The NEA Small Modular Reactor Dashboard: Volume II

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Nuclear Technology Development and Economics

The NEA Small Modular Reactor Dashboard: Volume II

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The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes;
- to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD analyses in areas such as energy and the sustainable development of low-carbon economies.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management and decommissioning, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

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Compilation of information for *The NEA Small Modular Reactor Dashboard*

When completing the assessments for *The NEA Small Modular Reactor Dashboard*, the OECD Nuclear Energy Agency (NEA) has exclusively used information from verifiable public sources. These sources are available on the NEA website (www.oecd-nea.org/dashboard-vol2-ref).

The majority of the sources are from third party references (e.g. governments, regulators, financiers, operators). None of the sources are from the SMR designers, except for some relating to fuel type, enrichment, reactor specifics and public announcements of financing. The NEA has used its best efforts to search available public sources which have been used to compile the assessment results.

Prior to publication, the SMR designers were consulted by the NEA and provided with a list of the sources used to compile the assessment. They were given the opportunity to comment on the draft assessments and supplement further information which could be independently verified. If this further information was independently verified, it has been used in the final published assessment.

The criteria to obtain the assessment

The assessments are driven by objective criteria applied to information compiled from public sources. They are not the subjective judgement of analysts. The criteria used for the evaluation is in the "Track Progress of SMRs" section of this document. The information used in the assessment was provided to the SMR designers for their awareness prior to publications. In this context, the SMR designers were provided with an opportunity to comment and provide further information that could be independently verified. The assessments in no way reflect the opinion of the OECD or the NEA.

Foreword

The second volume of *The NEA Small Modular Reactor Dashboard* (hereafter "*The NEA SMR Dashboard*") is another milestone in the ongoing efforts of the OECD Nuclear Energy Agency (NEA) to comprehensively assess the progress towards commercialisation and deployment of SMR technologies. It is important to note that the present publication is not an update to the complement of reactors assessed in Volume I. Instead, the work extends the same methodology to a further 21 SMR designs from around the world to assess their progress towards commercialisation and deployment as of 21 April 2023.

The NEA notes increased interest in SMRs driven by decarbonisation commitments by member country governments. As such, activity and news about the development of SMRs interests a broad array of stakeholders. As noted in Volume I, the variety of SMR designs and array of outlet temperatures allows for a variety of cogeneration configurations, where in addition to production of low-carbon electricity, SMRs can also provide heat for industrial processes such as desalination, hydrogen production, or district heating. Companies also see potential for SMR use in remote off-grid locations such as mining operations or isolated industrial facilities, reducing reliance on costly diesel generators and lowering carbon emissions.

Some advanced SMR designs continue to make progress towards demonstration of technologies that aim to close the back end of the fuel cycle by reprocessing and recycling spent nuclear fuel. In the interim, many countries are presently safely managing and storing spent nuclear fuel and some are moving forward with solutions for long-term management, including with deep geological repositories. For example, Finland has been making progress towards the world's first deep geological repository for spent nuclear fuel, which is under construction with a 2023 expected commission date. Additional research and development will be needed to ensure that there are appropriate plans for the long-term storage of all spent nuclear fuel, including novel waste streams from advanced SMRs.

Notable public announcements, even in the intervening months since NEA published Volume I in March 2023, now reflect technology choices and plans by chemical manufacturers, oil companies and copper mine owners. Market signals suggest that this trend will only continue to accelerate as awareness grows about the potential for SMRs to provide alternatives to fossil fuels for both power and non-power industrial applications.

Future volumes of *The NEA SMR Dashboard* will aim to help public and private sector decision-makers understand the pace of progress to commercial deployment. The NEA recognises that future editions of the Dashboard may need to adapt in order to keep pace with information from relevant sources, including regulatory agencies, utility operators, industry stakeholders, financial institutions and civil society.

Please e-mail NEA.SMR.Dashboard@oecd-nea.org to propose an SMR for inclusion in a future edition of *The NEA SMR Dashboard*.

Acknowledgements

This publication was prepared by the staff of the Nuclear Energy Agency (NEA) under the leadership of Diane Cameron, Head of the Division of Nuclear Technology Development and Economics. The project was managed by Emma Wong and Lucas Mir and included significant contributions from Brent Wilhelm, Takuya Funahashi, Shahnaz Hoque, Antonio Vaya Soler and Yereen Kim. Laurie Moore led on graphic design. The NEA Secretariat thanks participating SMR designers for substantive comments provided during the production of this report.

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Executive summary

Successive volumes of *The NEA SMR Dashboard* serve as a tool to track progress towards commercialisation and deployment of first-of-a-kind SMRs. When considered alongside assessments of technology readiness levels (TRL), the Dashboard presents a holistic "snapshot in time", documenting progress towards commercialisation and deployment of SMRs around the world. Volume II extends NEA assessments of progress to a further 21 SMRs as a complement to the first volume of the Dashboard.

Volume II applies the same methodology and criteria as Volume I (NEA, 2023) to assess progress in the areas of:

- **Licensing**: The progress criteria for licensing closely follows international licensing norms, including pre-licensing interactions with regulators, design approval, construction and the issuance of operating licenses. A bonus is given to SMRs with licensing activities in multiple jurisdictions at any level.
- **Siting**: The grading scale for siting assesses the selection and licensing reading of a particular site for SMR construction. A bonus is given to SMR technologies making progress at multiple sites at any level.
- **Financing**: The progress criteria for financing reflect both public announcement from reactor designers and financing reports from publicly available sources.
- **Supply chain**: The progress criteria are based levels of commitment reflected in memoranda of understandings, binding contracts, and formal partnerships, joint ventures or consortia.
- **Engagement**: The progress criteria reflect the number of engagements with communities associated with the SMR project evidenced by memoranda of understandings, endorsements, town hall meetings and benefit-sharing agreements.
- **Fuel**: The SMR progress criteria are based on their progress towards commercial supply of qualified fuel. Once a licensed and operating fuel fabrication facility exists for a fuel, it is considered alongside others already being used in operating plants. For SMRs at this level of maturity, the next stages include contracts for fuel supply and a license to operate the reactor with the specific fuel.

A summary of definitions of these criteria for tracking progress is included on page 17 in this volume for reference. For further information, please refer to *The NEA Small Modular Reactor Dashboard* (NEA, 2023). Based on these criteria, Volume II analysis continues to reveal substantial progress by SMR developers internationally towards deployment and commercialisation.

As SMR designs continue to make progress towards implementation, governments, regulators and vendors have begun consideration of how the spent fuels and other nuclear wastes produced by these technologies will be addressed. The NEA has initiated work to support review of these matters, but in most cases, continuing activity related to technology definition and development makes it premature to prepare fully for the back end of the fuel cycle for some technologies.

Light-water based SMR technologies, as a general matter, enjoy the benefits of familiarity. While there are some differences in configuration from traditional reactors, the NEA does not expect major technical challenges to planning for and implementing the disposal of used fuel from these technologies.

Other technologies, however, do raise some questions which will need to be addressed in the coming years. SMR developers aiming to deploy novel fuel cycles, are conducting important work to characterise their waste streams and work with waste management organisations to prepare appropriate plans for the long-term storage of the wastes. At the time of publication, there was insufficient information available from verifiable public sources to assess the progress of SMRs in terms of waste management planning and readiness for end of life cycle management. As a result, at this early stage, consideration of preparation for used fuel from innovative SMRs is not included in *The NEA SMR Dashboard*; however, it is anticipated that future editions of *The NEA SMR Dashboard* will elaborate a methodology and criteria for assessing progress in this area when sufficient progress is completed and information more generally available to enable authoritative evaluations.

As in Volume I, Volume II highlights the geographical diversity of the reactor developers and siting activity on world maps. The 21 SMRs in Volume II reflect activities underway in 11 countries on three continents. The SMRs in this volume span across a wide range of concepts (e.g. water-cooled, gas-cooled, fast spectrum, micro, and molten salt) and configurations (e.g. land-based, multi-module, marine-based, and mobile). This includes multiple reactor designs that aim to provide outlet temperatures above 800°C with one reactor tipping 1 000°C. These high temperatures enable carbon-free industrial applications such as aluminium production and can provide high temperature steam for a wide range of processes.

Tracking progress on SMRs

Key information for each of the SMR designs assessed in this volume is listed in Table 1.

Table 1. **SMRs assessed in *The NEA SMR Dashboard Volume II***

Name	Design organisation	Headquarter (city/region)	Country	Thermal power (MWth)	Outlet temperature (°C)	Spectrum (thermal/fast)	Fuel type
BANR SMR	BWX Technologies	Lynchburg, Virginia	United States	50	427	Thermal	UCO[7] TRISO and UN[8] TRISO prismatic
Project Pele	BWX Technologies	Lynchburg, Virginia	United States	N/A	N/A	Thermal	TRISO
Energy Well	CVŘ[1]	Central Bohemian Region	Czech Republic	20	700	Thermal	TRISO prismatic
DF300	Dual Fluid Energy	Vancouver, British Columbia	Canada	600	1 000	Fast	Liquid Metallic U-Cr alloy
SMR-160	Holtec International	Jupiter, Florida	United States	525	N/A	Thermal	UO_2 pellets
GTHTR300	JAEA[2]	Ibaraki	Japan	600	950	Thermal	TRISO prismatic
HTTR	JAEA[2]	Ibaraki	Japan	30	950	Thermal	TRISO prismatic
Jimmy	Jimmy Energy	Paris	France	10	550	Thermal	UCO TRISO prismatic
SMART	KAERI[3]	Daejeon	Korea	365	322	Thermal	UO_2 pellets
PWR-20	Last Energy	Washington DC	United States	60	300	Thermal	UO_2 pellets
LFR AS 200	*new*cleo	London	United Kingdom	480	530	Fast	MOX
BREST-OD-300	NIKIET[4]	Moscow	Russia	700	540	Fast	MNUP[9] fuel
Kaleidos	Radiant	El Segundo, California	United States	1.9	700	Thermal	TRISO prismatic
RITM-200M	Rosatom	Moscow	Russia	198	318	Thermal	UO_2 pellets
CMSR	Seaborg Technologies	Copenhagen	Denmark	250	670	Thermal	Molten salt fuel
HAPPY200	SPIC[5]	Beijing	China	200	120	Thermal	UO_2 pellets
IMSR	Terrestrial Energy	Oakville, Ontario	Canada	884	700	Thermal	Molten salt fuel
TMSR-500	ThorCon International	Dubai	United Arab Emirates	557	704	Thermal	Molten salt fuel
4S	Toshiba Energy Systems & Solutions Corporation	Kawasaki, Kanagawa	Japan	30-135	510	Fast	Metallic U-Zr alloy
Westinghouse LFR	Westinghouse Electric Company	Cranberry Township, Pennsylvania	United States	950	530-650	Fast	UO_2 pellets or MOX; then nitride pellets
TEPLATOR	ZČU and CIIRC CTU[6]	Prague	Czech Republic	170	180	Thermal	Spent nuclear fuel assemblies from LWRs[10] or natural uranium

(1) CVŘ = Research Centre Řež; (2) JAEA = Japan Atomic Energy Agency; (3) KAERI = Korea Atomic Energy Research Institute; (4) NIKIET = N.A. Dollezhal Research and Design Institute of Power Engineering; (5) SPIC = State Power Investment Corporation (SPIC); (6) ZČU and CIIRC CTU = Západočeská univerzita v Plzni and Czech Technical University in Prague; (7) UCO = Uranium Oxycarbide; (8) Uranium Nitride; (9) MNUP = Mixed uranium-plutonium nitride fuel; (10) In particular, spent nuclear fuel assemblies from VVER, BWR or PWR reactors as fuel.

The NEA SMR Dashboard provides a holistic assessment of progress to give an accurate presentation of the numerous different factors and pathways to commercialisation for these technologies. There are many different types of emerging and well-established organisations developing SMRs around the world. Figure 1 shown here, similar to that in Volume I, displays the geographical breadth of this growing industry. Figure 2 illustrates their progress on siting around the world.

Figure 1. **Locations of SMR designer headquarters**

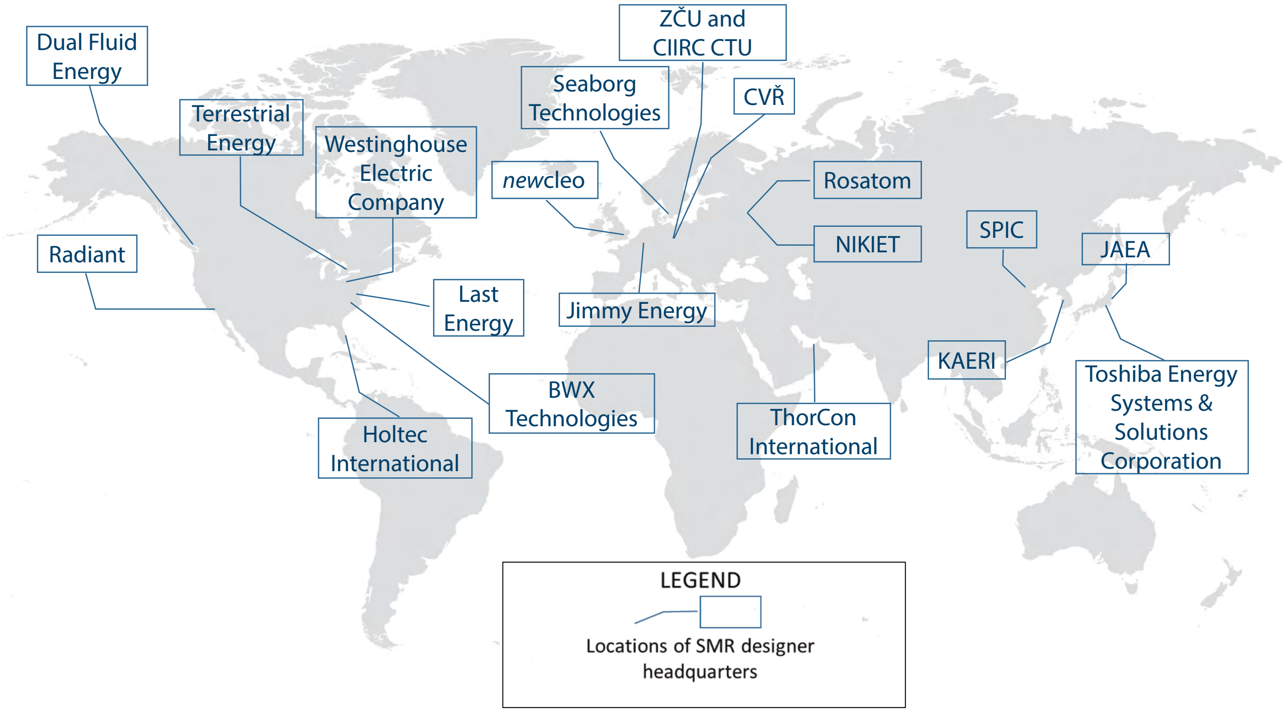
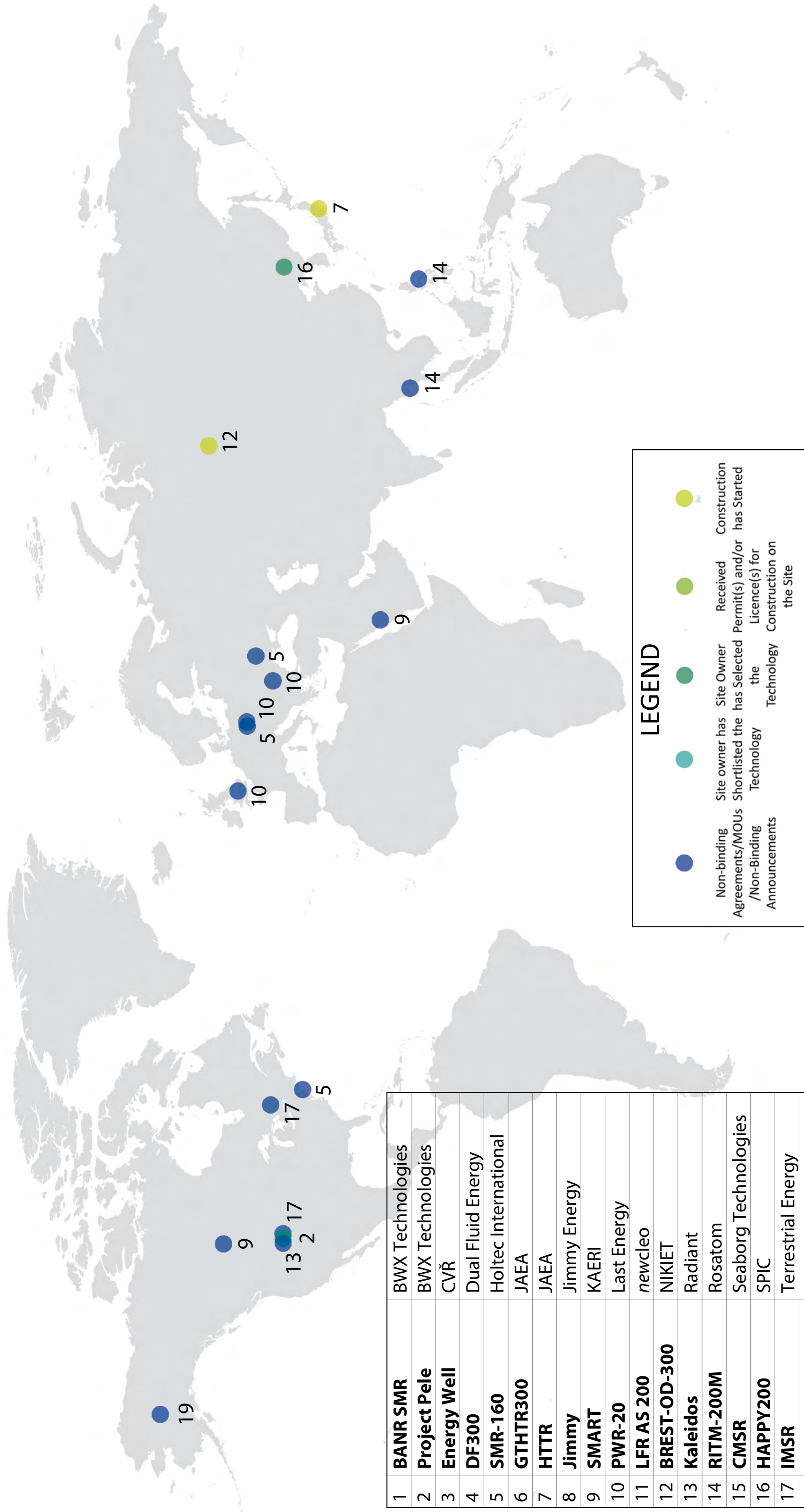


Figure 2. **Locations of sites of a selection of SMRs**



1	**BANR SMR**	BWX Technologies
2	**Project Pele**	BWX Technologies
3	**Energy Well**	CVŘ
4	**DF300**	Dual Fluid Energy
5	**SMR-160**	Holtec International
6	**GTHTR300**	JAEA
7	**HTTR**	JAEA
8	**Jimmy**	Jimmy Energy
9	**SMART**	KAERI
10	**PWR-20**	Last Energy
11	**LFR AS 200**	*newcleo*
12	**BREST-OD-300**	NIKIET
13	**Kaleidos**	Radiant
14	**RITM-200M**	Rosatom
15	**CMSR**	Seaborg Technologies
16	**HAPPY200**	SPIC
17	**IMSR**	Terrestrial Energy
18	**TMSR-500**	ThorCon International
19	**4S**	Toshiba Energy Systems & Solutions Corporation
20	**Westinghouse LFR**	Westinghouse Electric Company
21	**TEPLATOR**	ZČU and CIIRC CTU

The SMRs in this volume span a wider range of design concepts than those in Volume I, illustrating significant sector innovation beyond water-cooled reactors. This volume also identifies several additional mobile and multi-module design configurations in addition to land based applications.

