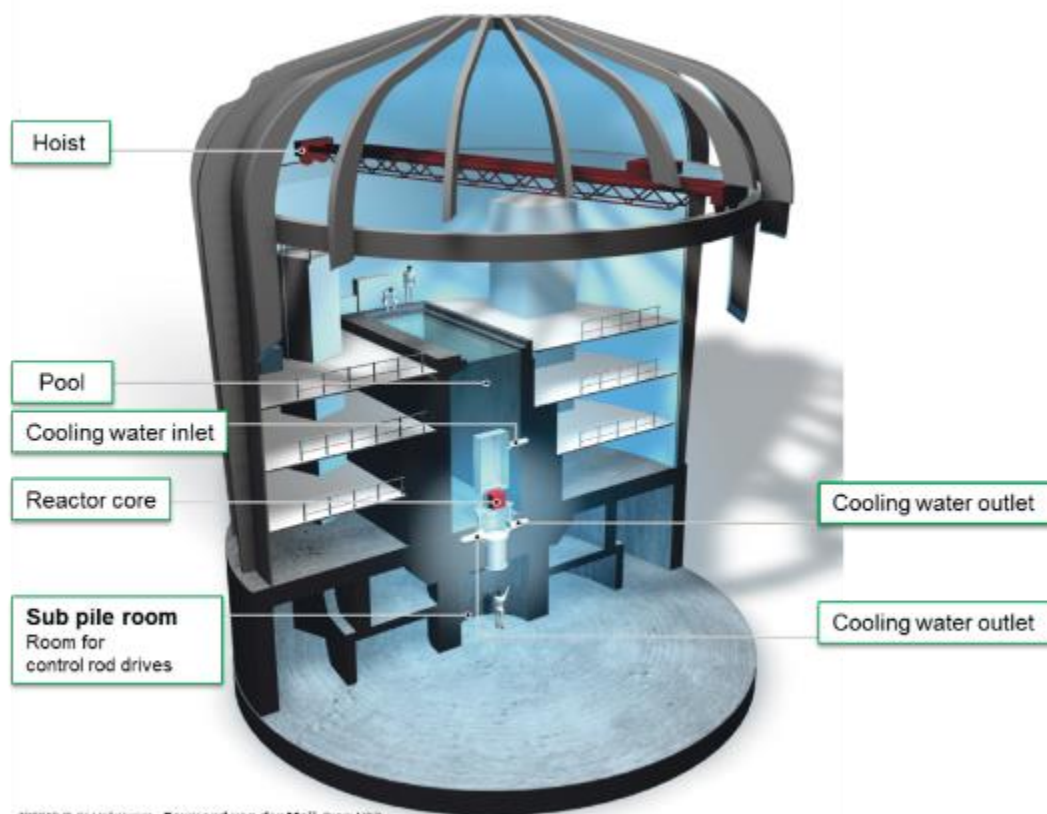
# CAMPUS: PRESENT AND FUTURE



# CAPABILITIES

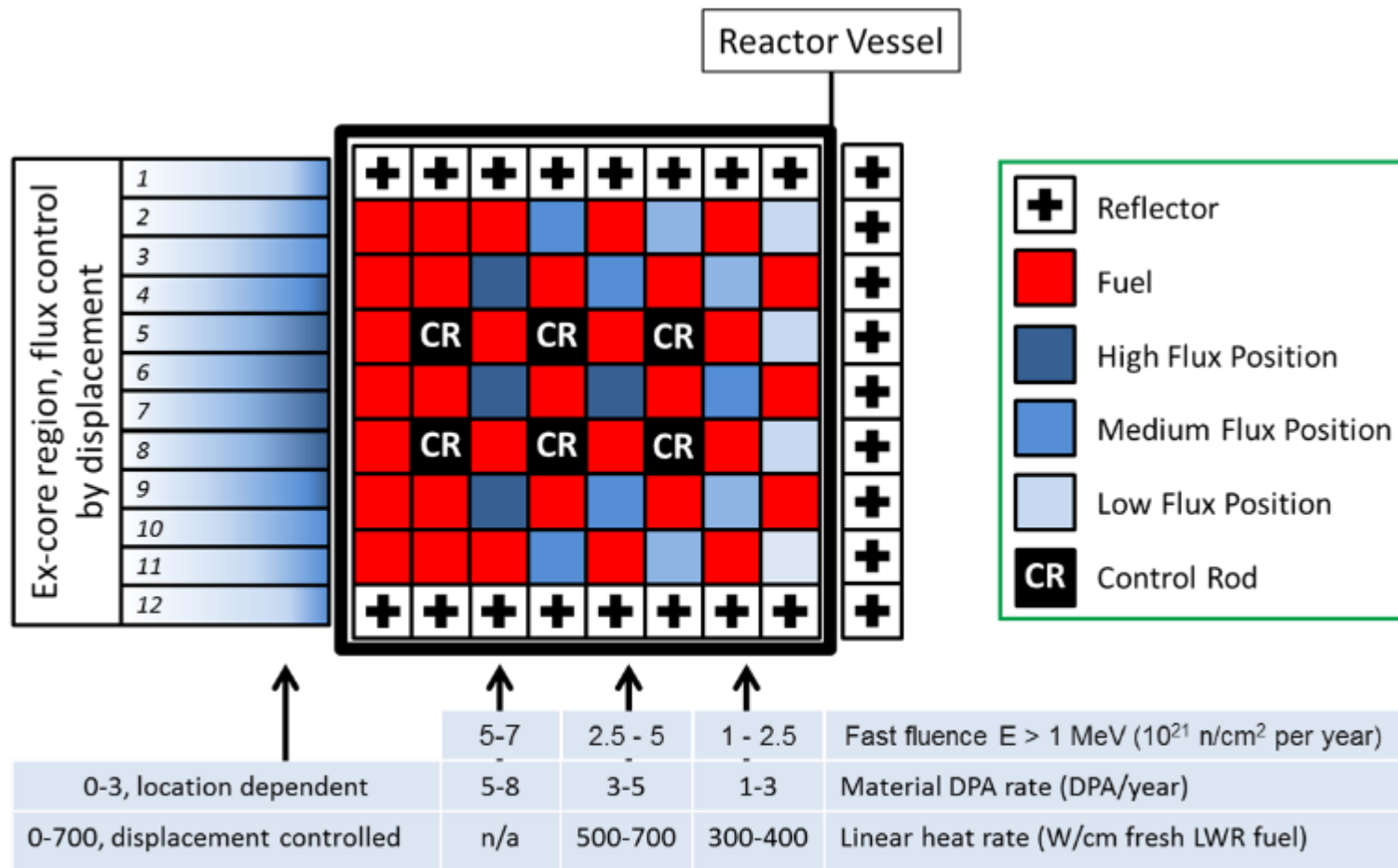


# THE HIGH FLUX REACTOR



- 45 MW thermal power
- **Stable and constant flux** profile in each irradiation position
- **31 operation days per irradiation cycle, 9 cycles a year**

# THE HIGH FLUX REACTOR (HFR)



The stable and constant flux profile in each irradiation position is a unique HFR feature

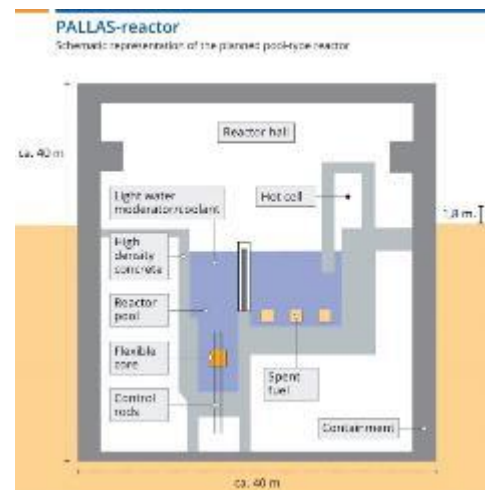


# FROM HFR TO PALLAS

- HFR is projected to operate until “2026”, but has no fixed end-of-life date
- PALLAS is taking over the roles of HFR from ~”2026” in a seamless cross-over



< “2026”



> “2026”

# ENSURING NUCLEAR PERFORMANCE

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We will consolidate and grow our existing business, by supporting new generation reactors, conduct materials and fuel research, implement measures to safely extend the lifetime of existing nuclear operations. We perform certifications and define safety protocols, measurement and compliance, performance optimization, implement smart software solutions, support decommissioning, decontamination, waste management, and medical safety.

