MMR Technology and End Use Applications

Foresight Nuclear Summit 2023

Mark Davies

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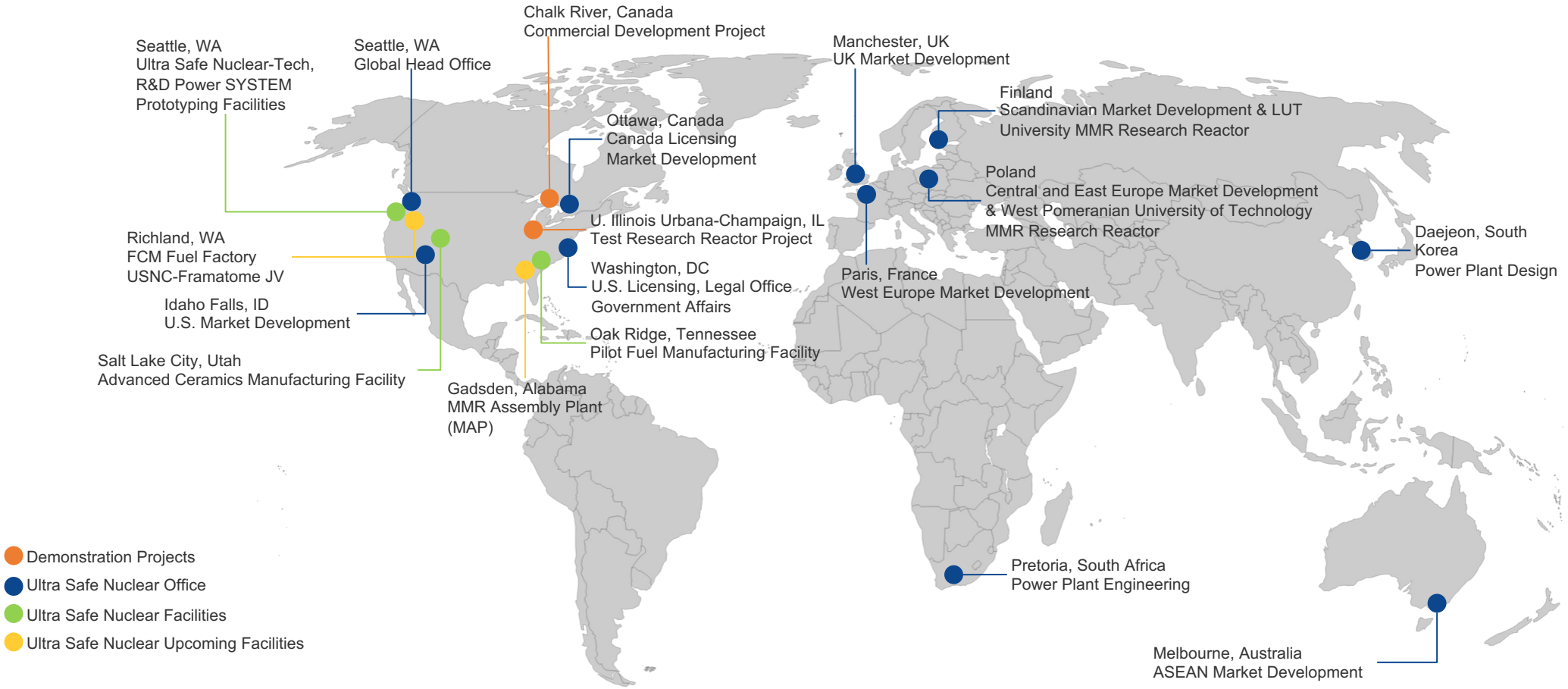
Ultra Safe Nuclear Business Operations

Ultra Safe Nuclear is headquartered in the US with 300+ employees in multiple countries, including Canada, UK, France, Poland, Finland, South Africa, South Korea and Australia.