Figure 3. **Reactor concepts**

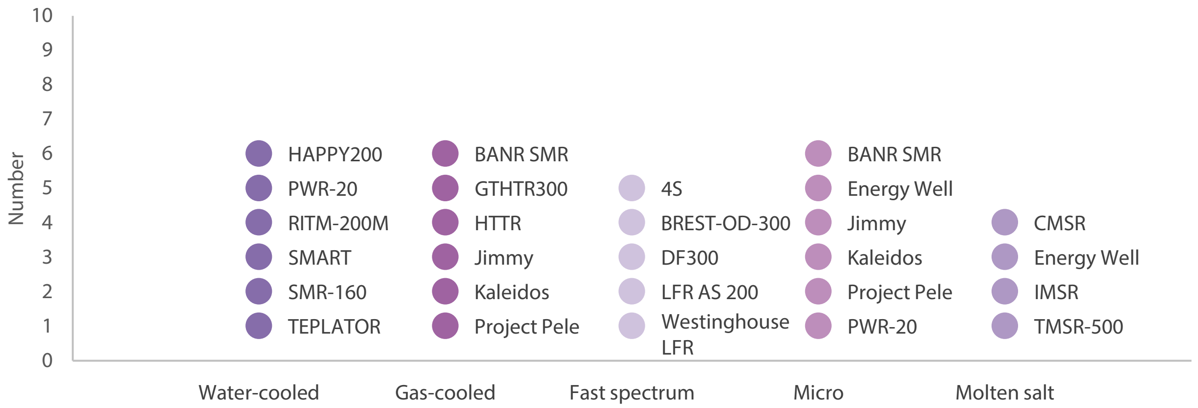
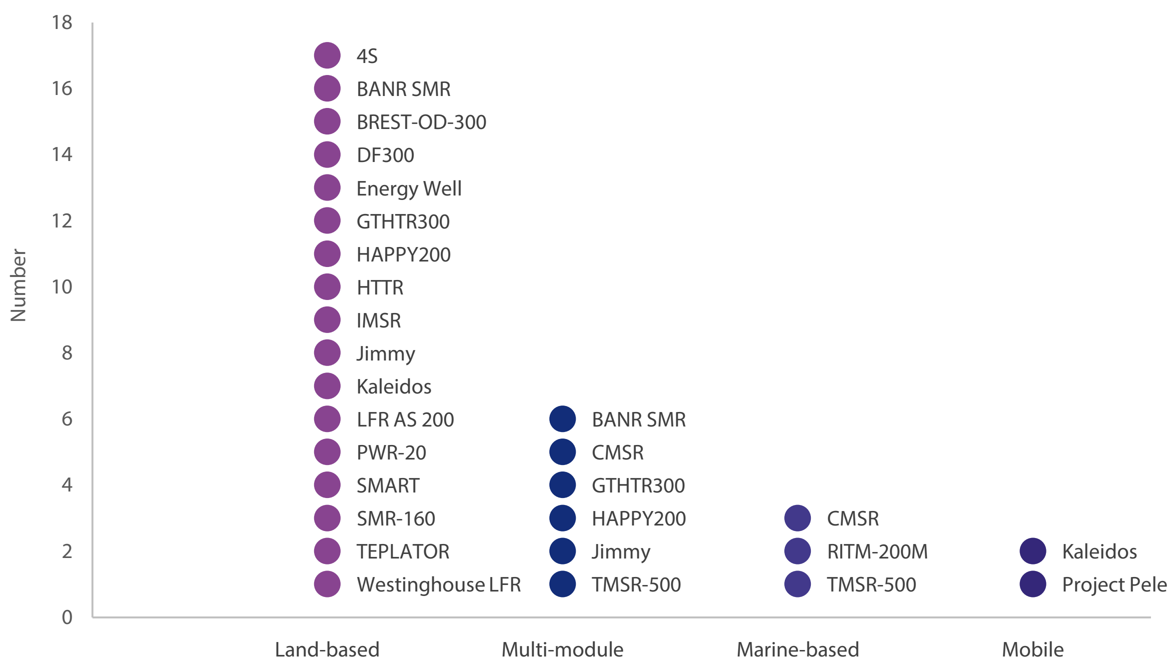


Figure 4. **Reactor configurations**



Figures 5 and 6 illustrate the continuing theme from Volume I that SMR designs under development internationally reflect a significant range of sizes, temperatures and fuel enrichments – potentially unlocking a new variety of applications and markets for the nuclear industry.

Figure 5. **SMRs: Range of sizes and temperatures for heat applications**

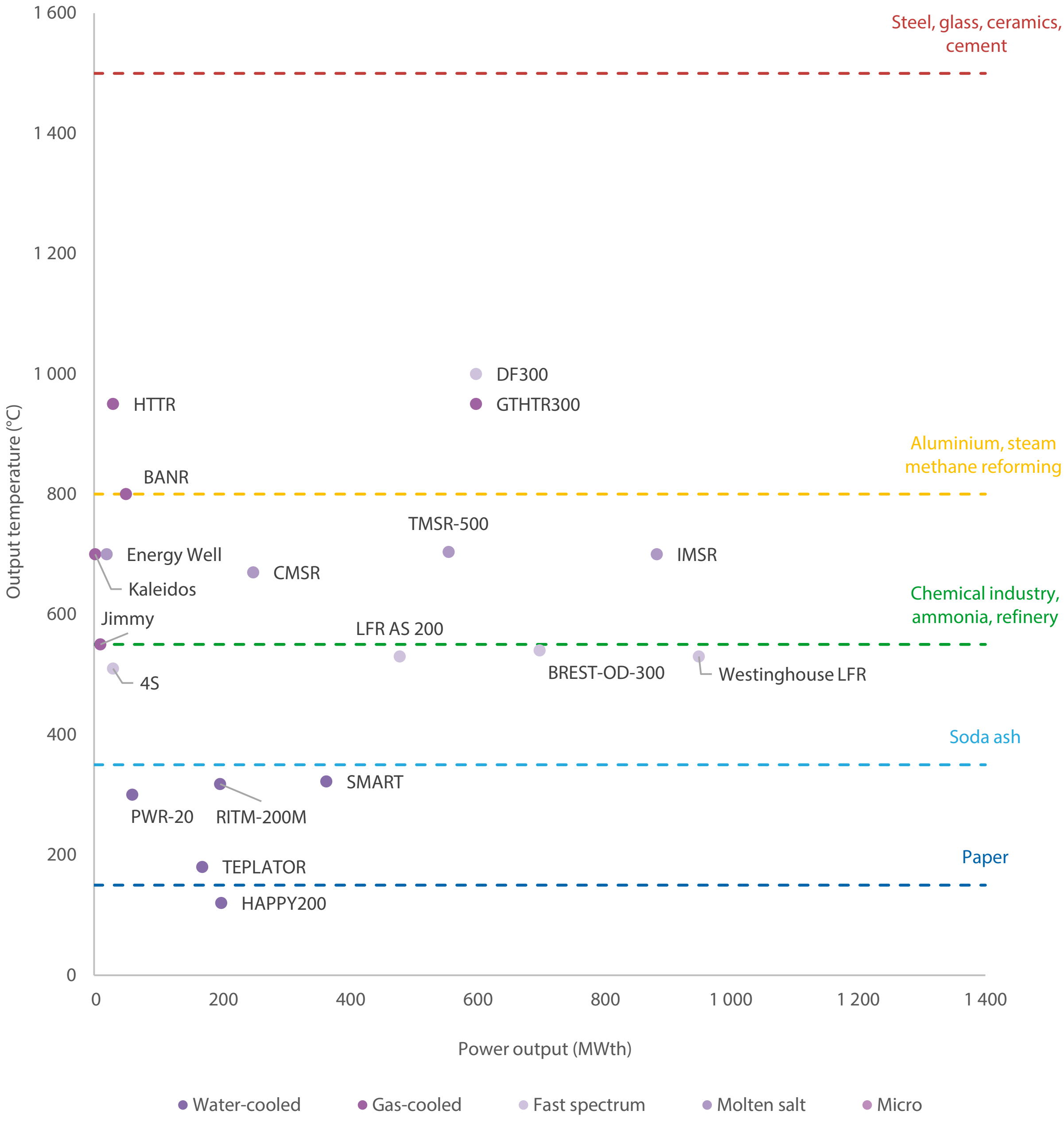
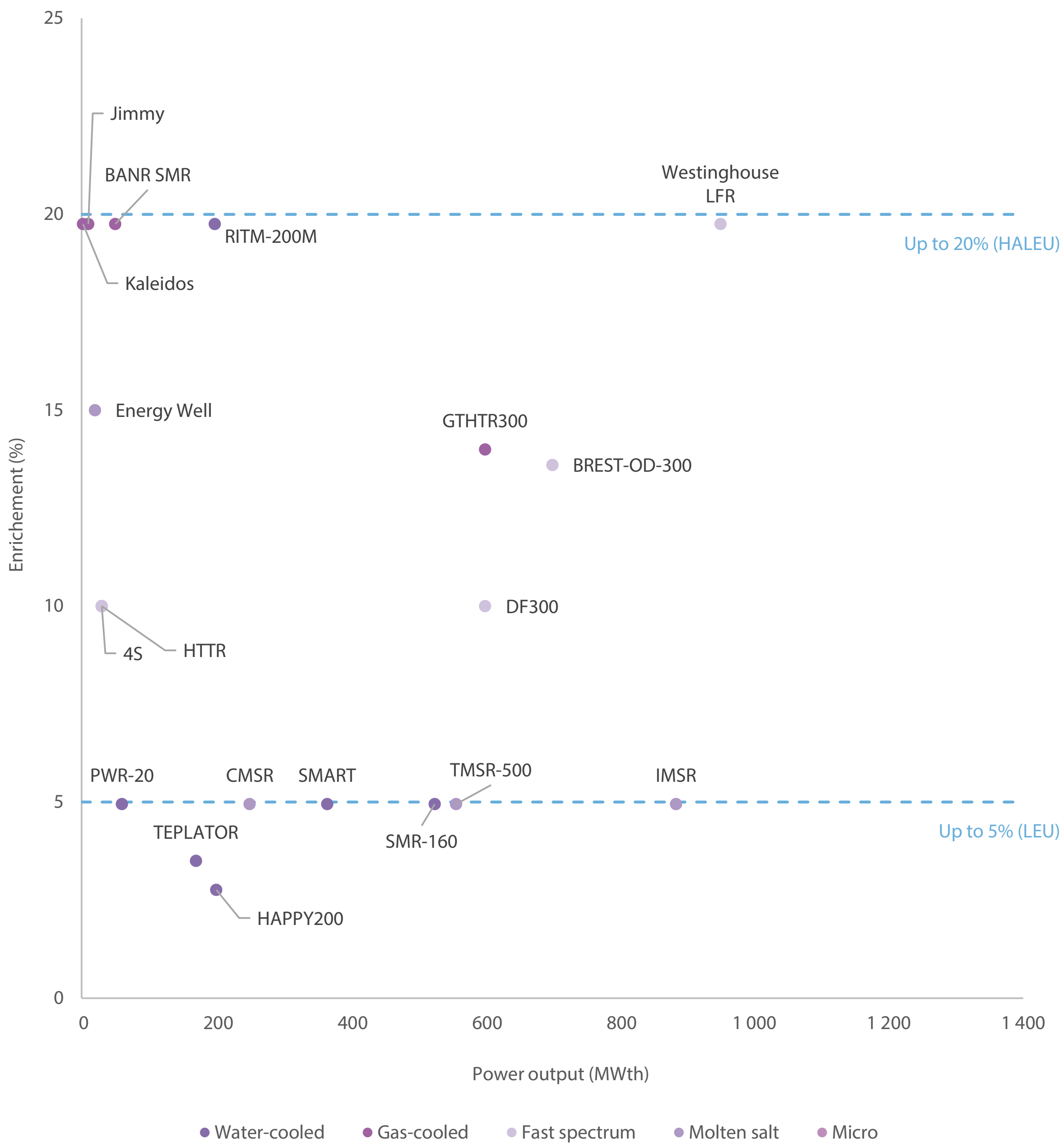


Figure 6. **SMR concepts by type, thermal power and enrichment**



The NEA SMR Dashboard

Volume I of *The NEA SMR Dashboard* (NEA, 2023) introduced and defined six assessment criteria to track the progress toward commercialisation and deployment of respective SMR designs. Volume II applies the same set of criteria to assess progress of an additional 21 SMR designs. Table 2 below summarises the definitions of the criteria applied to assess progress in the areas of: licensing, siting, financing, supply chain, engagement, and fuel.

Table 2. ***The NEA SMR Dashboard* progress criteria definitions**

Licensing	No information	Pre-licensing	Licence/construction/design certification application submitted	Design approved	Licence to construct approved	Licence to operate approved
	* Bonus for multiple jurisdictions					
Siting	No information	Non-binding agreements/MOUs/ non-binding announcements	Site owner has shortlisted the technology	Site owner has selected the technology	Received permit(s) and or licence(s) for construction on the site	Construction has started on the site
	* Bonus for multiple sites					
Financing(1)	No information	At least one announcement	Five or more announcements or USD 100 million	Ten or more announcements or USD 500 million	FOAK is fully financed	FOAK financed + progress for NOAK finance
Supply chain(2)	No information	Supplier days/ events/workshops/ trade shows/ non-binding agreements/MOUs/ non-binding announcements	Binding contracts for services & materials	Partnerships/joint ventures/consortia - all with EPCs	FOAK construction ongoing/ complete	NOAK construction ongoing
Engagement(3, 4)	No information	One or more engagements	Three or more engagements	Five or more engagements	Seven or more engagements	Ten or more engagements
Fuel	No information	Non-binding agreements & studies with national labs for RDD/Lab-scale production of fuel	Contracts/agreements with fuel supply chain (uranium/conversion/enrichment/ fabrication)	Operating fabrication facility producing fuel, or uses same fuel as existing/generation-III commercial reactors	Contracts for fuel for FOAK	Fuel loading has begun

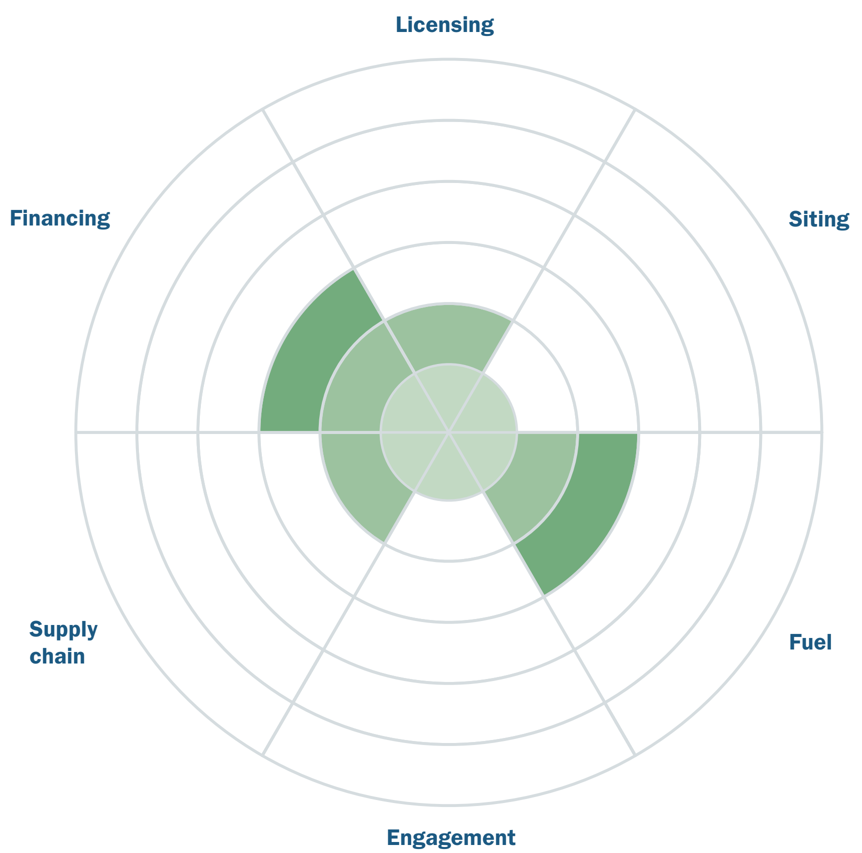
(1) **Types of financing announcements in scope**: Funding from private investors; government grants; loans; loan guarantees; cost sharing agreements; public-private partnerships; equity partnerships; announcements of becoming publicly traded; announcements of sizeable investments; power purchase agreements; financing approval from rate payers; export credit financing; bank financing; multilateral development bank financing.

(2) **Types of suppliers of interest in scope**: Engineering, procurement and construction organisations; universities, labs and research institutions when they are supplying research and development services to an SMR project.

(3) **Types of stakeholders for 'Engagement' in scope**: Subnational governments; Indigenous governments; labour unions; non-governmental organisations; civil society organisations; community organisations; universities; end users and customers; advisory boards.

(4) **Types of announcements for 'Engagement' in scope**: Memorandums of understanding; endorsements; town hall meetings; benefit-sharing agreements.

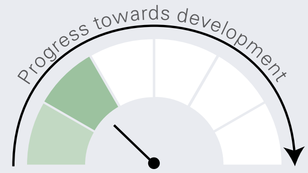
BANR SMR



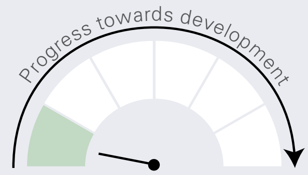
★ Active in multiple jurisdictions or countries.

Design organisation	BWX Technologies
Thermal power (MWth)	50
Outlet temperature (°C)	800
Spectrum (thermal/fast)	Thermal
Fuel type	Uranium Oxycarbide (UCO) TRISO (baseline core) and Uranium Nitride (UN) TRISO (upgraded core) prismatic
Fuel (LEU/HALEU/HEU)	HALEU

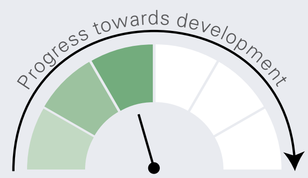
Licensing



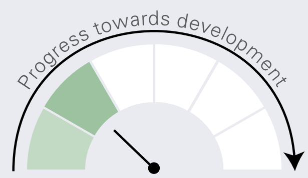
Siting



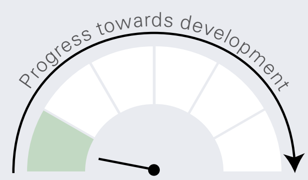
Financing



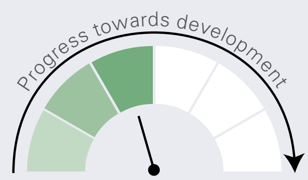
Supply chain



Engagement



Fuel



Assessment of BANR SMR's progress to deployment

Licensing

The BWXT Advanced Nuclear Reactor (BANR) is one of two modular, transportable, high-temperature micro gas-cooled SMRs under development by BWXT, along with the BWXT SMR for the US Department of Defense (DOD) Project Pele at the Idaho National Laboratory (INL). Experience gained in Project Pele may help inform and accelerate work on the BANR. BWXT submitted a regulatory engagement plan for the BANR to the US Nuclear Regulatory Commission (NRC) in 2022 to initiate pre-licensing activities. The engagement plan details proposed submittal dates for technical and topical reports. Additionally, in 2022, BWXT submitted a Quality Assurance Topical Report that supports fuel development activities for the BANR.