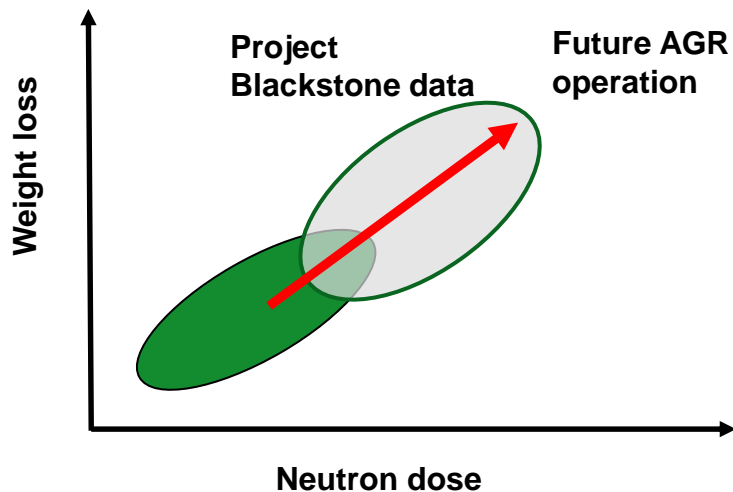
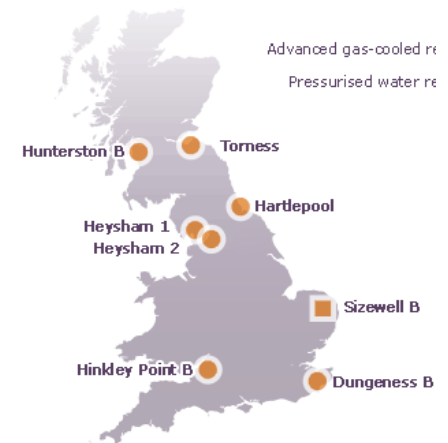
## NUCLEAR TECHNOLOGY ACTIVITIES

- Nuclear Compliance
  - Radiation Protection
  - Software solutions (ROSA)
  - Decommissioning
  - **Material & Fuel Qualification**
  - **Research & Innovation**
- 
- HTR  
MSR

# LIFETIME EXTENSION AGR REACTORS

## Supporting long life of Advanced Gas Cooled Reactors

- EDF Energy operates Advanced Gas Cooled Reactors, supplying ~ 20% of electricity in the United Kingdom
- Graphite cores age with time due to neutron damage and radiolytic oxidation
- Accelerated ageing tests to determine graphite properties ahead of actual AGR core structures



# HTR-PM FUEL QUALIFICATION

**Client:** HTR-PM reactor INET, China.

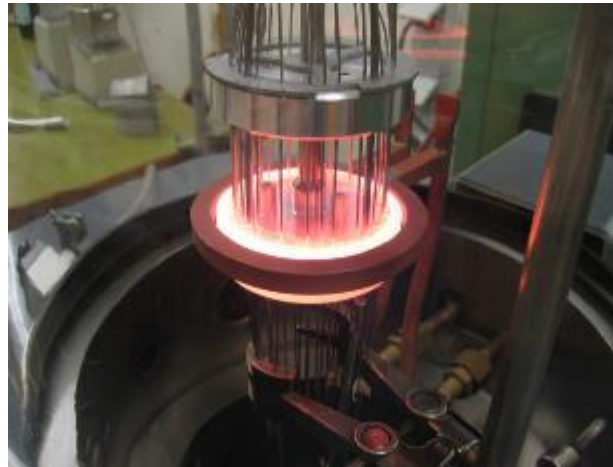
**Scope:**

- From Design to Manufacturing.
- Fuel irradiation in HFR.
- Monitoring of fission gas release (gamma spectroscopy).
- Monitoring temperatures (in-situ thermocouples).
- Transport to JRC- Itu for Küfa tests, by which the qualification is completed.