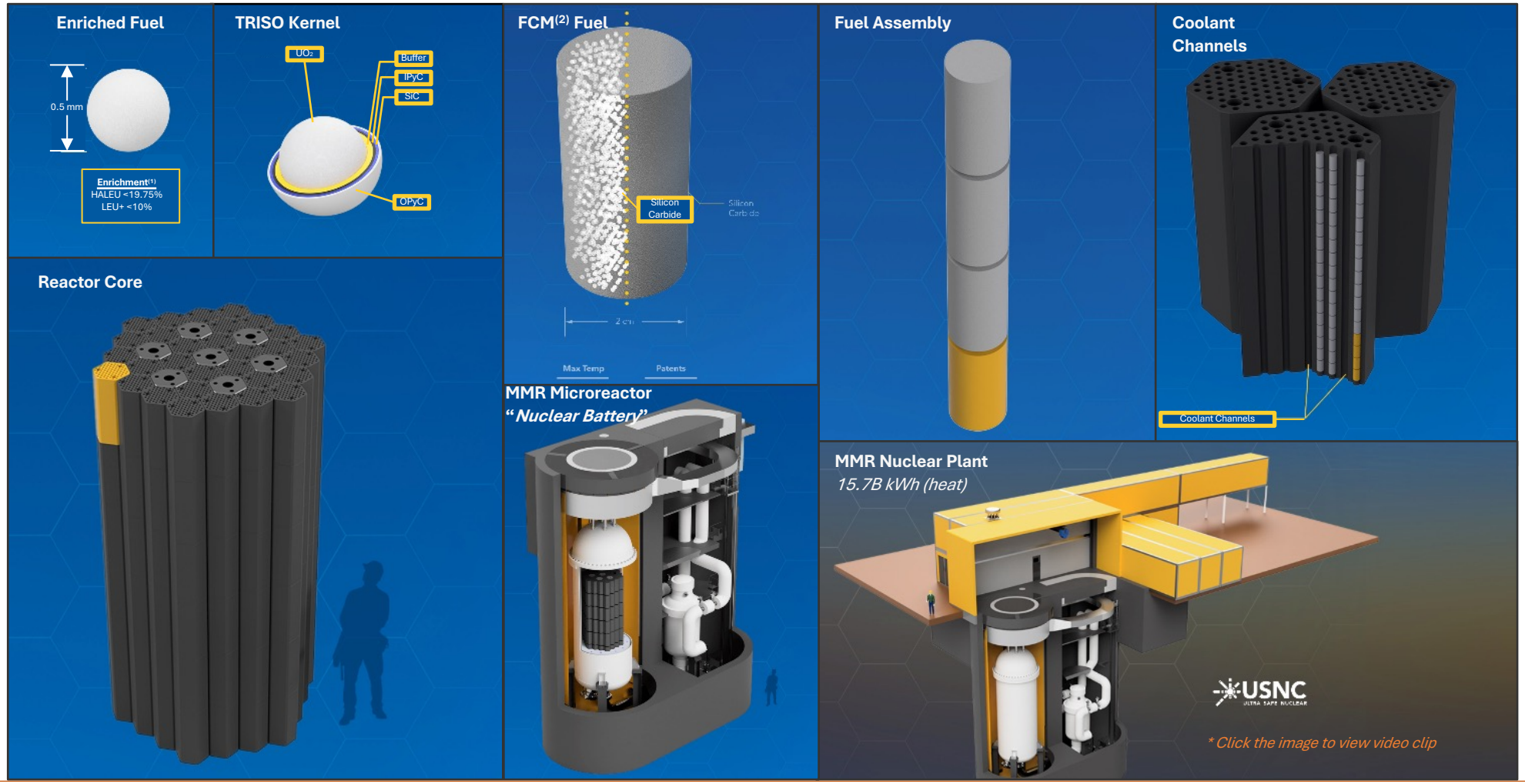


Source: Management Information.