Siting

At the time of assessment, no information related to siting was readily available from a site owner.

Financing

In 2020 it was announced that BWXT would receive a Risk Reduction award under the DOE Advanced Reactor Demonstration Program (ARDP). In 2022, BWXT finalised a cost-share award for the development of BANR, with DOE contributing USD 89 million and BWXT contributing USD 22.3 million.

Supply chain

BWXT operates a diverse supply chain specialised in the nuclear sector, including engineering, procurement and construction capabilities. BANR is expected to benefit from BWXT's established supply chain from Project Pele in which BWXT has been selected to be the prime contractor and integration lead.

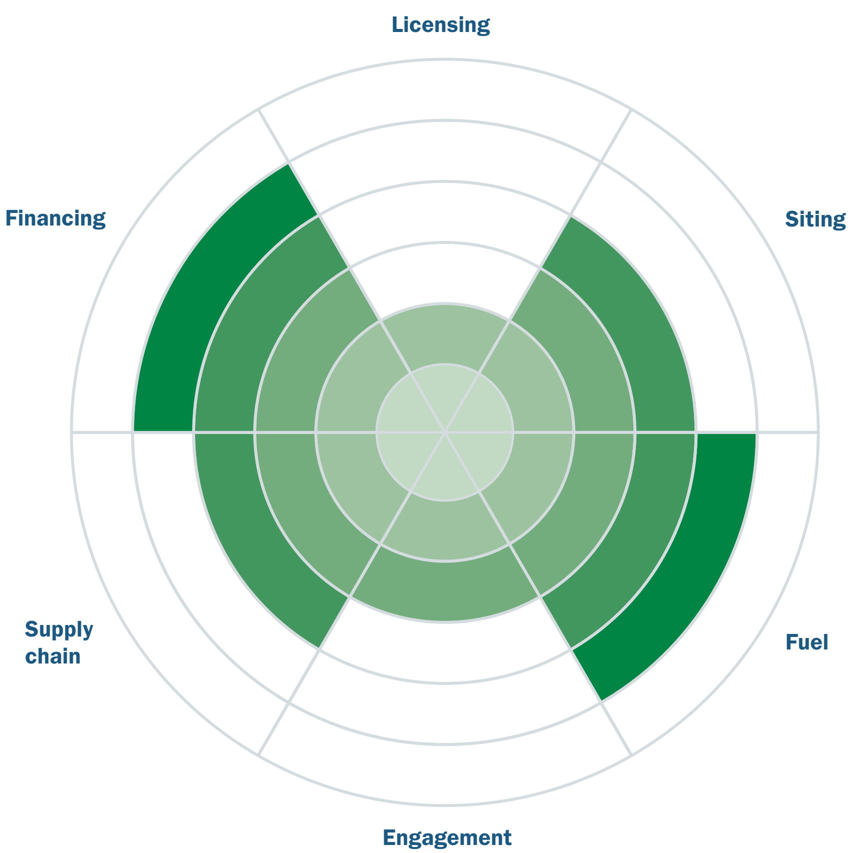
Engagement

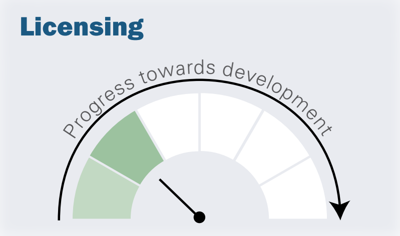
At the time of assessment no information was readily available from verifiable public sources related to engagement activities.

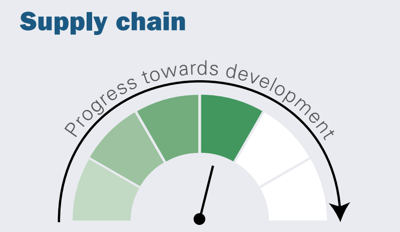
Fuel

High-Assay Low-Enriched Uranium (HALEU) is a technically proven fuel type; however, there is presently no commercial supply available from OECD countries. Additionally, TRi-structural ISOtropic (TRISO) fuel has been tested since 1960 in US national laboratories. BWXT proposes to use Uranium Oxycarbide (UCO) TRISO for the BANR baseline core and Uranium Nitride (UN) TRISO for the BANR upgraded core. BWXT plans to fabricate TRISO fuel at their facilities in Lynchburg, Virginia. Facilities to produce UCO TRISO are already licensed and in operation. Additionally, BWXT has also been working with the INL and Oak Ridge National Laboratory (ORNL) on the simulation, manufacturing and testing of their UN TRISO fuel concept.

Project Pele







★ Active in multiple jurisdictions or countries.

Design organisation	BWX Technologies
Thermal power (MWth)	N/A
Outlet temperature (°C)	N/A
Spectrum (thermal/fast)	Thermal
Fuel type	TRISO
Fuel (LEU/HALEU/HEU)	HALEU

Assessment of Project Pele's progress to deployment

Licensing

Project Pele is a defence reactor prototype of a micro-mobile gas-cooled SMR commissioned by the US Department of Defense (DOD) Strategic Capabilities Office (SCO) to demonstrate the feasibility for government applications and possible later commercial application. Due to the defence classification of this project, there is limited information available in public sources. It does not fall under the purview of the US Nuclear Regulatory Commission (NRC). The DOD and the US Department of Energy (DOE) have agreed that Project Pele will be tested and operated under DOE authorisation. A final environmental statement has been released by the DOD SCO in accordance with the requirements of the National Environmental Policy Act. The next step will be to submit the design for a Preliminary Documented Safety Analysis approval.

Siting

The DOD plans for the Project Pele SMR are that it be constructed off-site and delivered to the Idaho National Laboratory (INL) by 2024, where the fuel will be loaded and DOE will test and operate it.

Financing

The DOD has announced that the Project Pele prototype reactor will be completed under a cost-type contract valued at USD 300 million. Additionally, BWXT has received USD 42.5 million from the DOD to develop the reactor design and fuel, as well as USD 37 million from INL to manufacture the Project Pele core.

Supply chain

BWXT operates a diverse supply chain specialised in the nuclear sector – including engineering, procurement and construction. BWXT has been selected by the DOD to be the prime contractor and integration lead for Project Pele, and is responsible for building and demonstrating the prototype. The project team also includes Northrop Grumman, Aerojet Rocketdyne, Rolls-Royce LibertyWorks and Torch Technologies. The DOD SCO has a Memorandum of Understanding with the DOE and the NRC to provide technical support, advise on design and safety, and reduce commercial licensing risk. The SCO has signed an Interagency Agreement with the DOE to provide safety oversight and authorisation. The Army Corps of Engineers was also engaged as the technical lead on the National Environmental Policy Act Environmental Impact Statement.

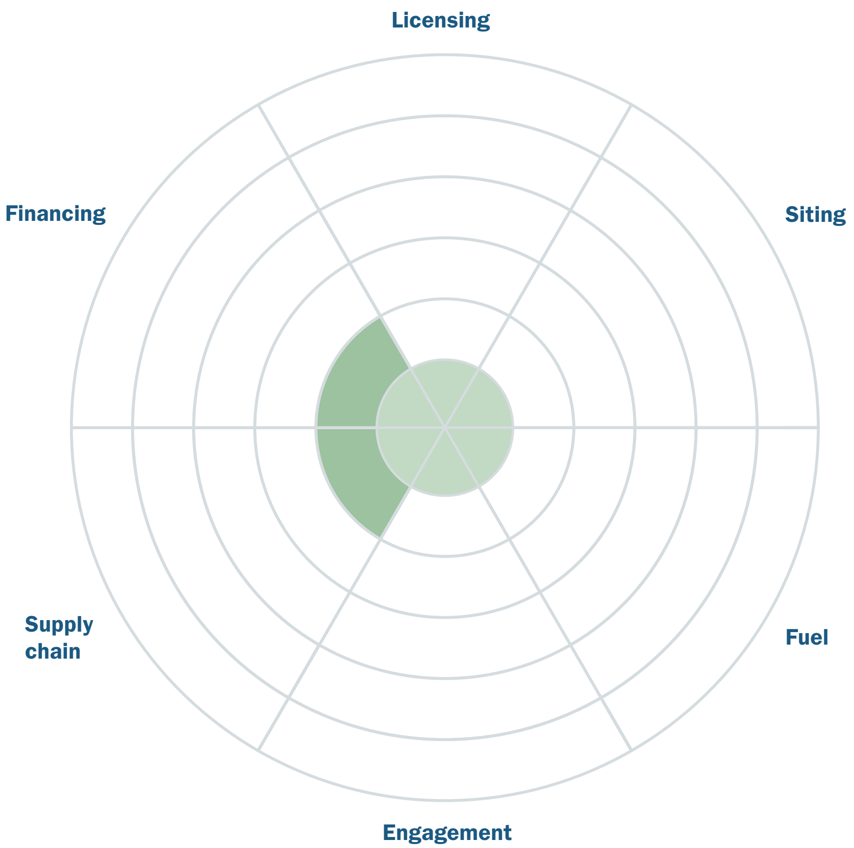
Engagement

Dr Jeff Waksman, Project Pele Program Manager was invited to participate in the Energy Communities Alliance (ECA) 2022 forum. The ECA is a non-profit organisation that aims to facilitate dialogue between the US DOE and local governments representatives adjacent to, or impacted by, US DOE activities. On 15 April 2022 he also appeared on Boise State Public Radio News to discuss public engagement about the project. The DOD also undertook public engagement through a public comment period during 2021-2022.

Fuel

The INL has contracted BWXT to produce the necessary TRi-structural ISOtropic (TRISO) fuel for the Project Pele first-of-a-kind prototype demonstration unit. As of early 2023, BWXT owns and operates the only privately owned facilities in the United States licensed to possess and process high-enriched uranium (HEU) for down-blending into High-Assay Low-Enriched Uranium (HALEU). The BWXT facilities are located in Lynchburg, Virginia. Under the contract with INL, BWXT will down-blend HEU stockpiles from National Nuclear Security Administration (NNSA) to produce HALEU for Project Pele.

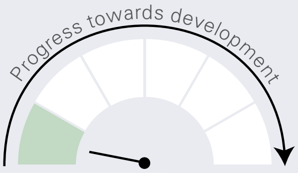
Energy Well



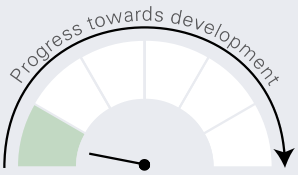
★ Active in multiple jurisdictions or countries.

Design organisation	Research Centre Řež (CVŘ)
Thermal power (MWth)	20
Outlet temperature (°C)	700
Spectrum (thermal/fast)	Thermal
Fuel type	TRISO prismatic
Fuel (LEU/HALEU/HEU)	HALEU

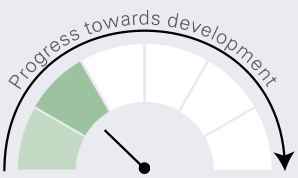
Licensing



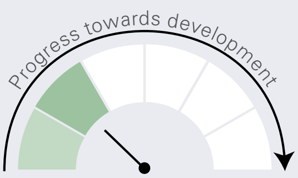
Siting



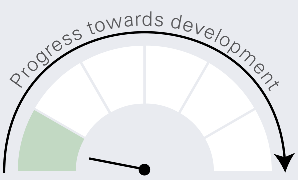
Financing



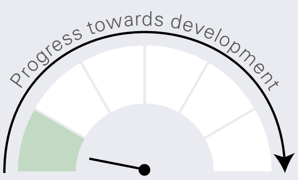
Supply chain



Engagement



Fuel



Assessment of Energy Well's progress to deployment

Licensing

Research Centre Řež (CVŘ) is developing the Energy Well SMR, a micro, molten salt-cooled reactor, fuelled by High-Assay Low-Enriched Uranium (HALEU) TRi-structural ISOtropic (TRISO) fuel in a solid prismatic fuel assembly. At the time of assessment, there was no information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

At the time of assessment, no information related to siting was readily available from a site owner.

Financing

In its 2020 Annual Report, CVŘ highlighted that the Energy Well SMR received funding from the Technology Agency of the Czech Republic to support work towards the conceptual design.

Supply chain

CVŘ has reported that ŠKODA JS (since acquired by ČEZ) is a key partner for the development of the transport container. CVŘ has stated their intention to work with the supply chain within the Czech Republic and they foresee potentially working in the future with MICO and ATEKO for main reactor components, ZAT and DEL for instrumentation and control, the Division of ENERGOPROJEKT within ÚJV Řež for primary engineering, and Sigma Group for pumps and valves.

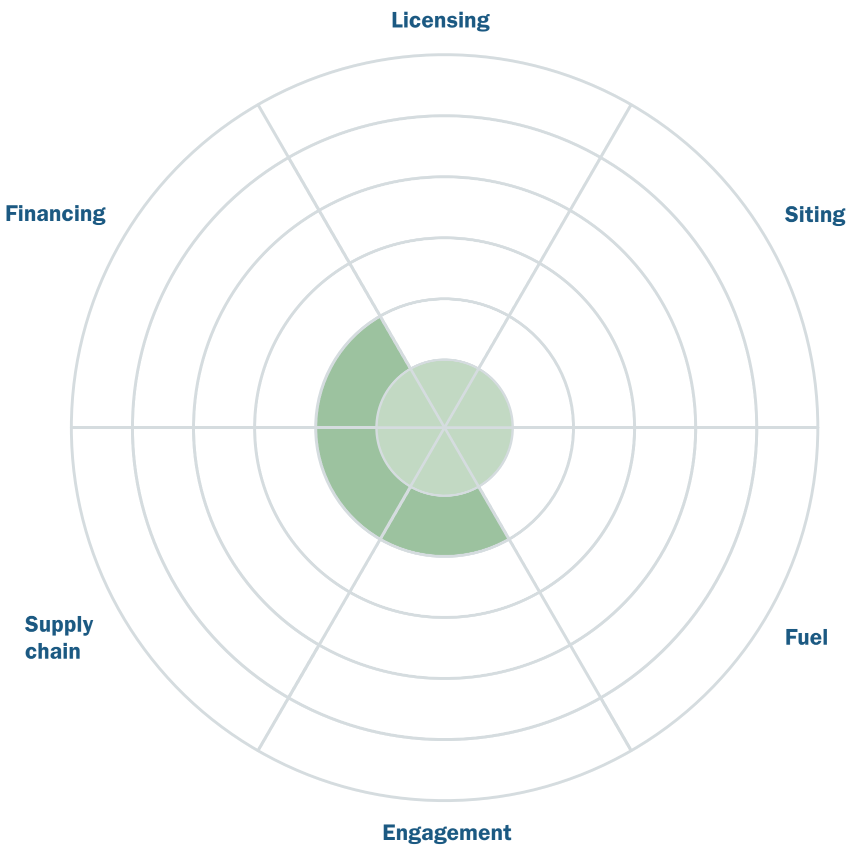
Engagement

At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

HALEU is a technically proven fuel type; however, there is presently no commercial supply from OECD countries. Additionally, TRi-structural ISOtropic (TRISO) fuel has been tested since 1960 in US national laboratories. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

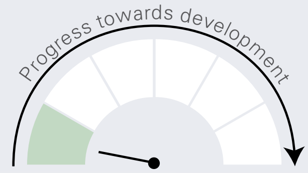
DF300



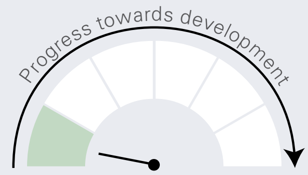
★ Active in multiple jurisdictions or countries.

Design organisation	Dual Fluid Energy
Thermal power (MWth)	600
Outlet temperature (°C)	1 000
Spectrum (thermal/fast)	Fast
Fuel type	Liquid metallic U-Cr alloy
Fuel (LEU/HALEU/HEU)	HALEU

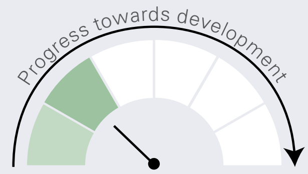
Licensing



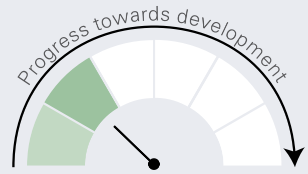
Siting



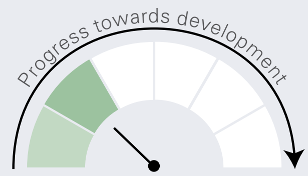
Financing



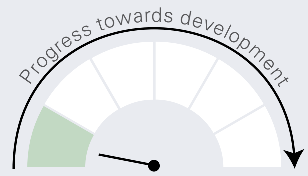
Supply chain



Engagement



Fuel



Assessment of DF300's progress to deployment

Licensing

The DF300 is a 600 MWth SMR which proposes to use liquid lead as coolant and liquid metallic fuel. Dual Fluid Energy joined Canada's SMR Action Plan in 2021 with a commitment to engage the Canadian Nuclear Safety Commission through its pre-licensing Vendor Design Review Process. At the time of assessment, there was no additional information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

At the time of assessment, no information related to siting was readily available from any site owners.

Financing

In June 2021, Dual Fluid announced that it had raised almost CAD 7 million (USD 5.6 million) in its first round of private financing for collaborations with research institutions on safety analysis in accordance with international regulatory standards, company build-up, as well as laboratory setup.

Supply chain

Dual Fluid signed a Memorandum of Understanding with the TRIUMF particle accelerator centre in British Columbia, Canada, to conduct materials research using TRIUMF's Proton and Neutron Irradiation Facilities and metallurgical testing capabilities. The first measurement campaign started in June 2023. Dual Fluid is engaged with research institutions, such as the Technical University of Munich, the Technical University of Dresden, the Polish National Centre for Nuclear Research (NCBJ) and the Swiss Paul Scherrer Institute to conduct research and demonstrate the safety of the Dual Fluid concept.

Engagement

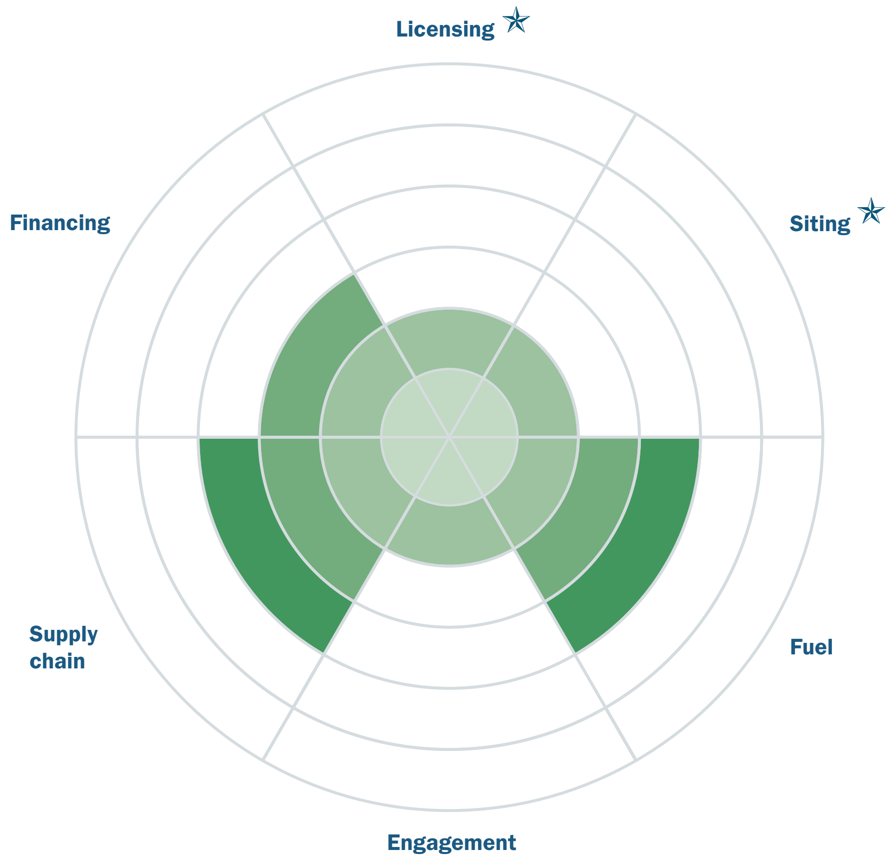
In 2013, Dual Fluid entered its reactor design into the GreenTec Awards, a national environmental contest in Germany, under the energy category. The Dual Fluid reactor was designated by the GreenTec judges, a 54-person jury, and a public vote as one of the top three technologies in the competition.