# HTR-PM FUEL QUALIFICATION

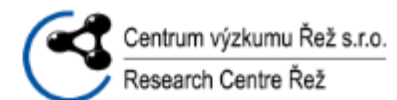
- 5 pebbles are placed in graphite samples holders
- Double containment
- A total of 48 thermocouples for accurate temperature registration
- Online gas monitoring
- Including neutron fluence registration
  - Self Powered Neutron Detectors
  - Activation monitor sets



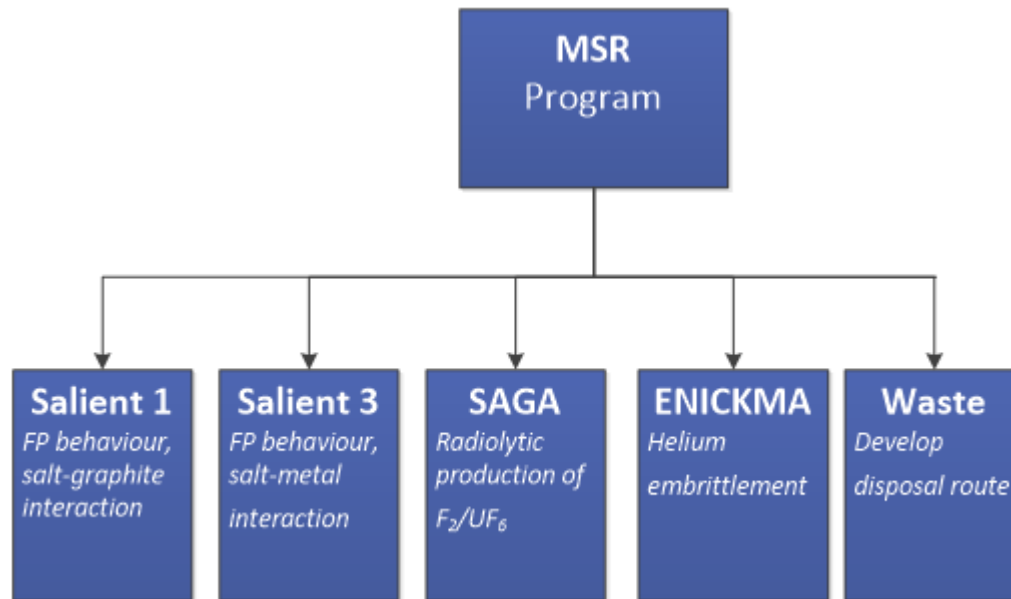


# THE DUTCH MOLTEN SALT PROGRAM

- **NRG = Enabler of MSR Technology due to nuclear know-how, infrastructure, international network.**
- **Collaborations with competence centers:**  
JRCs, TUDelft, FUBerlin and CV Rez.
- **Objectives:**
  1. **Obtain operational experience**
  2. **Safety**
    - Confirm Fission Products (FP) stability in the salt and FP migration
    - Investigate FP management methods
  3. **Material investigation:**
    - Material properties of irradiated containment materials
    - In-pile corrosion / deposition of metal alloys and SiC
  4. **Waste:**
    - Provide a waste route for spent molten salt fuel
  5. **Integral Demonstration:**
    - Feasibility of experimental Molten Salt loop for the HFR Petten



# THE DUTCH MOLTEN SALT PROGRAM



- Focus on irradiation technology
- Focus on generic topics
- Ambitious program open for collaborations



# TAKE AWAY MESSAGE

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**Nuclear. For life.**



**Advancing Nuclear Medicine**



**Ensuring Nuclear Performance**

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