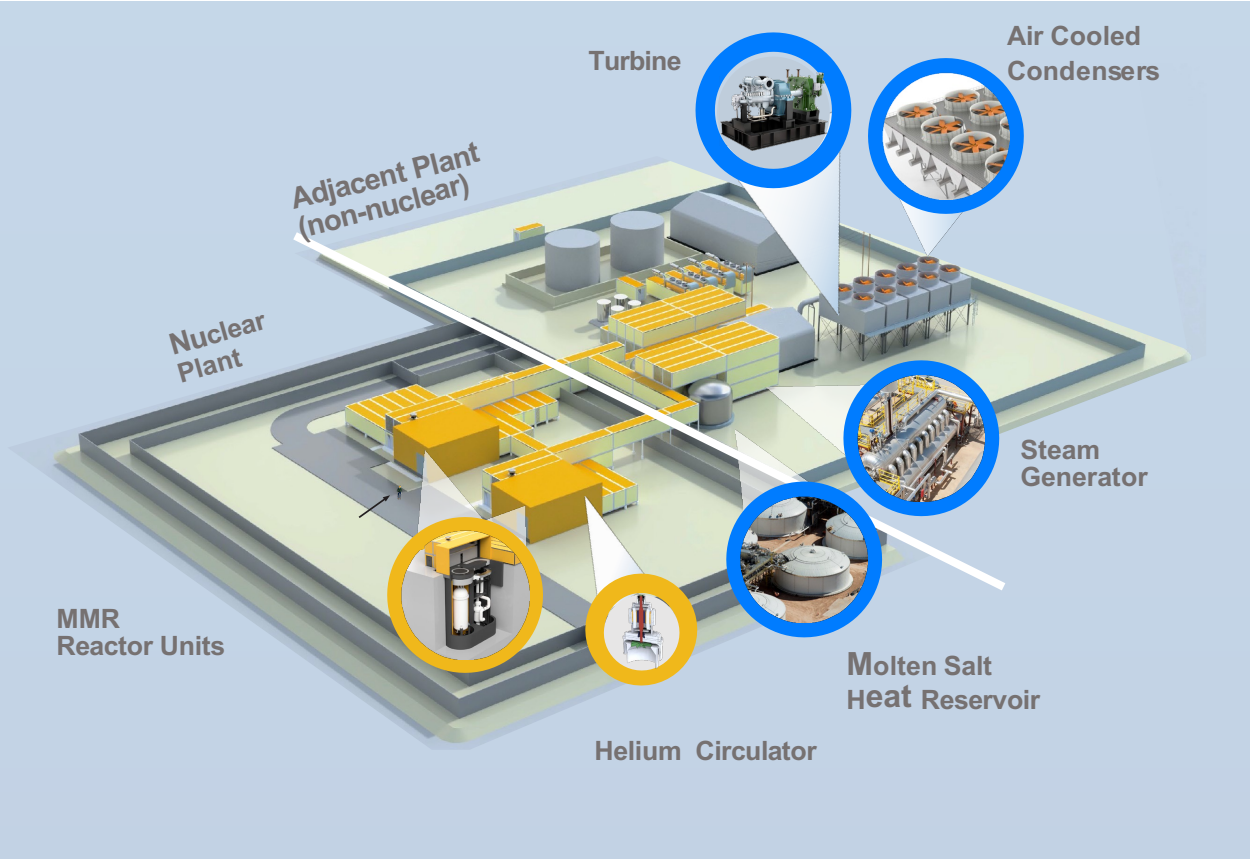
Gen-IV Micro-Modular™ Reactor (MMR®)

Micro-Modular Reactor (MMR) Overview

USNC will manufacture the MMR Microreactor Unit within the MMR Energy Systems.



Micro Modular Reactor Plant Layout and Key Benefits



Design

MMRs are Safe and can be Sited anywhere

Modular design facilitates factory assembly, short on-site construction periods, both of which delivers low energy costs with long-term predictability

Up to 40-year plant life with ~3- to 30-year refueling period

Scalable and Flexible

Scalable Flexible Configurations to serve any customer

Easy to Assemble

Modules are transported and assembled on site

Units are tested in approved factory before delivery

Standardized factory-produced units drives steep cost reductions

Easy to Decommission

- Exceedingly low likelihood of environmental contamination
- Site is returned to green field after operations
- Fission products contained in FCM