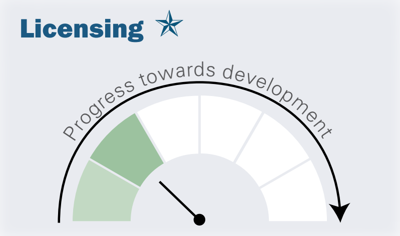
Fuel

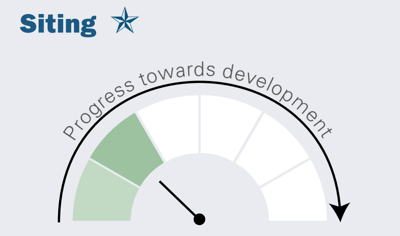
The Dual Fluid design principle allows for a high density of fissile material in the liquid fuel. For the DF300, a mixture of 80% actinide and 20% chromium is intended for an initial fuel inventory utilising either enriched uranium or reactor-grade plutonium. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

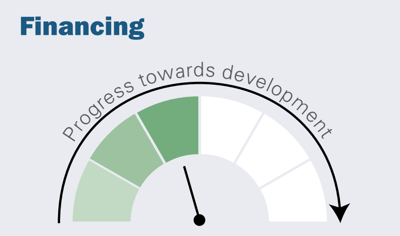
Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of CAD 1.254 equals the price of USD 1.000.

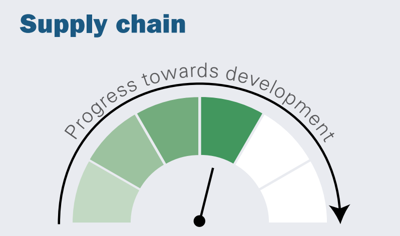
SMR-160

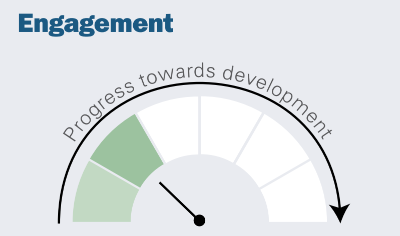


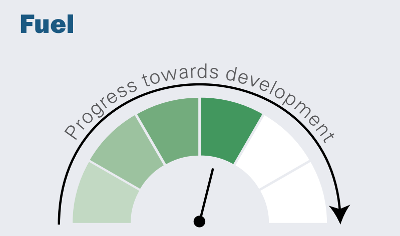












★ Active in multiple jurisdictions or countries.

Design organisation	Holtec International
Thermal power (MWth)	525
Outlet temperature (°C)	N/A
Spectrum (thermal/fast)	Thermal
Fuel type	UO_2 pellets
Fuel (LEU/HALEU/HEU)	LEU

Assessment of SMR-160's progress to deployment

Licensing ✯

The Holtec International SMR-160 is a 525 MWth land-based pressurised water reactor. The Holtec SMR-160 has completed Phase 1 of the pre-licensing Vendor Design Review (VDR) with the Canadian Nuclear Safety Commission (CNSC) and is also undergoing pre-licensing activities with the US Nuclear Regulatory Commission (NRC). In January 2023, Holtec submitted the SMR-160 design to the UK Generic Design Assessment (GDA) Entry process.

Siting ✯

Holtec has signed a Memorandum of Agreement (MoA) with Entergy Corporation to assess the feasibility of deploying the SMR-160 at Entergy's sites. Holtec is also considering installing a SMR-160 at the Oyster Creek nuclear site in New Jersey, US, which it purchased from Exelon in 2018. Holtec has also signed a MoA with the Czech nuclear operator ČEZ to evaluate the feasibility of deploying one or more SMR-160s at the ČEZ-owned nuclear power plant site in Temelin, Czech Republic. In Ukraine, Holtec has signed an MoU with NAEK Energoatom, the Ukraine national nuclear operator. Energoatom's president, Yury Nedashkovsky, who is also a member of the Holtec Advisory Council, has indicated Energoatom's interest in replacing two existing VVER-440 reactors at the Rovno site with Holtec SMR-160s.

Financing

Holtec International has secured USD 116 million from the US Department of Energy (DOE) Advanced Reactor Demonstration Program (ARDP) to advance early-stage design, engineering and licensing of the SMR-160.

Supply chain

Holtec has in-house nuclear engineering, manufacturing and construction capabilities. In March 2022, the DOE approved part I of a loan application from Holtec to expand the manufacturing capacity of its facility in Camden, New Jersey, US. Holtec has contracted Mitsubishi Electric to develop the digital instrumentation and control systems for its SMR-160; Kiewit Power Constructors and Hyundai Engineering and Construction (Hyundai E&C) for civil construction in the US and abroad, respectively. Holtec is also collaborating with the Idaho National Laboratory (INL) to develop a plant simulator. In 2018, Holtec signed a MoU with NAEK Energoatom for the possible development of a manufacturing hub in Ukraine.

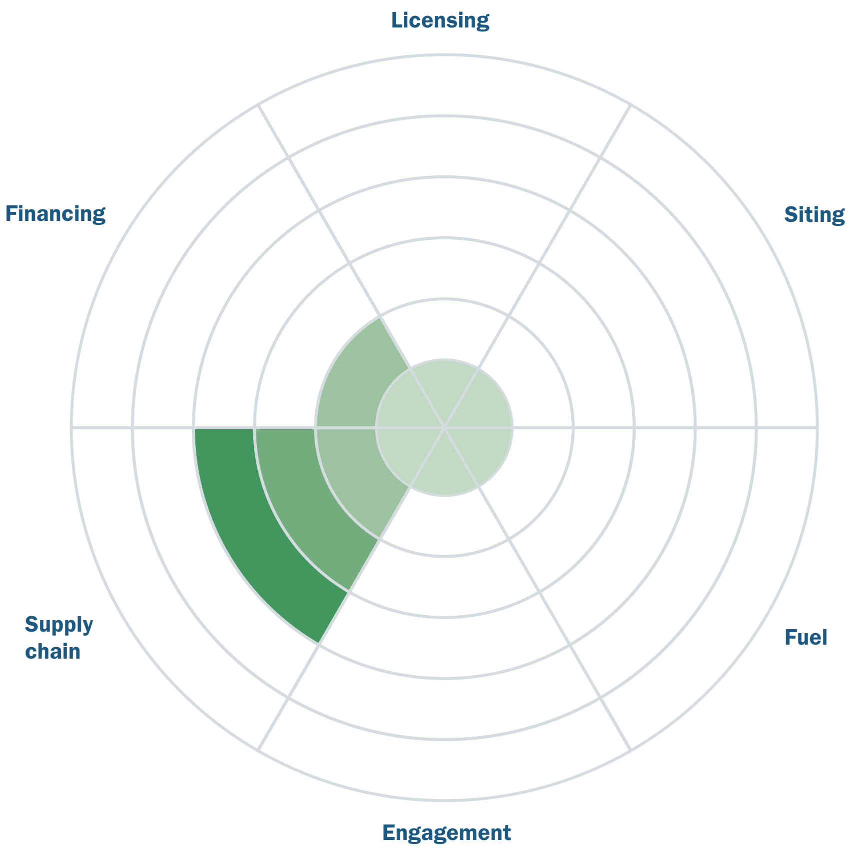
Engagement

In 2022, Joe Delmar and Pat O'Brien, Senior Director and Senior Manager of Holtec's Government Affairs and Communications division were invited to present Holtec's activities, including the development of the SMR-160, to Van Buren County Council, Michigan. In 2023, Gareth Thomas, Senior International Program Manager at Holtec International, appeared in the Southwest Public Policy Institute's podcast dedicated to SMRs.

Fuel

The SMR-160 uses Low-Enriched Uranium (LEU), the fuel used in most existing light water reactors. In 2018, Holtec International signed an MoU with Global Nuclear Fuel, a joint venture led by GE Hitachi Nuclear Energy, to develop nuclear fuel and control rod drive mechanisms for the SMR-160. In 2020, Hotlec signed a contract with Framatome, a French nuclear fuel manufacturer, to supply nuclear fuel for the SMR-160.

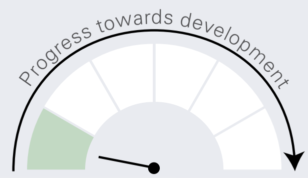
GTHTR300



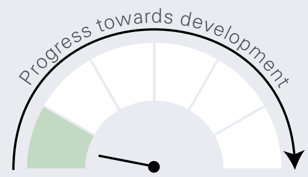
★ Active in multiple jurisdictions or countries.

Design organisation	Japan Atomic Energy Agency (JAEA)
Thermal power (MWth)	600
Outlet temperature (°C)	950
Spectrum (thermal/fast)	Thermal
Fuel type	TRISO prismatic
Fuel (LEU/HALEU/HEU)	HALEU

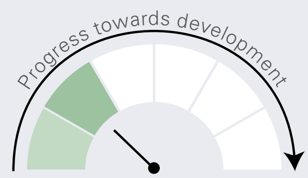
Licensing



Siting

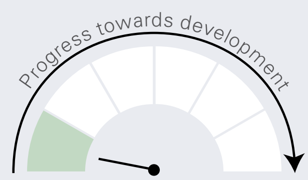


Financing

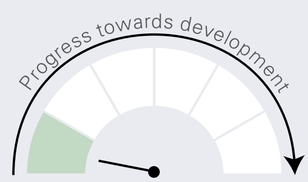


Supply chain

Engagement



Fuel



Assessment of GTHTR300's progress to deployment

Licensing

The Gas Turbine High Temperature Reactor (GTHTR300) was developed by the Japan Atomic Energy Agency (JAEA). JAEA's experience with the High Temperature Engineering Test Reactor (HTTR) helped the development of the GTHTR300. At the time of assessment, there was no information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

At the time of assessment, no information related to siting was readily available from any site owners.

Financing

The basic design for GTHTR300 was completed in 2003 by the JAEA with funding from the Ministry of Education, Culture, Sports, Science and Technology. At the time of assessment, no additional information about financing was readily available from verifiable public sources.

Supply chain

Mitsubishi Heavy Industries (MHI), Toshiba, IHI Corp, Fuji Electric, and domestic nuclear fuel industries in Japan have existing supply chain capabilities developed under the HTTR project.

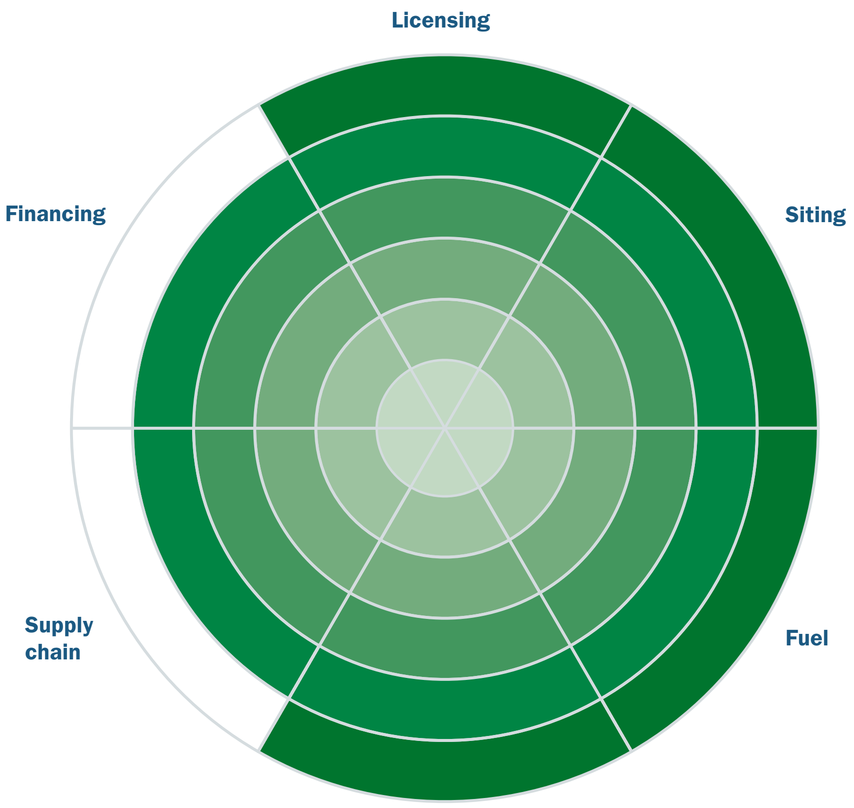
Engagement

At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

The GTHTR300 utilises High-Assay Low-Enriched Uranium (HALEU) fuel. HALEU is a technically proven fuel type; however, there is presently no commercial supply available from OECD countries. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

HTTR



★ Active in multiple jurisdictions or countries.

Design organisation	Japan Atomic Energy Agency (JAEA)
Thermal power (MWth)	30
Outlet temperature (°C)	950
Spectrum (thermal/fast)	Thermal
Fuel type	TRISO prismatic
Fuel (LEU/HALEU/HEU)	LEU, HALEU

Licensing

Siting

Financing

Supply chain

Engagement

Fuel

Assessment of HTTR's progress to deployment

Licensing

The High Temperature Engineering Test Reactor (HTTR) is an operating 30 MWth high-temperature gas-cooled reactor built to advance technology readiness and demonstrate high-temperature nuclear heat application systems. The HTTR is fully licensed by the Nuclear Regulatory Authority (NRA) in Japan. The HTTR started operating in 1998.

Siting

The HTTR is currently operating at a Japan Atomic Energy Agency (JAEA) site in Oarai, Ibaraki Prefecture.

Financing

The one-of-a-kind HTTR is operating and has been fully financed.

Supply chain

Construction of the one-of-a-kind HTTR finished in 1997. The construction was led by Toshiba, Hitachi, Fuji Electric and Mitsubishi Heavy Industries (MHI), with MHI as the managing company. The JAEA is also working with MHI on a project commissioned by the Ministry of Economy, Trade and Industry's Agency for Natural Resources and Energy to use the HTTR for the mass production of hydrogen.

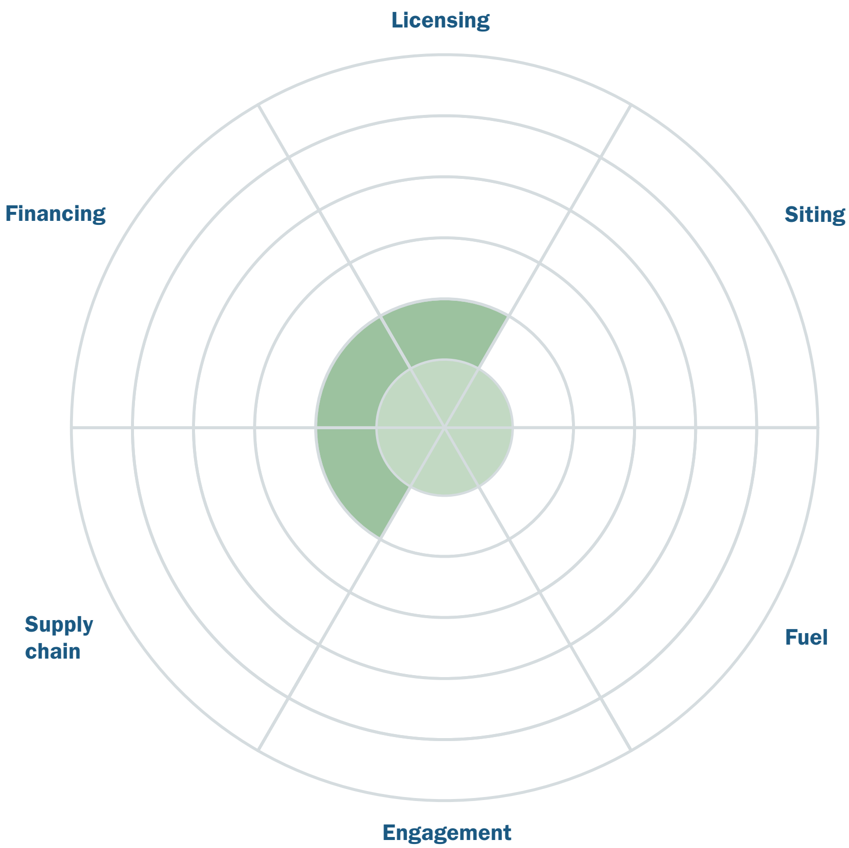
Engagement

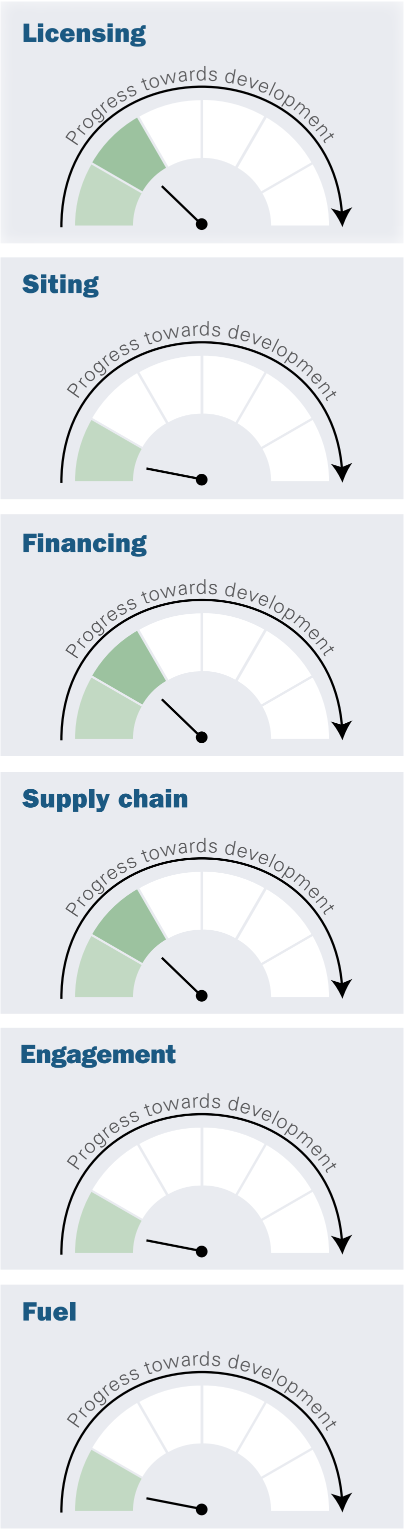
JAEA regularly hosts "Open Lab" events at its sites, including the Oarai site where the HTTR is operating, during which the general public is invited to tour the laboratories and discuss their questions. With hundreds of Open Lab events, the JAEA has engaged with thousands of members of the general public on its nuclear science and technology programme including the HTTR. In addition, JAEA Oarai staff regularly deliver science lectures for the general public, including discussion about the capabilities of their laboratories and the HTTR. The JAEA also regularly makes presentations and participates in discussions during meetings of the local government through the Ibaraki Prefecture Nuclear Safety Committee.

Fuel

The HTTR started operating in 1998 and receives its fuel from Nuclear Fuel Industries (NFI), Japan.

Jimmy





★ Active in multiple jurisdictions or countries.

Design organisation	Jimmy Energy
Thermal power (MWth)	10
Outlet temperature (°C)	550
Spectrum (thermal/fast)	Thermal
Fuel type	Uranium Oxycarbide (UCO) TRISO prismatic
Fuel (LEU/HALEU/HEU)	HALEU

Assessment of Jimmy's progress to deployment

Licensing

Jimmy is a 10 MWth gas-cooled micro reactor dedicated to the production of industrial process heat. In May 2022, the Autorité de Sûreté Nucléaire (ASN) and the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) started a preliminary pre-licensing analysis of Jimmy's Dossier d'Options de Sûreté (DOS) (*safety options file*). The IRSN, the primary entity providing technical analytical support to ASN, completed and published its analysis in September 2022.

Siting

At the time of assessment, no information related to siting was readily available from any site owners.

Financing

Jimmy Energy raised more than EUR 17 million (USD 20.1 million) in private sector financing during 2022 from investors that included Eren Group, Noria, Otium Capital, and Polytechnique Ventures. Jimmy Energy was one of the 127 awardees of the BPI France 2021-2022 competition for innovation under the i-Nov programme, which co-finances start-ups for up to EUR 5 million (USD 5.9 million). Jimmy Energy was also one of the awardees for the second edition of the French Tech Green20 programme, a government sponsored start-up incubator.

Supply chain

Jimmy Energy is a member of the Nuclear Valley network, a group of more than 400 companies involved in the French nuclear supply chain.

Engagement

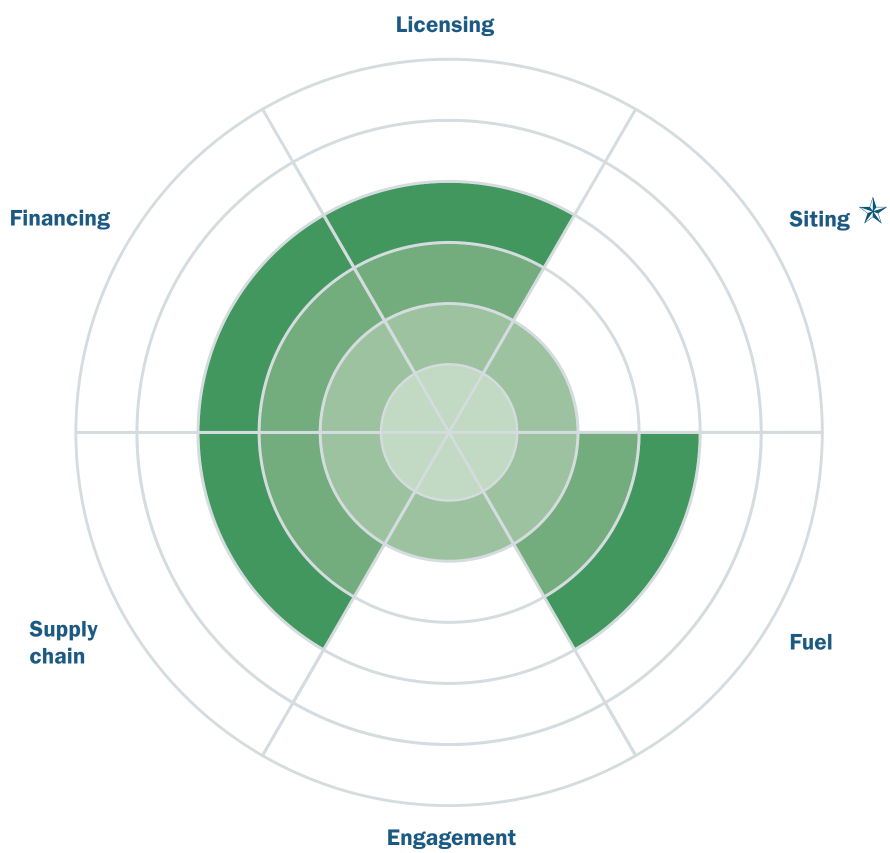
At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

High-Assay Low-Enriched Uranium (HALEU) is a technically proven fuel type; however, there is presently no commercial supply available from OECD countries. Additionally, TRi-structural ISOtropic (TRISO) fuel, has been tested since 1960 in US national laboratories. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of EUR 0.845 equals the price of USD 1.000.

SMART

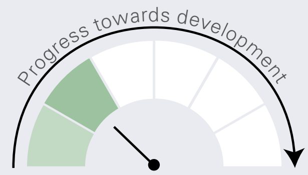


★ Active in multiple jurisdictions or countries.

Design organisation	Korea Atomic Energy Research Institute (KAERI)
Thermal power (MWth)	365
Outlet temperature (°C)	322
Spectrum (thermal/fast)	Thermal
Fuel type	UO_2 pellets
Fuel (LEU/HALEU/HEU)	LEU

Licensing

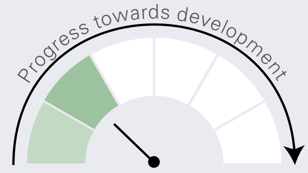
Siting ★



Financing

Supply chain

Engagement



Fuel

Assessment of SMART's progress to deployment

Licensing

The System-integrated Modular Advanced ReacTor (SMART) SMR developed by the Korea Atomic Energy Research Institute (KAERI) is a 365 MWth land-based pressurised light water reactor. KAERI received a Standard Design Approval for the SMART SMR from the Korean Nuclear Safety and Security Commission (NSSC) in 2012.

Siting ☆

In 2015, KAERI signed a Memorandum of Understanding (MoU) with King Abdullah City for Atomic and Renewable Energy (K.A.CARE) in Saudi Arabia to assess the potential of siting multiple SMART SMRs at K.A.CARE. In 2023, KAERI signed a MoU with the Government of Alberta, Canada to collaborate on the possible deployment of SMART SMR technology in the Canadian province.

Financing

The Government of Korea, Korea Electric Power Corporation (KEPCO), and various others, including POSCO, Daewoo and STX Heavy Industries have contributed KRW 310 billion (USD 270.9 million) in financing the development of the SMART SMR plus an additional KRW 170 billion (USD 148.6 million) to support the Standard Design Approval process. In 2015, the South Korean Ministry of Science and ICT announced that KAERI was partnering with K.A.CARE on pre-project engineering (PPE) to construct SMART units in Saudi Arabia, supported by investments by the two partners totalling USD 130 million (USD 100 million from Saudi Arabia and USD 30 million from South Korea).

Supply chain

KAERI and K.A.CARE have established the joint venture "SMART EPC". Korea Hydro & Nuclear Power (KHNP) is leading this project, which intends to involve both Korean and Saudi enterprises. KHNP also signed an MoU with KEPCO Engineering & Construction (E&C) to jointly develop SMART units in Saudi Arabia. For the SMART reactor: KEPCO E&C and POSCO conducted the balance of plant design; KEPCO Nuclear Fuel designed the fuel; Hyosung Goodsprings developed the reactor coolant pumps and conducted reactor coolant pump performance testing; BHI designed the fuel handling system; Soosan ENS verified the reactor protection system and engineered the safety feature component control system; and Doosan Enerbility is providing design and engineering services for major components.

Engagement

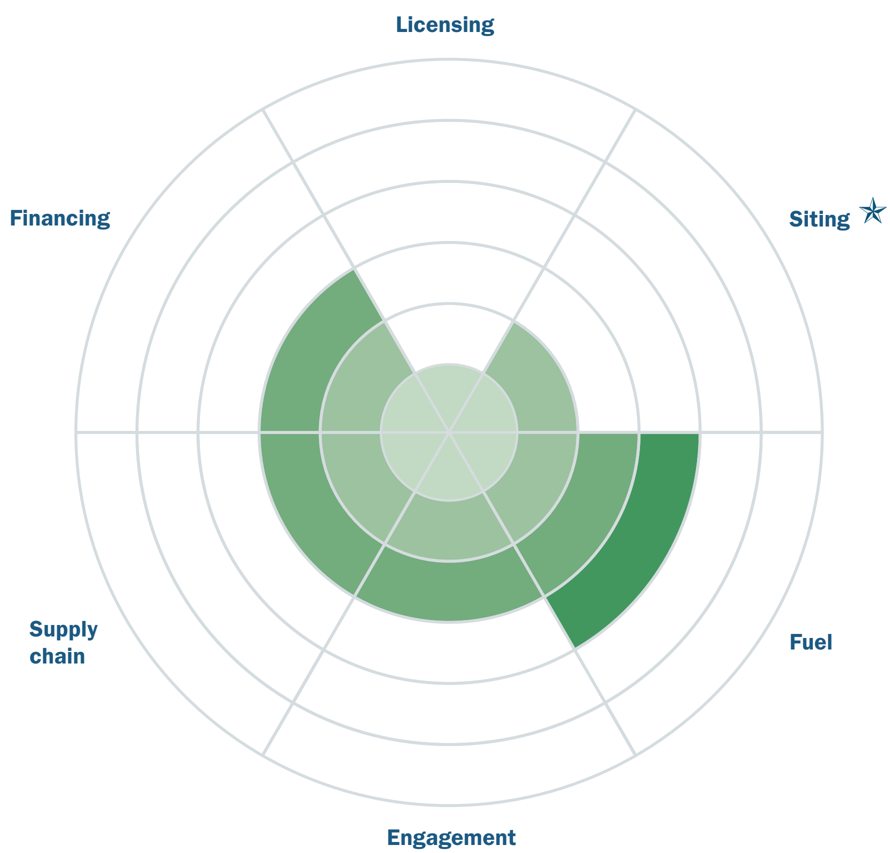
The Korea Atomic Energy Cultural Foundation and KAERI signed an MoU to collaborate on enhancing public understanding and awareness of nuclear technology, including the SMART SMR, in 2009. KAERI and Government of Alberta signed an MoU to utilise SMRs, including SMART, for emissions reduction in Alberta.

Fuel

SMART utilises the same fuel as the current industry standard for similar design water-cooled reactor technologies. Given this, no barriers are expected in the fuel supply chain for this SMR.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of KRW 1 143.952 equals the price of USD 1.000.

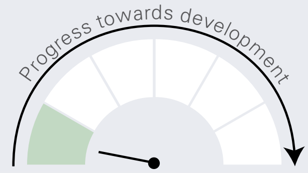
PWR-20



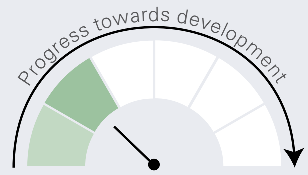
★ Active in multiple jurisdictions or countries.

Design organisation	Last Energy
Thermal power (MWth)	60
Outlet temperature (°C)	300
Spectrum (thermal/fast)	Thermal
Fuel type	UO_2 pellets
Fuel (LEU/HALEU/HEU)	LEU

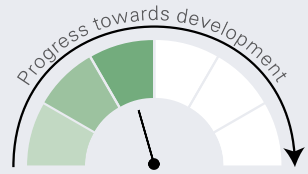
Licensing



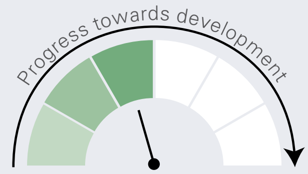
Siting ★



Financing



Supply chain



Engagement

Fuel

Assessment of PWR-20's progress to deployment

Licensing

The PWR-20 is a land-based micro SMR based on conventional pressurised light water reactor designs. At the time of assessment, there was no information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting ✫

In 2022, the Prime Minister of Romania announced the intention to demonstrate and deploy the Last Energy SMR in collaboration with the state-owned Regia Autonomă Tehnologii pentru Energia Nucleară (RATEN) (*Technologies for Nuclear Energy State Owned Company*) at their nuclear site in Mioveni. In 2022 and 2023, Last Energy signed agreements with site owners in Poland, including: virtual Power Purchase Agreements (PPAs) with the Katowice and the Legnica Special Economic Zones; and Letters of Intent for the deployment of PWR-20 in Poland with the Polish energy group Enea. In 2023 Last Energy also signed three PPAs in the UK. These include one virtual PPA and two physical PPAs.

Financing

Last Energy has received USD 24 million in venture capital funding in two rounds: USD 3 million in a first round in 2020 led by First Round Capital; and USD 21 million in a second round led by Gigafund. Last Energy has also signed four PPAs with industrial partners in Poland and the UK, including a data centre and hydrogen production capacity. The PPAs set out that an estimated USD 18.9 billion in revenue could be generated from 34 PWR-20 SMRs over 24 years.

Supply chain

Last Energy plans to use pre-existing supply chains to the maximum extent possible, make use of off-the-shelf components wherever possible to minimise supply chain and construction risks. The design is based on modular manufactured units. In 2022, Last Energy contracted Hydrock, a UK energy consultancy, for a strategic review of the key components in the PWR-20 safety case. Last Energy has also worked with Atkins and Wood in the development of the PWR-20 project. A mechanical demonstration of the PWR-20 nuclear island was built in January 2023 in Brookshire, Texas, United States. Last Energy has joined Britain's Energy Coast Business Cluster (BECBC), a membership organisation for the clean energy and nuclear decommissioning supply chain, to facilitate sourcing local content for projects in the UK and Europe.

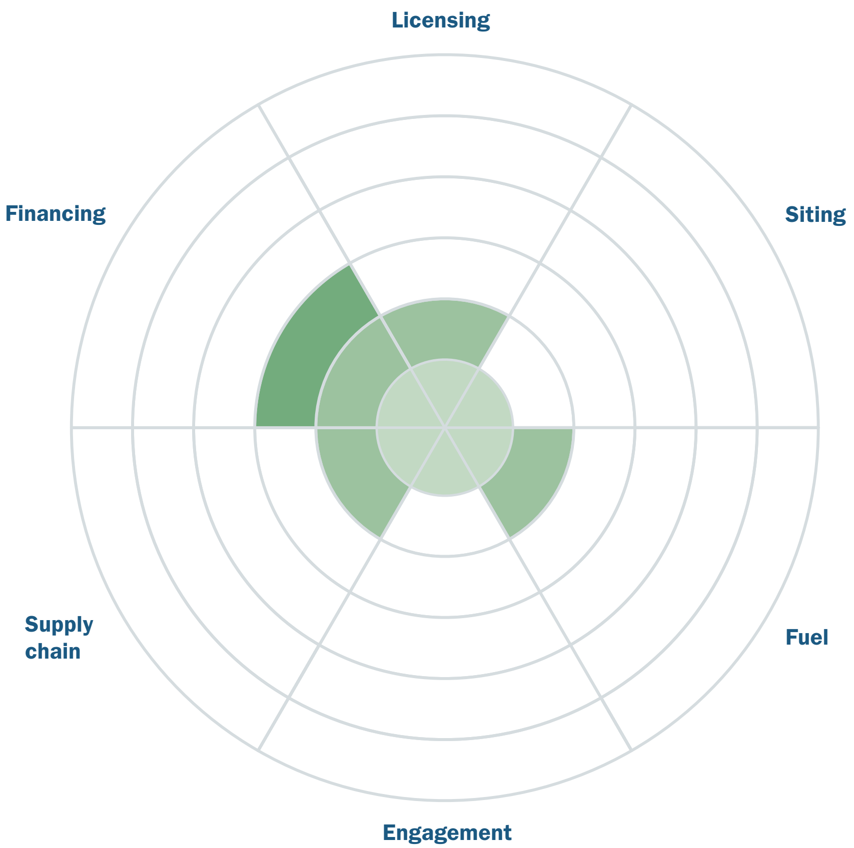
Engagement

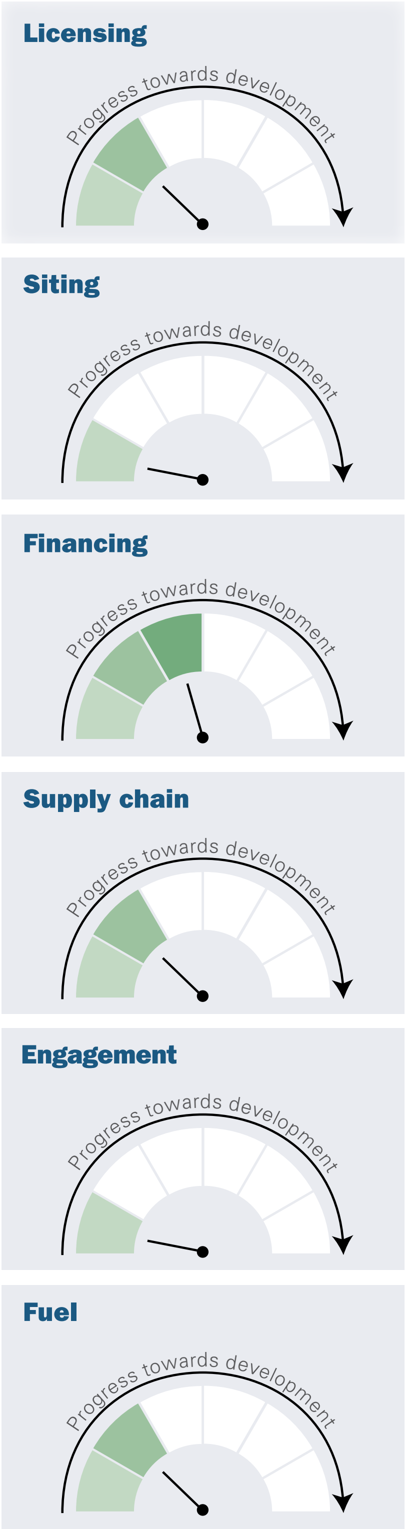
Last Energy has received endorsements from local and federal governments in Poland and Romania. Prime Minister Nicolae Ciuca of Romania announced his government's intention to collaborate on the demonstration and deployment of the Last Energy PWR-20. Alongside the Prime Minister, Enea's CEO, Pawel Majewski, highlighted the potential positive impact of deploying the PWR-20 for the Polish economy. In 2022, Last Energy testified in front of the UK Parliamentary Science and Technology Committee on modular manufacturing techniques. In the Netherlands, Last Energy is a member of the Limburg Alliance, a regional alliance created by local authorities to assess the benefits of SMRs.

Fuel

The PWR-20 SMR plans to use fuel that is the current industry standard for water-cooled reactor technologies of similar design. There are no barriers expected in the fuel supply chain for this SMR.

LFR AS 200





★ Active in multiple jurisdictions or countries.

Design organisation	*new*cleo
Thermal power (MWth)	480
Outlet temperature (°C)	530
Spectrum (thermal/fast)	Fast
Fuel type	MOX
Fuel (LEU/HALEU/HEU)	Uranium oxide and plutonium

Assessment of LFR AS 200's progress to deployment

Licensing

The *new*cleo LFR AS 200 is a 480 MWth fast spectrum, lead-cooled reactor using Mixed-oxide (MOX) fuel. *new*cleo Ltd proposes a three-step approach for the deployment of its LFR AS 200 SMR, beginning with the construction of an electrical prototype in Italy, following by the development of a first-of-a-kind mini 30 MWe LFR in France, before deploying the LFR AS 200 in the United Kingdom. In January 2023, *new*cleo submitted the LFR AS 200 design to the UK Generic Design Assessment (GDA) Entry process.

Siting

At the time of assessment, no information related to siting was readily available from any site owners for the *new*cleo LFR AS 200.