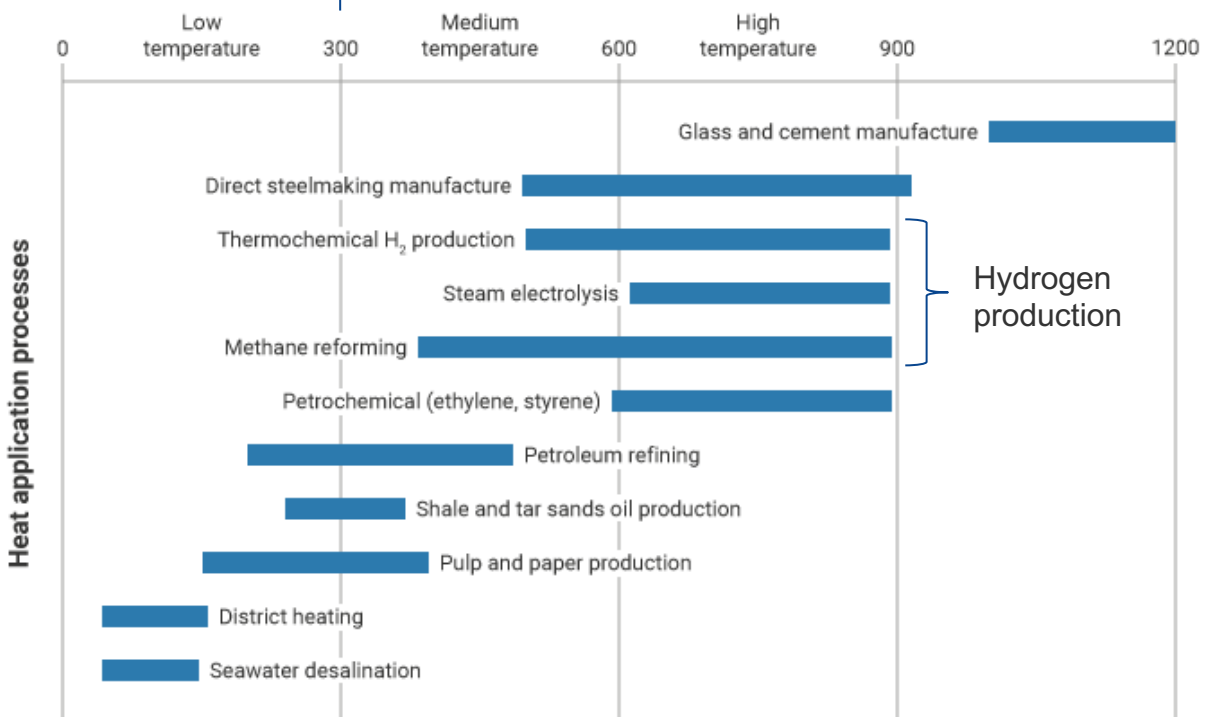
End Use Applications

Ultra Safe Nuclear: High-Temperature Industrial Process Heat and Power Applications

MMR Nuclear Batteries are small, safe, reliable high temperature gas reactors (HTGR) producing zero-carbon heat behind the fence for industrial applications and drop-in combined heat and power generation.

Traditional Nuclear
(< 300° C / 570° F)

Ultra Safe Nuclear
(600° C / 1100° F and higher)



Benefits

- Zero-carbon heat and electricity generation behind the fence for industrial applications
- Zero carbon solution for hard to abate industries requiring high temperature heat
- Drop-in replacement for coal and gas fired boilers
- Co-location with industrial facilities enabled by Zero Emergency Planning Zone (EPZ)

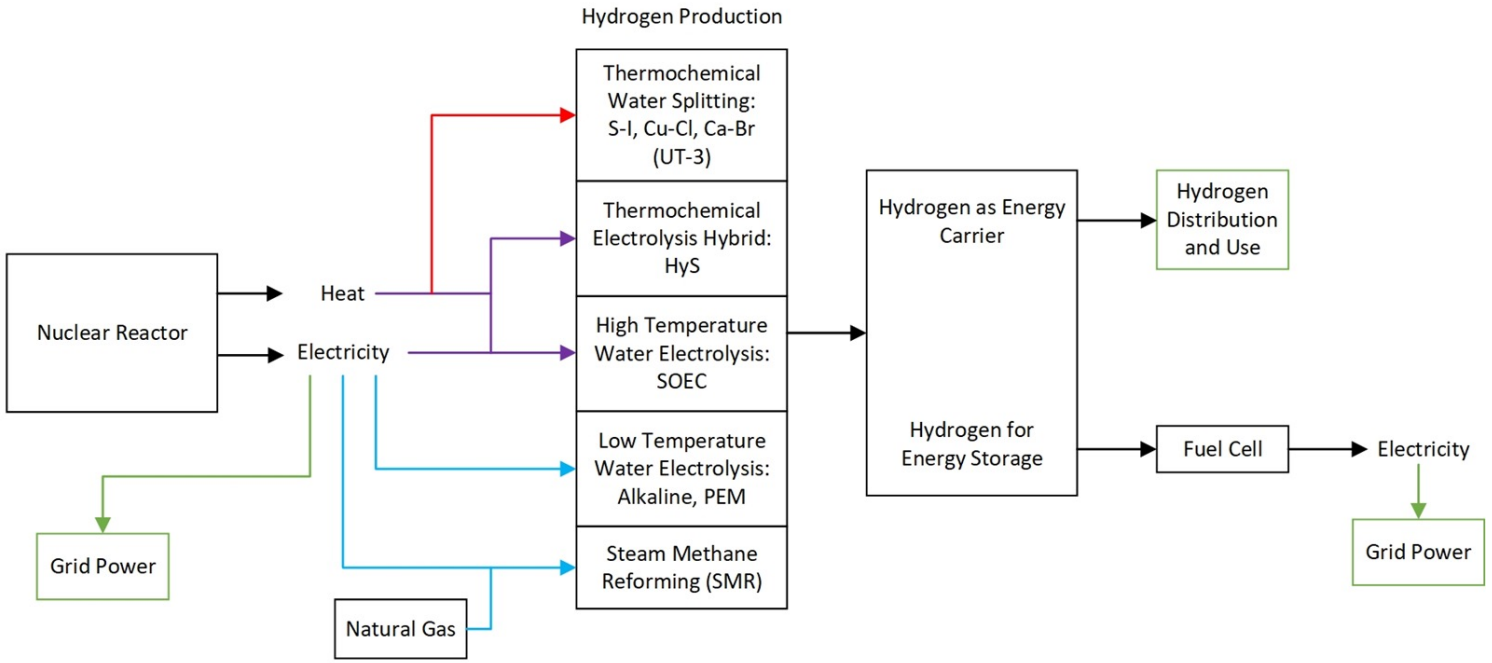
Target Industries

- **Chemicals**
- **Biofuel (SAF)**
- **Petroleum Refining**
- **Hydrogen**
- **Pulp and Paper**
- **District heating**
- **Food Processing**