Financing

By mid-2022 *new*cleo had raised EUR 300 million (USD 355 million), with the first EUR 118 million (USD 139.6 million) having been secured as initial capital in 2021 alongside its acquisition of Hydromine Nuclear Energy. As of mid-2022 the company had hired approximatively 100 staff, mainly nuclear physicists and engineers.

Supply chain

In Italy, *new*cleo is engaged with the Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA) (*National Agency for New Technologies, Energy and Sustainable Economic Development*) to develop an electrical prototype of the lead-cooled fast reactor to study its thermo-dynamic, mechanical and functional performance. *new*cleo is also collaborating with the Italian energy group Enel, which is sharing its expertise on advanced nuclear technologies in exchange for an option to invest in the first *new*cleo nuclear power plant. In France, *new*cleo is a member of the Nuclear Valley network, a group of more than 400 firms involved in the French nuclear supply chain.

Engagement

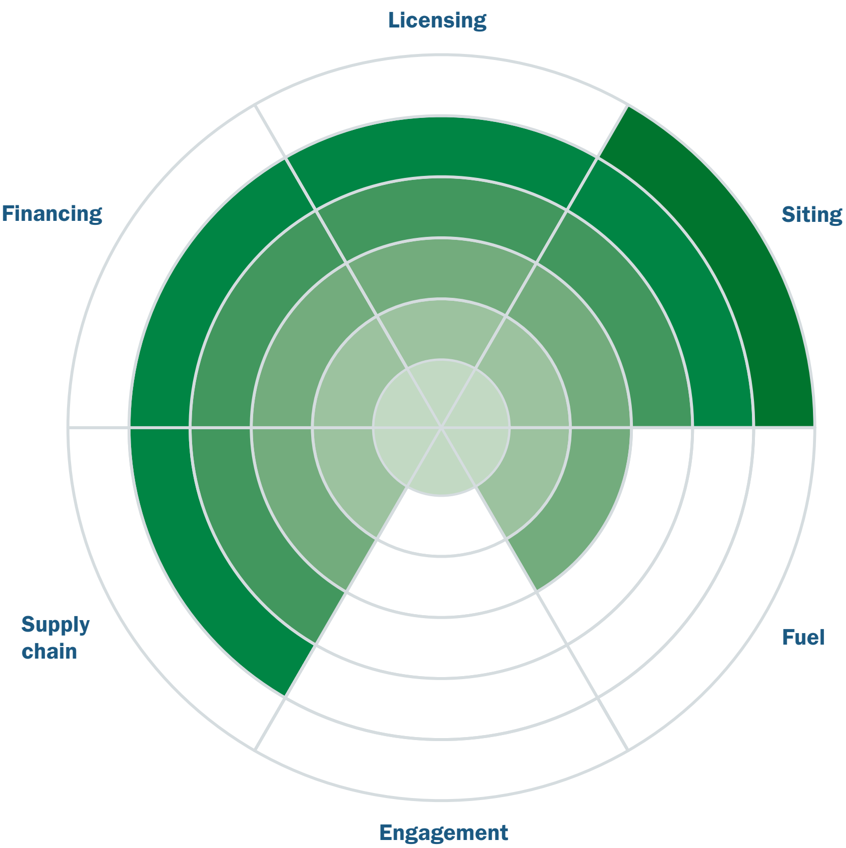
At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

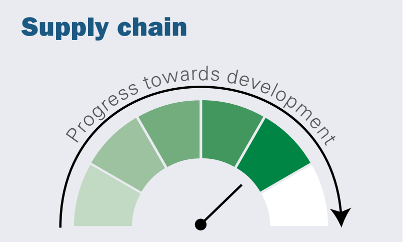
Fuel

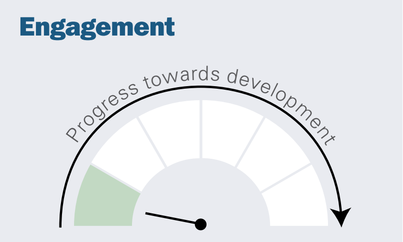
*new*cleo will use mixed plutonium-uranium oxide fuel. Mixed plutonium-uranium oxide fuel is a technically proven fuel type; however, there are presently limited suppliers – in particular for fast reactors. *new*cleo has contracted Orano for feasibility studies related to the possible new production of mixed plutonium-uranium oxide fuel.

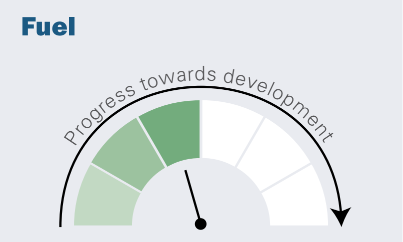
Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of EUR 0.845 equals the price of USD 1.000.

BREST-OD-300









☆ Active in multiple jurisdictions or countries.

Design organisation	N.A. Dollezhal Research and Design Institute of Power Engineering (NIKIET)
Thermal power (MWth)	700
Outlet temperature (°C)	540
Spectrum (thermal/fast)	Fast
Fuel type	Mixed uranium-plutonium nitride (MNUP) fuel
Fuel (LEU/HALEU/HEU)	Natural or depleted uranium and plutonium

Assessment of BREST-OD-300's progress to deployment

Licensing

The Brest-OD-300, designed by N.A. Dollezhal Research and Design Institute of Power Engineering (NIKIET), is a lead-cooled fast reactor demonstration unit of one of the technologies that Rosatom has selected for its "Waste-free Atom" strategy. The Rosatom strategy seeks to deploy a mix of thermal and fast spectrum reactors to close the nuclear fuel cycle. A licence to construct the BREST-OD-300 was issued by the Russian nuclear regulator Rostechnadzor in February 2021.

Siting

Construction of the BREST-OD-300 started in 2021 at the Siberian Chemical Combine site in Seversk, Russia. The BREST-OD-300 demonstration reactor at this site is part of the larger "Proryv" (Breakthrough) Project. The Proryv project seeks to advance Rosatom's strategy to close the nuclear fuel cycle by co-locating thermal and fast spectrum reactors. Within the project, the Siberian Group of Chemical Enterprises (SGChE) will create a pilot demonstration energy complex (PDEC) to potentially introduce new technologies for the recycling of nuclear materials, which could expand the nuclear sector's raw material base while reducing the volumes of waste generated by the industry.

Financing

In 2010, the Russian government announced RUB 110 billion (USD 1.5 billion) over 10 years, which included RUB 60 billion (USD 800 million) for fast spectrum reactors including the BREST-OD-300. In 2021, the government approved a project cost of RUB 506 billion (USD 6.9 billion) for new nuclear technologies by 2030, including BREST-OD-300. In 2022, the government announced RUB 100 billion (USD 1.4 billion) for new nuclear technologies including the BREST-OD-300. The government has approved RUB 64.2 billion (USD 900 million) for the Proryv project, which includes the BREST-OD-900.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of RUB 73.654 equals the price of USD 1.000.

Supply chain

Construction of the BREST-OD-300 reactor began in June 2021. The SGChE is responsible for building the pilot demonstration power complex. The Siberian Chemical Combine (SCC) a subsidiary of Rosatom's fuel company TVEL, contracted the Concern Titan-2 engineering company for RUB 26.3 billion (USD 400 million) to undertake construction and installation works. As of early 2023, CKBM (a subsidiary of the Rosatom machine-building unit Atomenergomash) had started assembling the main circulation pump prototype. ZiO-Podolsk (part of Rosatom's machine-building unit) will provide and install the steam generators for the reactor facility.

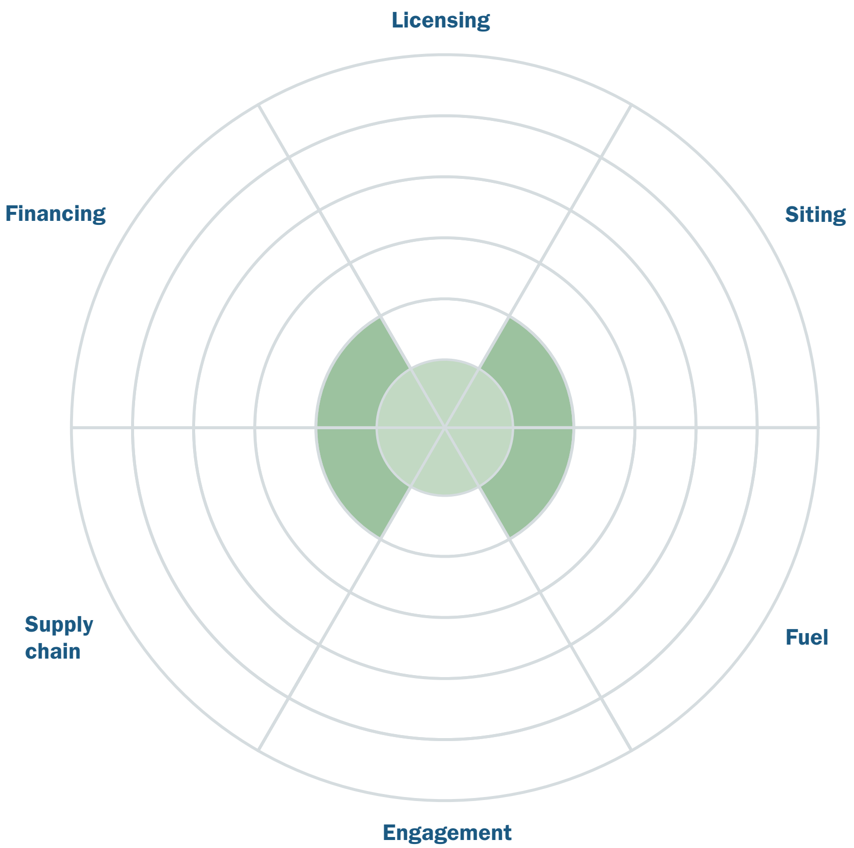
Engagement

At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

The BREST-OD-300 proposes to use novel, specially developed, mixed uranium-plutonium nitride (MNUP) fuel, which will require validation. In 2021, the Siberian Chemical Combine was making test batches of MNUP fuel as prototype fuel for the BREST-OD-300. A fuel fabrication plant is planned to be built alongside the BREST-OD-300 as part of the "Proryv" Project. It is planned to be completed by the end of 2023 with an irradiated fuel reprocessing module planned to have started construction by the end of 2024 on the same site. SCC is continuing the construction of the MNUP fuel fabrication and re-fabrication module as part of the PDEC pilot demonstration power complex. The SCC also signed a contract with CKBM for manufacturing and supply of equipment for the refuelling complex.

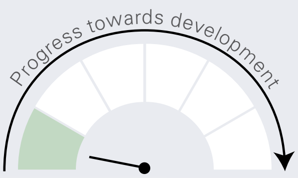
Kaleidos



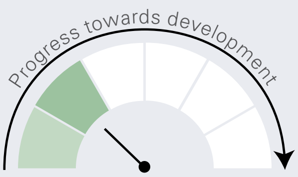
★ Active in multiple jurisdictions or countries.

Design organisation	Radiant
Thermal power (MWth)	1.9
Outlet temperature (°C)	700
Spectrum (thermal/fast)	Thermal
Fuel type	TRISO prismatic
Fuel (LEU/HALEU/HEU)	HALEU

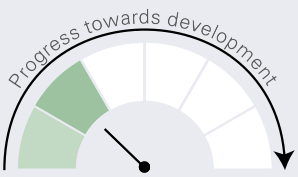
Licensing



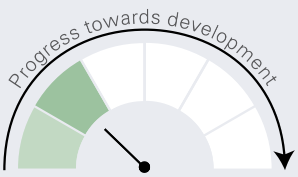
Siting



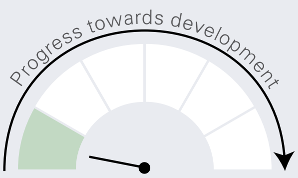
Financing



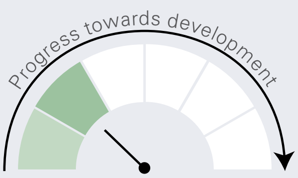
Supply chain



Engagement



Fuel



Assessment of Kaleidos' progress to deployment

Licensing

Kaleidos is a mobile, micro 1.2 MWe high-temperature gas reactor. As part of the 2023 US Congressional Budget Justification, the US Nuclear Regulatory Commission indicated that they expect to review the licence application for the Radiant demonstration micro reactor during the 2024 fiscal year. At the time of assessment, there was no additional information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

National Reactor Innovation Center, a US Department of Energy (DOE) programme led by the Idaho National Laboratory (INL), has reported that it is working with Radiant to consider the possible demonstration of the Kaleidos micro reactor at the INL's Demonstration of Microreactor Experiments (DOME) facility in Idaho, United States.

Financing

Radiant has secured public and private sector financing in support of the Kaleidos micro reactor. This includes more than USD 10 million in private financing and two awards through the US Small Business Innovation Research programme totalling nearly USD 250 000 to support modelling and simulation capabilities.

Supply chain

Radiant has been awarded two vouchers under the US DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative to advance modelling capabilities for their proposed reactor concept in partnership with both the INL and Argonne National Laboratory.

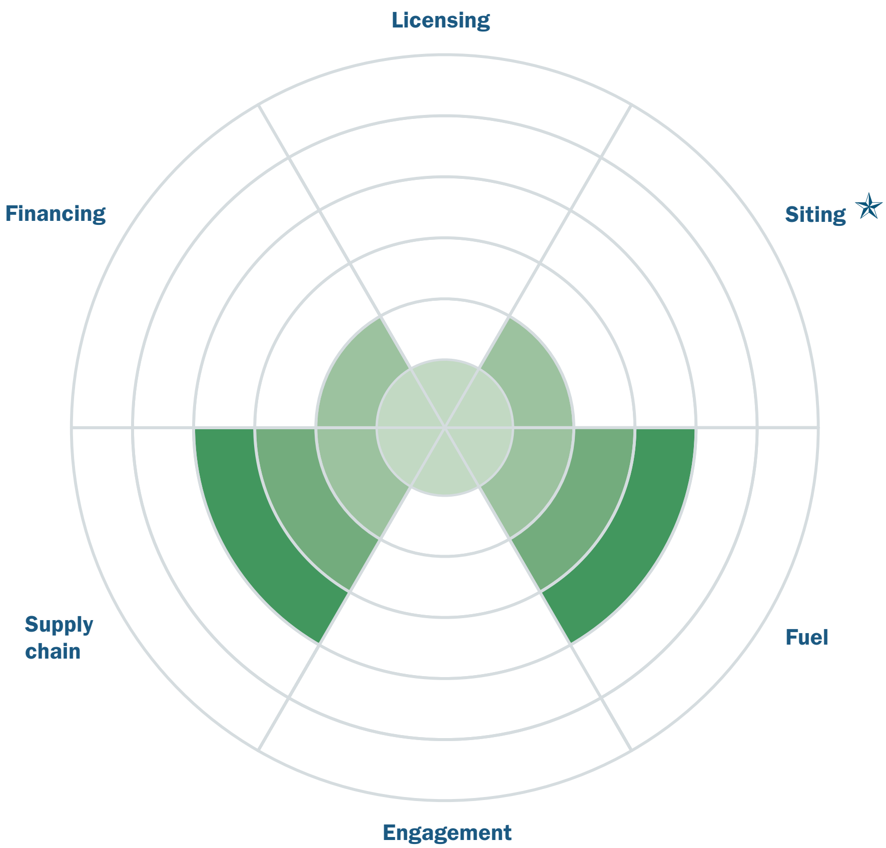
Engagement

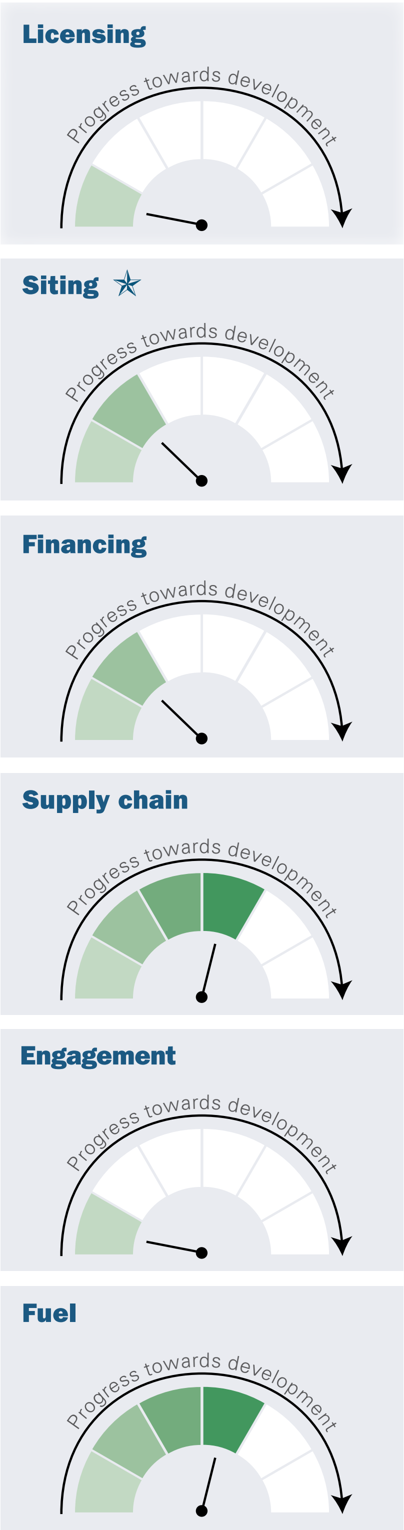
At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

Kaleidos intends to use High-Assay Low-Enriched Uranium (HALEU) TRi-structural ISOtropic (TRISO) fuel. HALEU is a technically proven fuel type; however, there is presently no commercial supply available from OECD countries. In 2022, Radiant launched a Request for Proposals for fuel fabricators to produce TRISO fuel, and in 2023 the company entered into an agreement with Centrus Energy to work towards identifying a path to provide a future supply of HALEU for up to 20 Kaleidos micro reactors.

RITM-200M





★ Active in multiple jurisdictions or countries.

Design organisation	Rosatom
Thermal power (MWth)	198
Outlet temperature (°C)	318
Spectrum (thermal/fast)	Thermal
Fuel type	UO_2 pellets
Fuel (LEU/HALEU/HEU)	HALEU

Assessment of RITM-200M's progress to deployment

Licensing

The RITM-200M SMR designed by Rosatom, Russia's State Atomic Energy Corporation, is a floating SMR in the RITM-200 series. Six RITM-200 units are already licensed and in operation on dual-draft icebreakers – two each on the icebreaker ships Arktika, Sibir and Ural. Licensing for the floating RITM-200M will benefit from Rosatom's prior experience in licensing and operation of the RITM-200 SMRs on icebreakers. At the time of assessment, there was no additional information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting ✭

In 2019, Rosatom signed a Memorandum of Intent with the Ministry of Energy in the Philippines to conduct a preliminary feasibility study on the possible deployment of an RITM-200M. In 2023 the Director General of Rosatom indicated that Rosatom is working in co-operation with the government of Myanmar on the possible deployment of an RITM-200M in Myanmar. In 2023, Russia and Myanmar signed an intergovernmental agreement on co-operation in peaceful nuclear power, which included RITM SMRs.

Financing

In 2021, the Russian government approved a project cost of RUB 506 billion (USD 6.9 billion) for new nuclear technologies by 2030, which includes the RITM-200M. In 2022, the Russian government announced that the government would invest RUB 100 billion (USD 1.4 billion) in new nuclear technologies, including the RITM-200M.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of RUB 73.654 equals the price of USD 1.000.

Supply chain

Rosatom has significant experience and capabilities in nuclear power development, engineering, procurement, and construction, including with the deployment of several RITM-200 units for icebreakers. As RITM-200M is a floating SMR within the RITM-200 series, it is expected that the RITM-200M supply chain will benefit significantly from the work on the other RITM-200 series SMRs.

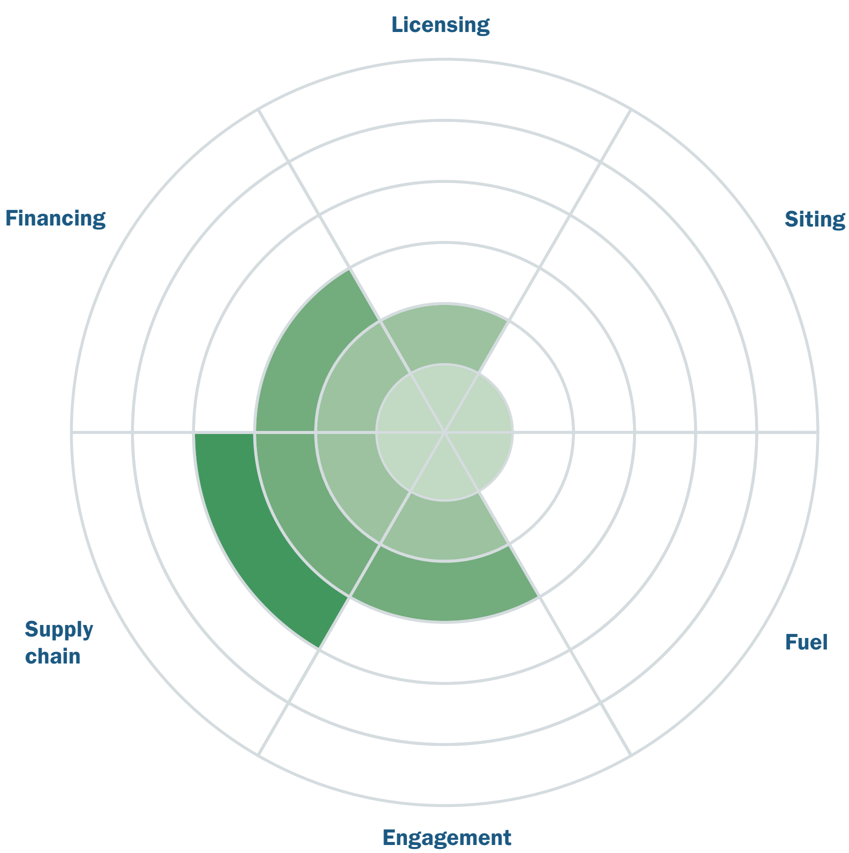
Engagement

At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

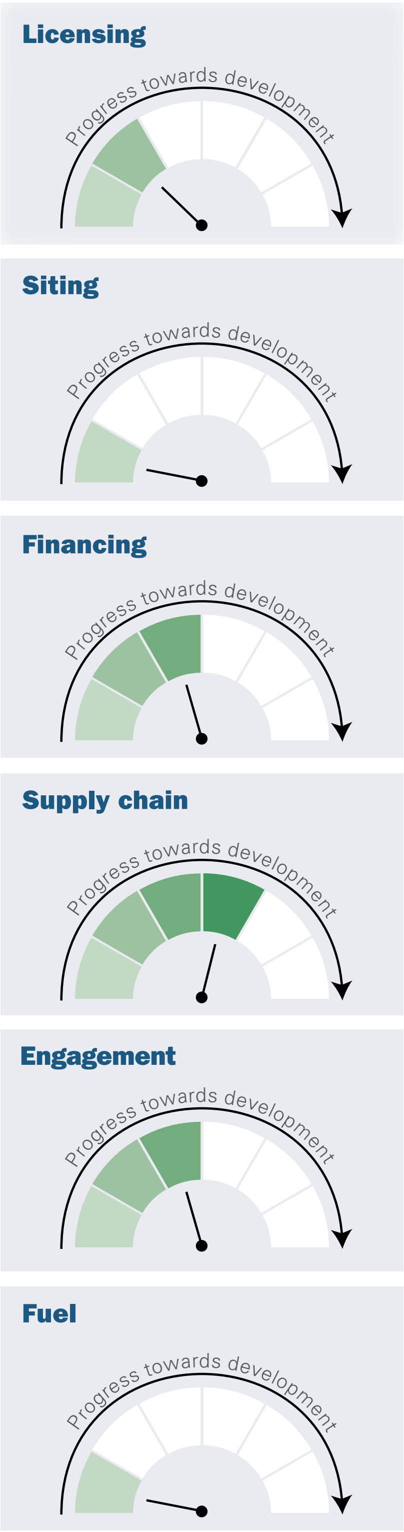
The RITM-200M is designed to use High-Assay Low-Enriched Uranium (HALEU) fuel enriched to less than 20%. Russia has existing capabilities to produce HALEU fuel on a commercial scale. The floating RITM-200M shares aspects of the fuel design for the RITM-200 series SMRs, and is expected to leverage the same fuel supply chain. Compared to the RITM-200S, which requires refuelling every 5 years, the RITM-200M requires refuelling over a period of up to 10 years. Fuel elements for the RITM-200 series reactors have been designed and developed by specialists at the Bochvar Research Institute of Inorganic Materials, part of the Russian fuel manufacturer TVEL, which supplies nuclear fuel to all Russian nuclear power plants, including marine-based reactors.

CMSR



★ Active in multiple jurisdictions or countries.

Design organisation	Seaborg Technologies
Thermal power (MWth)	250
Outlet temperature (°C)	670
Spectrum (thermal/fast)	Thermal
Fuel type	Molten salt
Fuel (LEU/HALEU/HEU)	LEU



Assessment of CMSR's progress to deployment

Licensing

The Seaborg Compact Molten Salt Reactor (CMSR) is a multi-module, molten salt SMR for deployment on a non-self-propelled power barge. Seaborg has been advancing qualification activities with respect to the international maritime legal framework. The American Bureau of Shipping (ABS) evaluated the CMSR through its New Technology Qualification process and in 2020 found that it satisfied the Feasibility Stage, the first of five phases. In 2022, ABS issued an Approval in Principle to South Korean shipbuilder Samsung Heavy Industries for the use of the CMSR on a power barge. The CMSR will require separate licensing from a nuclear safety regulator. At the time of assessment, there was no information readily available from verifiable public sources related to engagement with nuclear safety regulators.

Siting

Seaborg conducted a joint study with Siemens Energy and Vietnamese power engineering consultancy PECC2 to explore the requirements for deploying floating nuclear power plants in Viet Nam, which included the preparation of a Strategic Environmental Assessment and the identification of potential sites to deploy an CMSR power barge. Seaborg has a draft MoU with the Philippines Nuclear Research Institute related to the potential deployment of the CMSR in the Philippines. Seaborg has also engaged with the Badan Tenaga Nuklir Nasional (BATAN) (Indonesian National Atomic Energy Agency) to explore the potential construction of an CMSR in Indonesia. At the time of assessment, no information related to siting was readily available from any site owners.

Financing

Seaborg Technologies has received private and public sector funding to advance its CMSR and related technologies. In 2018, Seaborg raised DKK 11.5 million (USD 1.83 million) in venture financing, including from PreSeed Ventures – whose shares were later acquired by HEARTLAND. In 2020, the company secured two loans from the Danish state's investment fund Vaekstfonden, and announced that they had secured USD 24 million in private funding from a range of investors to accelerate the deployment of its CMSR technology. In 2022, the European Innovation Council (EIC) provided a EUR 2.5 million (USD 2.96 million) grant and committed EUR 15 million (USD 17.8 million) in equity through the 2022 EIC Accelerator programme.

Supply chain

In April 2023, Seaborg joined a consortium with Korea Hydro & Nuclear Power and Samsung Heavy Industries (SHI). SHI completed the conceptual design for the CMSR Power Barge in January 2023. Seaborg is working with the Technical University of Denmark (DTU) to explore corrosion induced by molten sodium hydroxide. Seaborg is also advancing research with the ISIS Neutron and Muon Source near Oxford in the United Kingdom and the European Spallation Source research centre in Sweden. Through the European Commission ERA-LEARN programme, Seaborg is working with DTU, the Chalmers University of Technology in Sweden, and others to develop multi-physics software. In May 2022, Seaborg signed an MoU with Best Engineering in Energy Solutions Inc. for regulatory support services.

Engagement

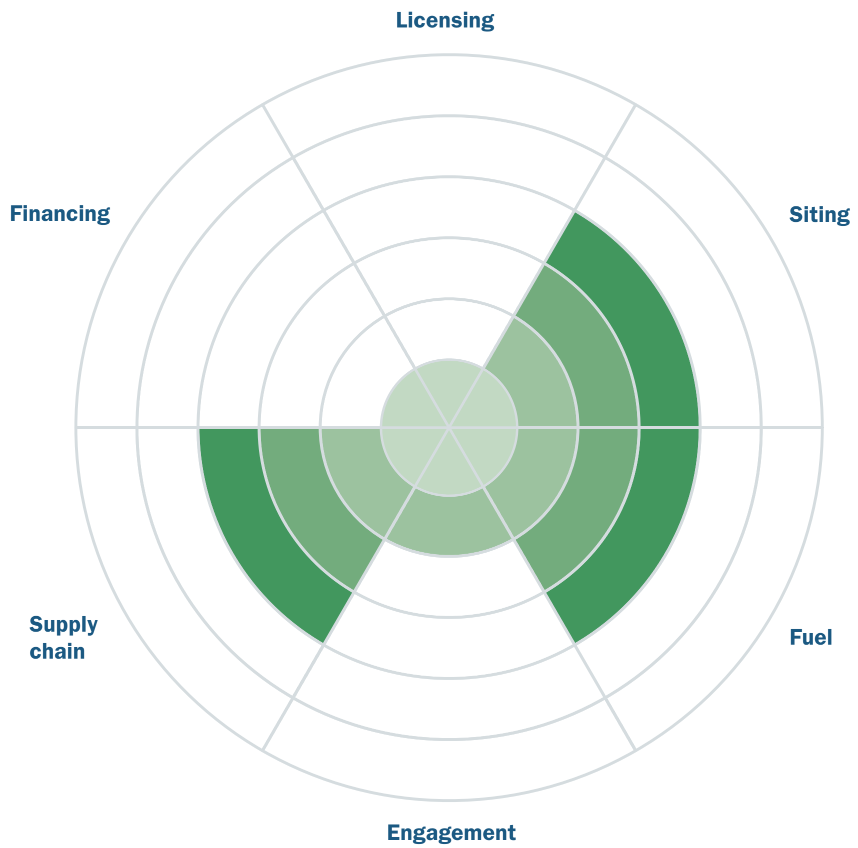
Seaborg has joined the coal-to-nuclear REPOWER initiative lead by NGO TerraPraxis. Seaborg founders have also taken steps to reach public audiences beyond the nuclear sector, for example through interviews in the *Harvard Business Review*-hosted podcast in March 2022, with Azeem Azhar, Korea's Arirang News media outlet, as well as a TEDx presentation in 2019.

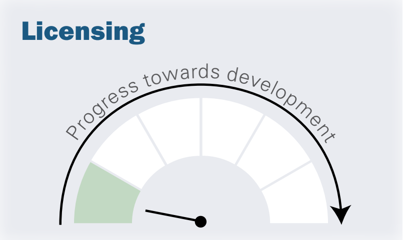
Fuel

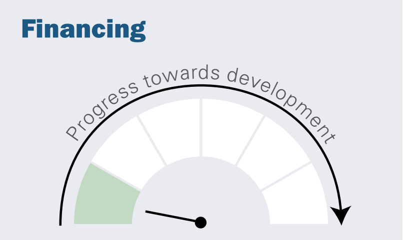
The CMSR proposes to use LEU in a molten salt, which will be a blend of UF_4 LEU with sodium and potassium fluoride salts. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

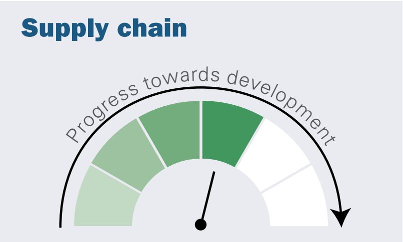
Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of DKK 6.287 equals the price of USD 1.000 and EUR 0.845 equals the price of USD 1.000.

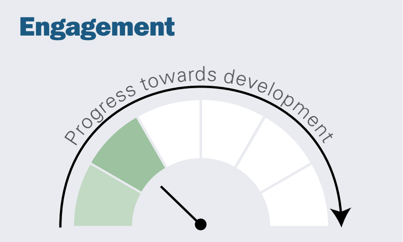
HAPPY200

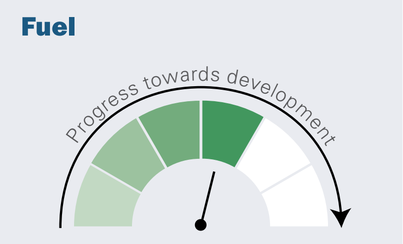












★ Active in multiple jurisdictions or countries.

Design organisation	State Power Investment Corporation (SPIC)
Thermal power (MWth)	200
Outlet temperature (°C)	120
Spectrum (thermal/fast)	Thermal
Fuel type	UO_2 pellets
Fuel (LEU/HALEU/HEU)	LEU

Assessment of HAPPY200's progress to deployment

Licensing

HAPPY200, designed by the State Power Investment Corporation of China (SPIC), is a low-temperature, low-pressure light water reactor. At the time of assessment, there was no information readily available from verifiable public sources related to ongoing licensing or pre-licensing activities.

Siting

In 2019, the HAPPY200 was selected for the Nuclear Energy Heating Demonstration Project in Baishan in Jilin province of the People's Republic of China (China), which could provide heating for an area over 80 square kilometres. This technology selection decision builds on a co-operation agreement that was signed earlier in 2019 between China's State Power Investment Corporation (SPIC) and the municipal government of the city of Baishan to explore the deployment of the HAPPY200 in Baishan. The site for the Baishan Nuclear Energy Heating Project was selected in September 2018.

Financing

At the time of assessment, no information about financing was readily available from verifiable public sources.

Supply chain

In 2015 China Power Investment Corporation and the State Nuclear Power Technology Corporation merged to form SPIC. SPIC is an integrated energy organisation and performs nuclear supply chain roles associated with the development of the HAPPY200 SMR. This includes research, design and manufacturing of nuclear power components and equipment, as well as construction, operation, and management activities. The State Power Investment Corporation signed a general contracting framework agreement with the Shanghai Nuclear Engineering Institute to support the Nuclear Energy Heating Demonstration Project in Baishan. The HAPPY200 reactor is expected to benefit from existing light water reactor supply chains.

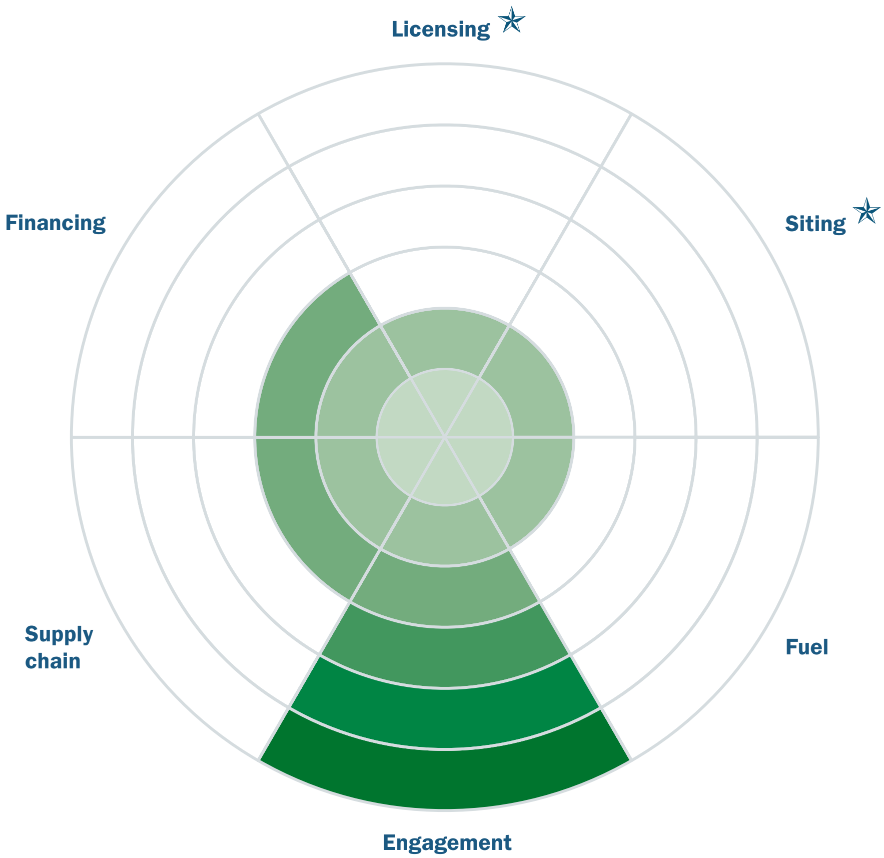
Engagement

In 2019 the State Power Investment Corporation signed a co-operation agreement with the municipal government of the city of Baishan in the Jilin province, China, for the Baishan Nuclear Energy Heating Demonstration Project. The aim was to explore the HAPPY200 SMR's ability, among other nuclear heating solutions, to meet local heating demand in the Jilin province.

Fuel

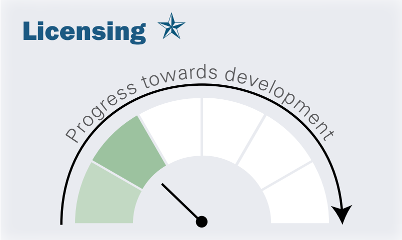
The HAPPY200 utilises fuel that is the current industry standard for water-cooled reactor technologies and therefore relies on well-established supply chains.

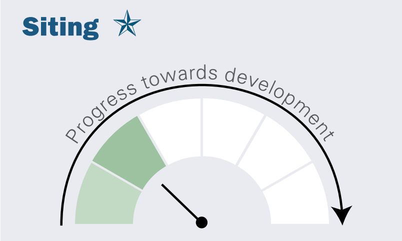
IMSR

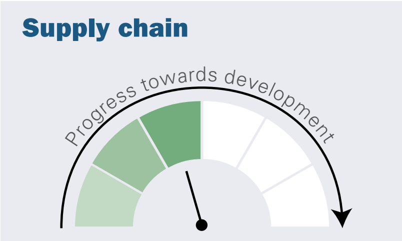


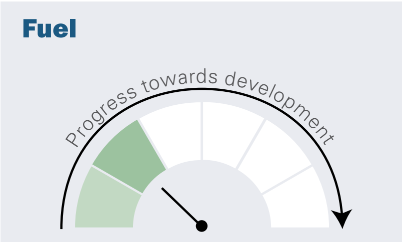
★ Active in multiple jurisdictions or countries.

Design organisation	Terrestrial Energy
Thermal power (MWth)	884
Outlet temperature (°C)	700
Spectrum (thermal/fast)	Thermal
Fuel type	Molten salt
Fuel (LEU/HALEU/HEU)	LEU









Assessment of IMSR's progress to deployment

Licensing ✯

Terrestrial Energy has completed Phase 2 of the Canadian Nuclear Safety Commission (CSNC) Vendor Design Review pre-licensing process for its Integral Molten Salt Reactor (IMSR) and is also engaged in pre-application activities with the US Nuclear Regulatory Commission (NRC). The CNSC and NRC are collaboratively reviewing the IMSR technology and aim to issue a common report providing feedback on the IMSR design.