Source: World Nuclear Association

Hydrogen Markets and Roadmaps:

Nuclear Hybrid Hydrogen Generation



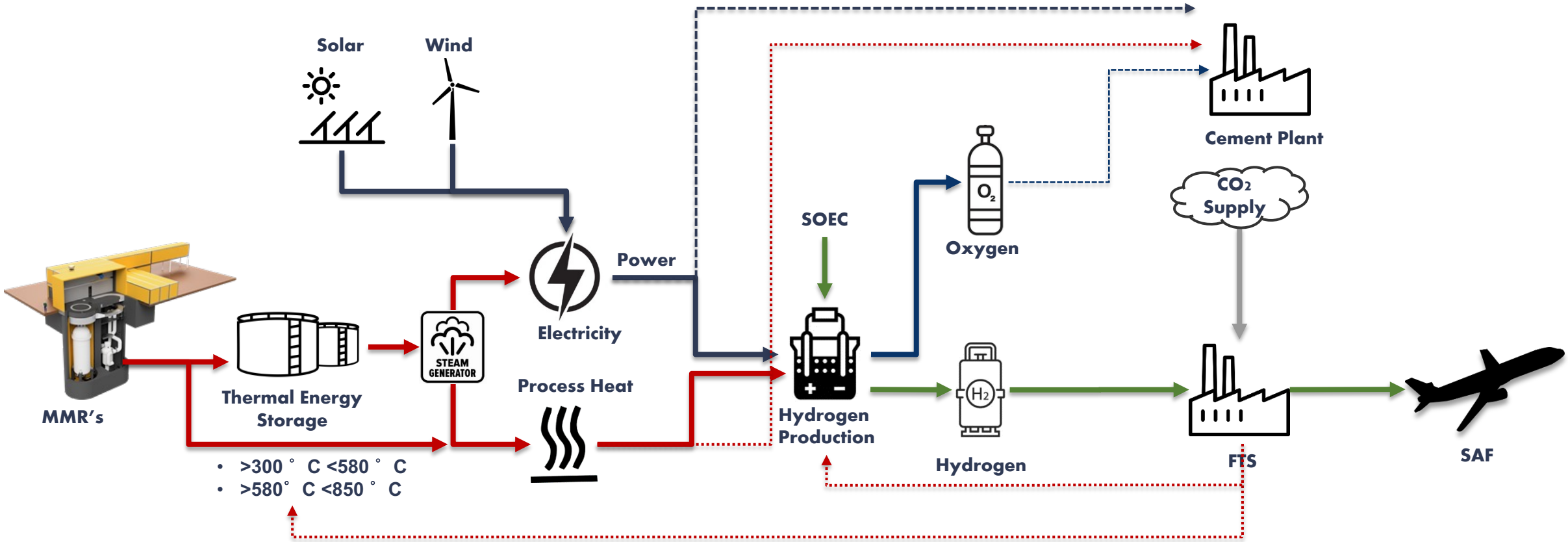
Summary of Nuclear Hybrid Energy Systems (NHES) technologies:

	Electrolysis			Thermochemical			Hybrid	
	Alkaline	PEM	SOEC	SMR	S-I	Ca-Br	HyS	Cu-Cl
Temperature	20-80° C	20-200° C	500-1000° C	870° C	800-950° C	760° C	910° C	550° C
Electrical Consumption per kg H_2	~50 kWe	~57 kWe	~40.7 kWe	~0.4 kWe	~20 kWe	~7 kWe	~20 kWe	~19 kWe
Thermal Consumption per kg H_2	~7.5 kWt	~7 kWt	~8 kWt	NA	~97 kWt	~84 kWt	~70 kWt	~44 kWt
TRL	9	6-8	5	9	4	3	3-4	< 3

Pinsky, R. et al. (2020) 'Comparative review of hydrogen production technologies for nuclear hybrid energy systems', Progress in Nuclear Energy, 123(March), p. 103317. doi: 10.1016/j.pnucene.2020.103317.

End Use Applications SAF PtL

1 Energy Supply → 2 Hydrogen production → 3 CO_2 supply → 4 Synthesis & conditioning → 5 End-User Application



Gen-IV Micro Modular Reactor Projects

Domestic and International Deployment Projects

USNC has a robust pipeline of energy projects with deliveries worldwide. These are a sample of those publicly announced to date.

315 MW_{th}
Total Power[(1)]

7
Units Announced

Chalk River - Canada

GLOBAL FIRST POWER

Canadian Nuclear Laboratories

University of Illinois Urbana-Champaign - USA

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

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McMaster University - Canada

GLOBAL FIRST POWER

McMaster University

Lappeenranta - Finland

Lappeenranta University of Technology

Lappeenrannan energia oy

Police - Poland

Grupa Azoty

West Pomeranian University of Technology in Szczecin

Source: Management Information
(1) Assumed 45MWth for each project.

Zoom into Chalk River: Active Deployment in Canada

Ultra Safe Nuclear is deploying its first commercial demonstration project in Canada. The Chalk River project is expected to be operated by a 50/50 JV held by USNC and Ontario Power Generation ("OPG"), the largest Canadian utility and nuclear operator.

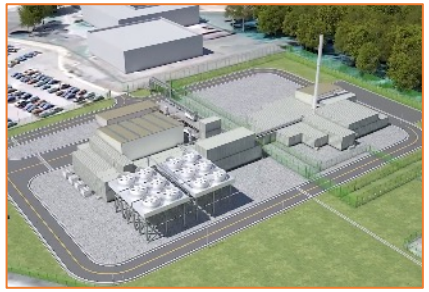
Overview

Key Info

- **Number of MMR Units**: 1
- **Capacity**: Full size battery (15.7B kWh)
- **Power**: Up to 45 MWt (15 MWe)
- **Reactor Type**: High temperature gas-cooled reactor ("HTGR")

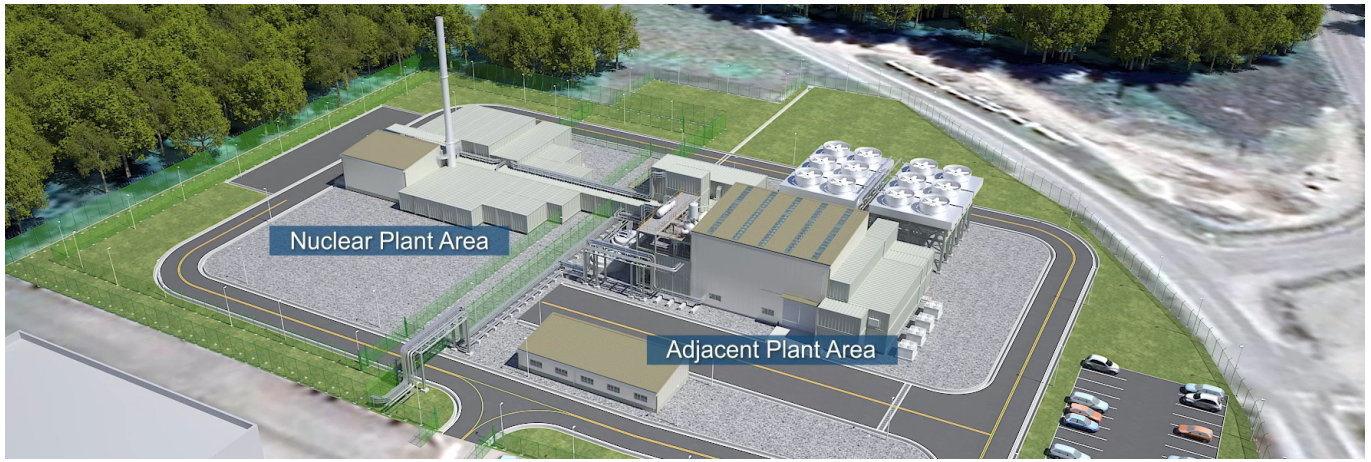
Key Objectives

- Demonstrate the benefits and viability of carbon-free MMR(1) nuclear battery (global market)
- Power plant for remote site mining and off-grid use (Canadian market)
- Provide a local clean energy supply



Parties Involved

Owners	USNC ULTRA•SAFE•NUCLEAR; ONTARIO POWER GENERATION
Operator	GLOBAL FIRST POWER (50/50 JV between Ultra Safe Nuclear and OPG)
Industrial Partners	HYUNDAI ENGINEERING CO., LTD; HATCH; PCL
Customer(s)	Canadian Nuclear Laboratories; AECL



Source: Management Information.
(1) Micro-Modular Reactor

Zoom into University of Illinois (UIUC): Active Deployment in the U.S.

Ultra Safe Nuclear is currently developing a 5 MWe project at University of Illinois. The UIUC project aims to demonstrate how Micro-Modular Reactor (MMR) systems can integrate with existing fossil fuel infrastructure.

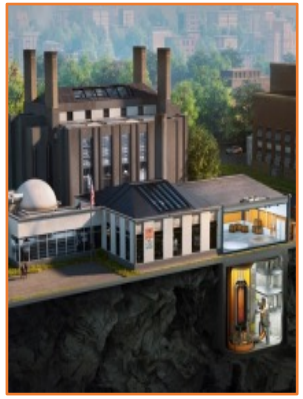
Overview

Key Info

- **Number of MMR Units**: 1
- **Capacity:** Full size battery (15.7B kWh)
- **Power**: Up to 45 MWt
- **Reactor Type**: High temperature gas-cooled reactor ("HTGR")

Key Objectives

- Partially replace heat from the University's power station to provide carbon-free district heating
- Demonstrate how MMR systems can integrate with existing fossil fuel infrastructure



Parties Involved

Owner / Operator

- University of Illinois Urbana-Champaign

Industrial Partners

- MPR (Quality / Safety Analyses)
- Argonne National Laboratory (Independent Verification)
- AECOM (Field Studies)
- U.S. Department of Energy (Fuel Supply Plan)

Customer

- University of Illinois Urbana-Champaign

Source: Management Information.

UK AMR RD&D FEED Study: MMR 3 Programme

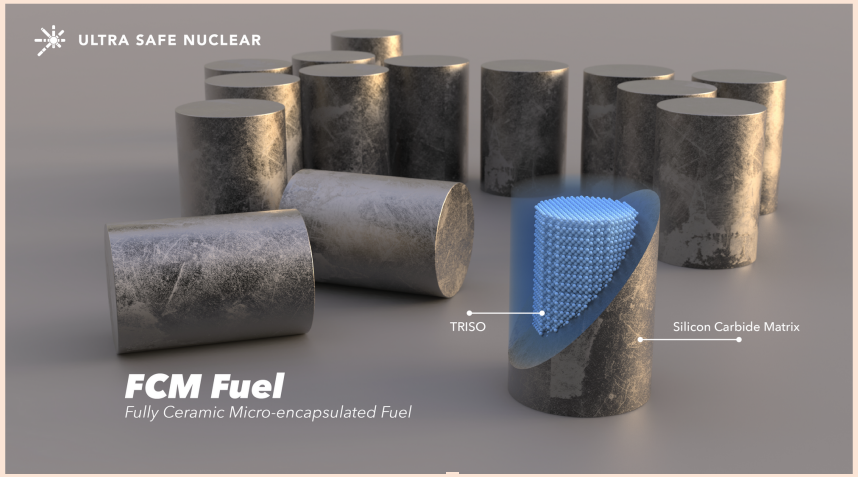
Major Objectives of DESNZ AMR RD&D Programme

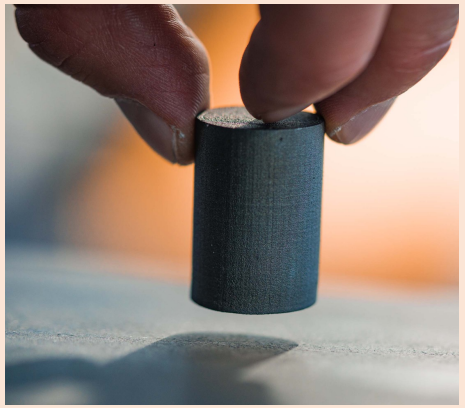
Overarching aim is to support the development and demonstration of HTGR technology with the capability to make a significant contribution to UK Government's commitment to Net Zero CO2 emissions by 2050:

- HTGRs seen as potential solution to difficult to decarbonise industrial process heat sector but UK Government's view is that there are market barriers preventing deployment
- Objective is to support the fast-track design and build of a UK demonstration plant by early 2030s to reduce perceived risks and facilitate large commercial scale deployment before 2050

3 Phase Programme:

- Phase A – Concept and Solution Development
- **Phase B – Front End Engineering Design (FEED)**
- Phase C – Detailed Design and Construction of Demonstration Plant

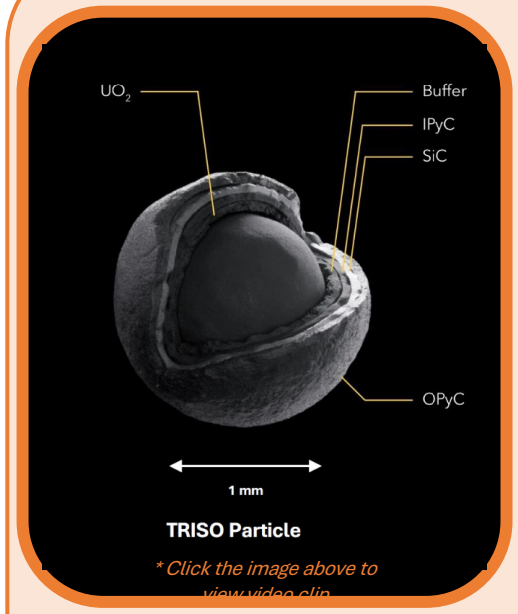




FCM fuel

FCM Advanced fuel

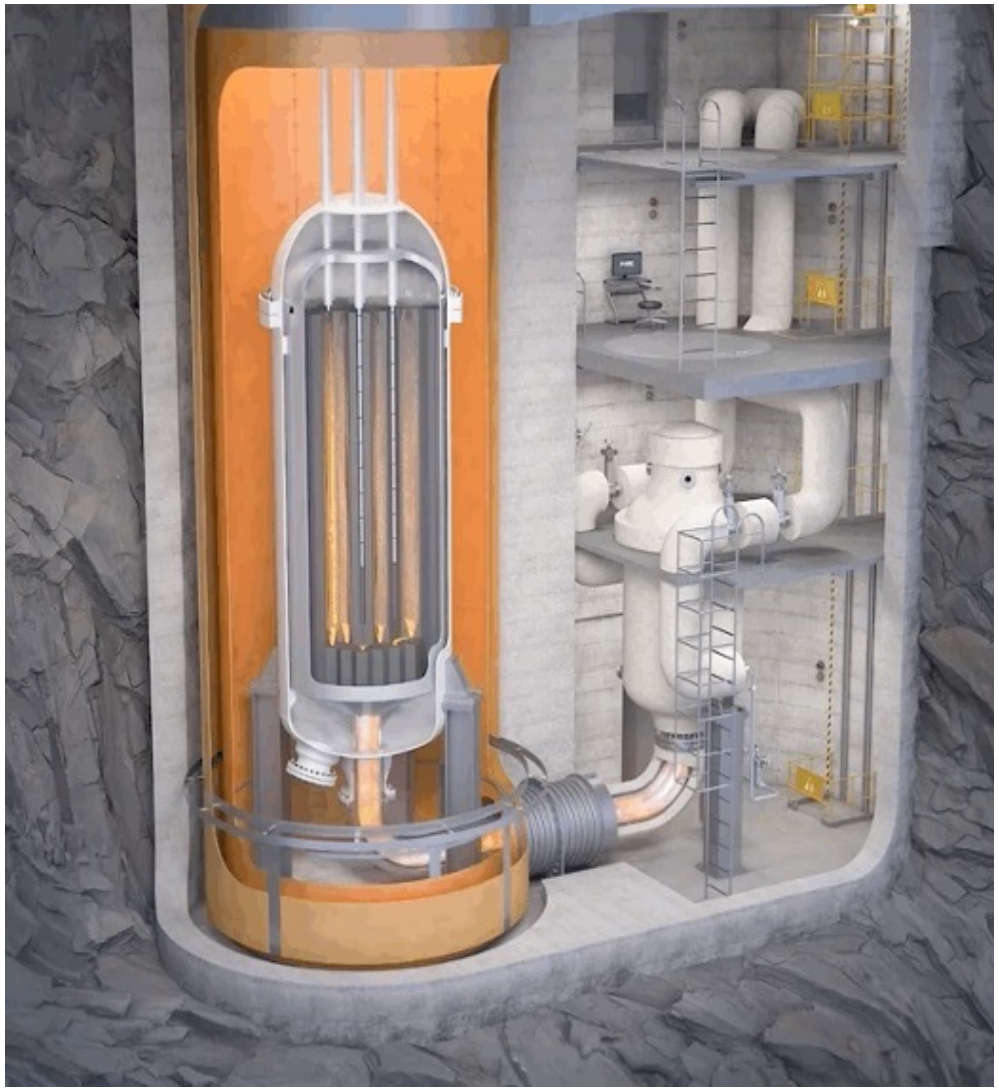
DESNZ AMR RD&D Programme Phase B : USNC MMR 3



- USNC is one of two successful bidders for Phase B USNC will provide £22.5 of matched funding to support the 20-month programme to:
  - Develop a FEED design that is ready to enter Generic Design Assessment (GDA) by UK regulators
  - Develop the business case for the construction of a demonstration plant
- USNC will work with UK supply chain partners, including our principal sub-contractor Jacobs with whom we have sept up an Integrated Project Team, to deliver our “next generation” MMR
  - Increased Reactor Outlet Temperature 750^{o}C +
  - Increased Reactor Power 60 MWt
  - High Temperature Offtake
  - Retain flexibility of existing solar salt system for heat storage at 580^{o}C

Summary

- TRISO fuel is a robust and proven fuel
- MMR technology is ready for deployment
- Large addressable market in the UK for process heat and synthetic fuels production
- USNC UK through DESNZ UK AMR programme are planning to deliver a higher ROT/higher Power MMR demonstrator by early 2030s



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Questions

October 2023