Siting ✯

Terrestrial Energy is participating in an "Invitation to Site" an SMR as a demonstration unit at a site owned by Atomic Energy of Canada Limited (AECL) and to be operated by Canadian Nuclear Laboratories (CNL). The IMSR completed the prequalification phase in 2019, which is the first of four stages that could eventually result in the technology being selected for deployment at a CNL-operated facility. In 2018, Terrestrial Energy signed an MoU with US utility Energy Northwest to explore the possible siting construction and operation of an IMSR at an Idaho National Laboratory site.

Financing

Terrestrial Energy has raised more than USD 35 million in public and private sector financing in support of commercialising the IMSR. This includes more than CAD 15 million (USD 12.0 million) in Series A financing, support from the US federal government for R&D, and CAD 25.7 million (USD 20.5 million) in Canadian federal funding through Sustainable Development Technology Canada and Canada's Strategic Innovation Fund.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of CAD 1.254 equals the price of USD 1.000.

Supply chain

Terrestrial Energy has contracts with Aecon Group to confirm construction costs and timelines, Hatch for engineering, procurement, and project management, and Siemens Energy Canada to supply steam turbines and other equipment. Terrestrial Energy also has contracts with BWXT, L3Harris Technologies, and KSB Pumps, as well as a Memorandum of Understanding with Energy Northwest. R&D is being advanced with universities, CNL, Oak Ridge National Laboratory, and the Nuclear Research and Consultancy Group in the Netherlands. Terrestrial Energy has received four vouchers under the US Gateway for Accelerated Innovation in Nuclear initiative. Frazer-Nash, an engineering consultancy in the UK, has been contracted for graphite moderator fabrication engineering services.

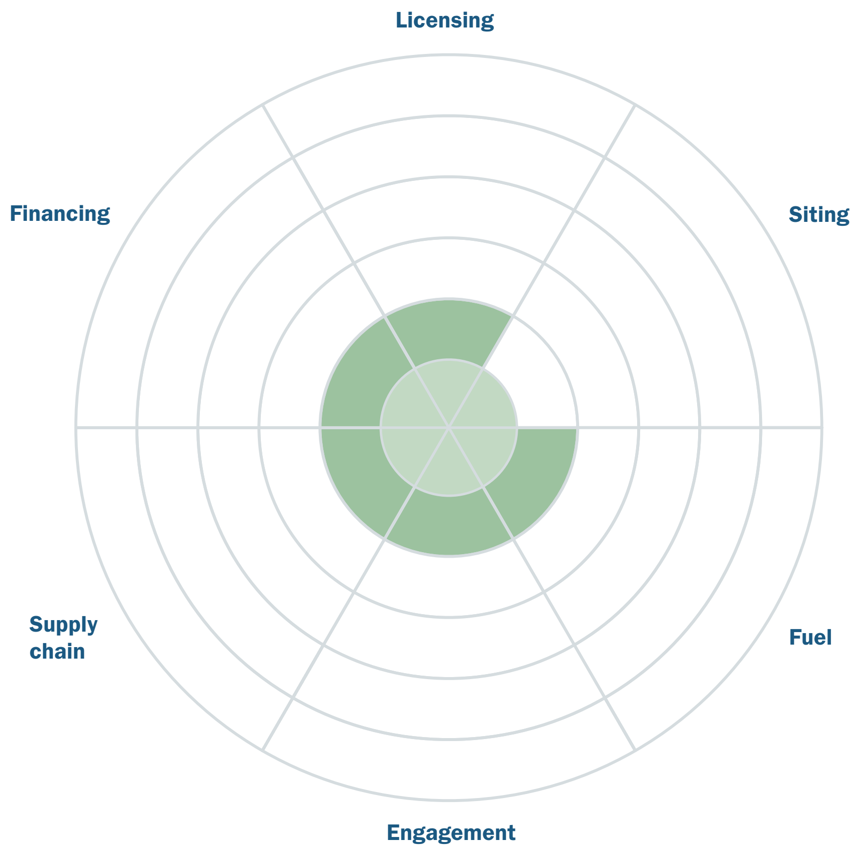
Engagement

Terrestrial Energy (TE) has signed a Letter of Intent with NGO TerraPraxis and joined the Fuel Cell & Hydrogen Energy Association. TE is a member of the First Nations Power Authority and has signed an MoU with Invest Alberta, Canada. TE's advisors include a former Canadian Prime Minister, a former US Secretary of Energy, a former UK Climate Change Minister, a former TVA COO, a former Lockheed Martin CTO of, a former BP CEO, a former CNSC President, a former NRC Commissioner, the Climate Change Capital founder, the Bright New World Executive Director, and a former Head of Risk at Goldman Sachs. The TE President has advanced public outreach since 2017 through such media as the *New York Times*, *Mother Jones*, *The Globe and Mail*, the Canadian Broadcasting Corporation, and the *Edmonton Journal*.

Fuel

TE plans to use Low-Enriched Uranium (LEU) in molten salt in a once-through fuel cycle. The concept is based on the Molten Salt Reactor Experiment, which operated at Oak Ridge National Laboratory 1965-1969. TE is advancing research to develop molten salt for the IMSR, including by working with ENGIE Laborelec, Belgium, Canadian Nuclear Laboratories, the Joint Research Centre, Germany, and the Argonne National Laboratory, United States. TE has been working to understand the process of transitioning from laboratory to commercial scale, including through an agreement with Westinghouse and the UK National Nuclear Laboratory to scale up and commercialise enriched uranium fuel, signing a contract with Orano and MoUs with Centrus Energy and Cameco for fuel and uranium supply, respectively.

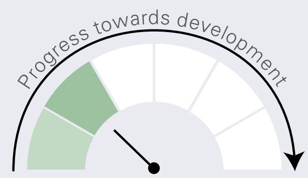
TMSR-500



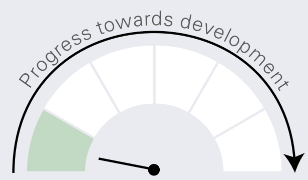
Active in multiple jurisdictions or countries.

Design organisation	ThorCon International
Thermal power (MWth)	557
Outlet temperature (°C)	704
Spectrum (thermal/fast)	Thermal
Fuel type	Molten salt
Fuel (LEU/HALEU/HEU)	Phase 1: LEU; Phase 2: HALEU with thorium conversion

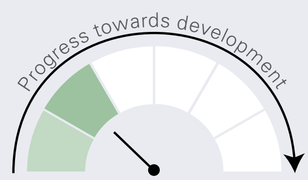
Licensing



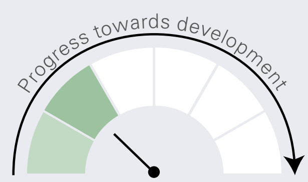
Siting



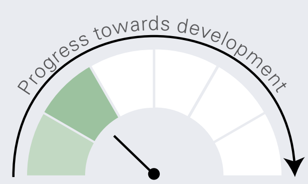
Financing



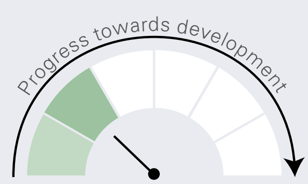
Supply chain



Engagement



Fuel



Assessment of TMSR-500's progress to deployment

Licensing

The ThorCon TMSR-500 is a 557 MWth thorium molten salt reactor integrated into a floating hull ballasted to the seabed or the shore. The hull is designed for 2 power modules. In March 2023, ThorCon submitted a consultation paper for its TMSR-500 to the Badan Pengawas Tenaga Nuklir (BAPETEN) (*Indonesian Nuclear Energy Regulatory Agency*), to initiate the pre-licensing process in Indonesia.

Siting

ThorCon has reported their interest to demonstrate and site ThorCon's TMSR-500 on Gelasa (Kelasa) Island in Bangka Belitung (Babel) Islands Province. At the time of assessment, no information related to siting was readily available from any site owners.

Financing

ThorCon has created a Singapore-based special purpose company, supported by private investors, for the purpose of financing the TMSR-500 project in Indonesia. ThorCon has prepared an investment fund of RP 17 trillion (USD 1.19 million) for the construction of the TMSR-500 on Gelasa Island. ThorCon has indicated that the funds will not be dispersed until the project is approved.

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of RP 14 308.144 equals the price of USD 1.000.

Supply chain

In 2017, ThorCon entered into collaboration with the Indonesia Thorium Consortium of state-owned companies to assess the feasibility of deploying the TMSR-500 in Indonesia. ThorCon is also collaborating with the Badan Riset dan Inovasi Nasional (BRIN) (National Research and Innovation Agency of the Republic of Indonesia) and the Universitas Sebelas Maret on R&D. In 2019, ThorCon signed MoUs with Daewoo Shipyard & Marine Engineering in South Korea and PT PAL Indonesia. In 2022, ThorCon signed an agreement for collaboration with the Spanish firm Empresarios Agrupados for project management, engineering, licensing, site preparation, construction, operation and decommissioning. ThorCon has also signed an agreement with Bureau Veritas, a conformity assessment body, to work on project certifications.

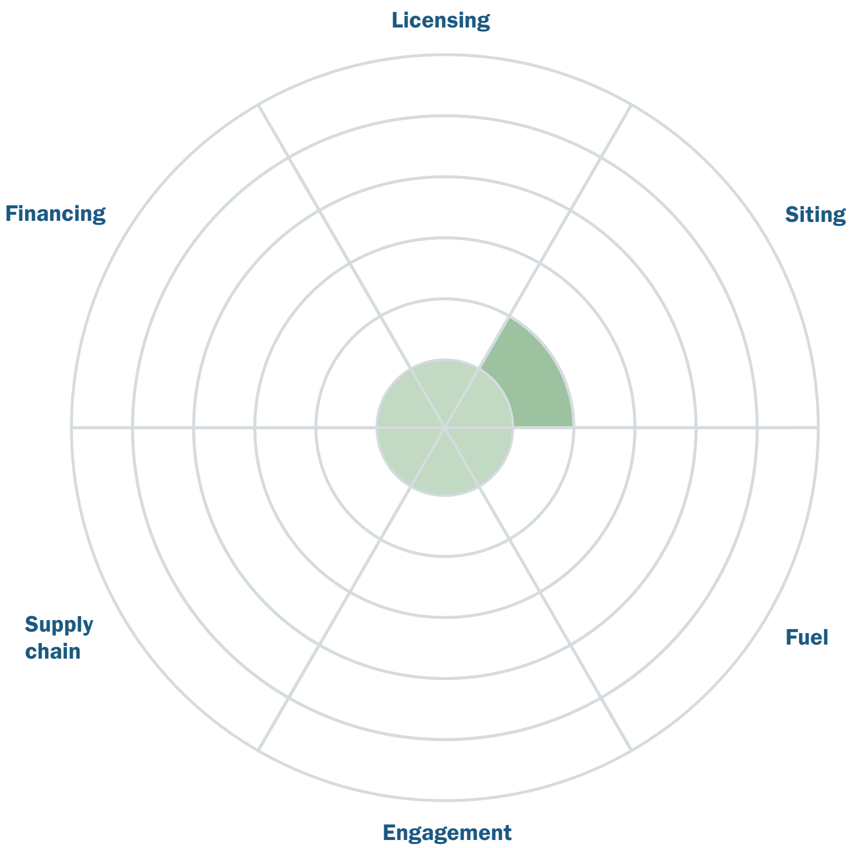
Engagement

ThorCon has signed both an MoU and a Partnership Agreement with the Universitas Sebelas Maret Surakarta (*Sebelas Maret University*) to advance research and conduct a mapping survey of community acceptance related to the establishment of nuclear power plants as a source of low carbon energy for Indonesia.

Fuel

Initially, ThorCon intends to use Low-Enriched Uranium (5% LEU) as a source of fuel. ThorCon intends to transition to High-Assay Low-Enriched Uranium (19.7% HALEU) fuel with thorium conversion once HALEU becomes commercially available in suitable quantities. ThorCon has been awarded a voucher under the United States Department of Energy Gateway for Accelerated Innovation in Nuclear (GAIN) initiative in partnership with Argonne National Laboratory (ANL) to work on sodium fluoride and beryllium fluoride salt properties for liquid fuelled fluoride molten salt reactors.

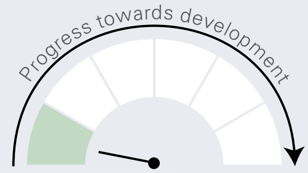
4S



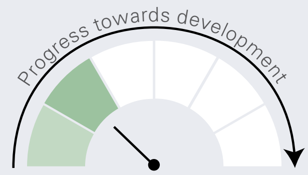
★ Active in multiple jurisdictions or countries.

Design organisation	Toshiba Energy Systems & Solutions Corporation
Thermal power (MWth)	30 and 135
Outlet temperature (°C)	510
Spectrum (thermal/fast)	Fast
Fuel type	Metallic U-Zr alloy
Fuel (LEU/HALEU/HEU)	HALEU

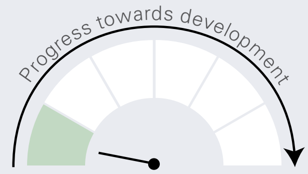
Licensing



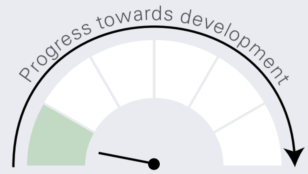
Siting



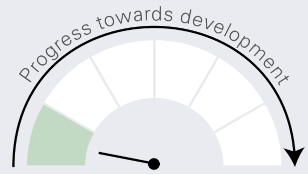
Financing



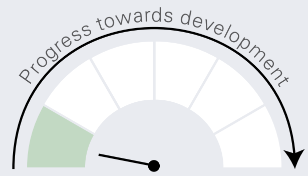
Supply chain



Engagement



Fuel



Assessment of 4S's progress to deployment

Licensing

The 4S ("Super-Safe, Small and Simple" SMR) designed by Toshiba is a small sodium-cooled fast reactor intended for remote areas. The 4S reactor has two options: 30 MWth and 135 MWth. Toshiba had engaged with the US Nuclear Regulatory Commission (NRC) for the 30 MWth 4S reactor. In 2007 Toshiba first began engagement with the US Nuclear Regulatory Commission (NRC) through a pre-application review for design approval of the 4S. In 2012, Toshiba submitted Technical Reports to the NRC related to safety design criteria for the 4S to support this pre-application review. These materials have since been archived by the NRC. At the time of assessment, there was no additional information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

In 2007, the Alaska Electric Light and Power Company and the City of Nome both wrote to the NRC indicating their interest in the 4S SMR for replacing diesel generators in remote areas of Alaska.

Financing

At the time of assessment, no information about financing was readily available from verifiable public sources.

Supply chain

At the time of assessment, no information about supply chain readiness was readily available from verifiable public sources.

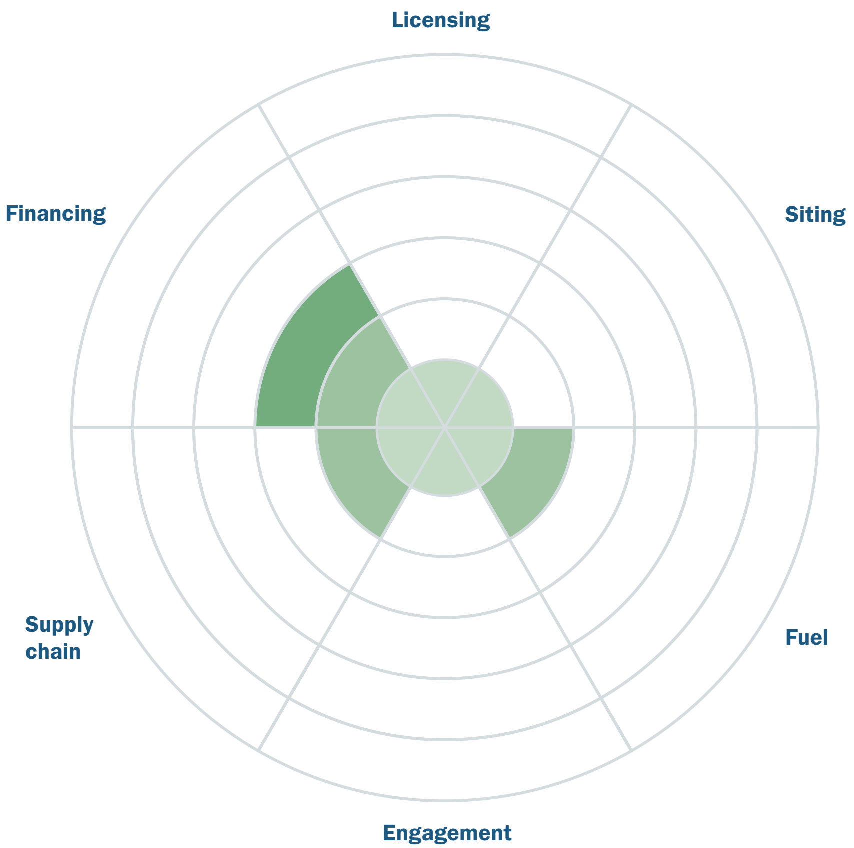
Engagement

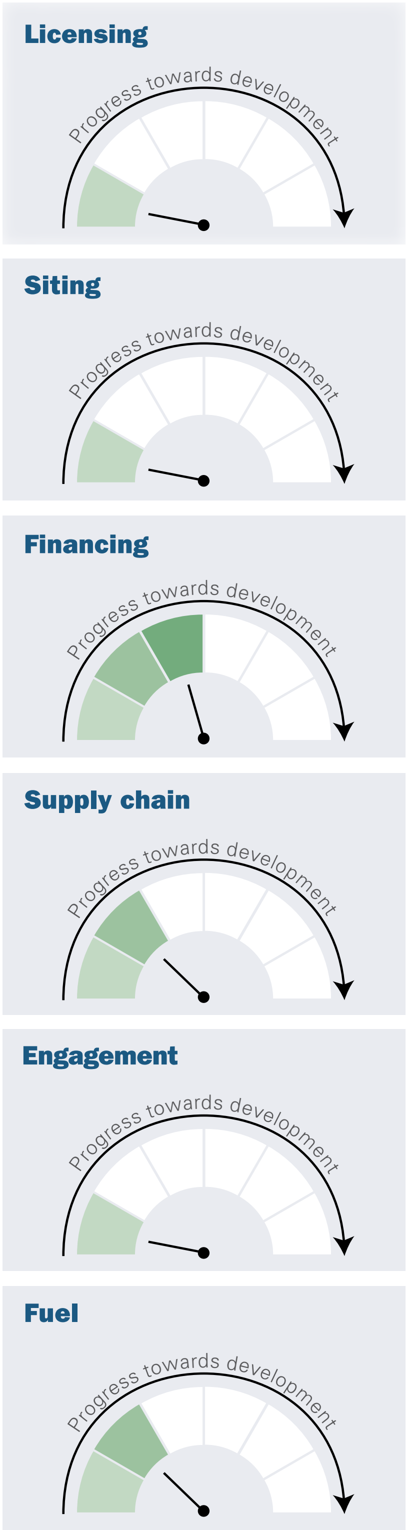
At the time of assessment, no recent information was readily available from verifiable public sources related to engagement activities.

Fuel

The 4S proposes to use High-Assay Low-Enriched Uranium (HALEU) fuel. HALEU is a technically proven fuel type, however there is presently no commercial supply available from OECD countries. At the time of assessment, no information was readily available from verifiable public sources to assess progress towards the commercial supply of qualified fuel.

Westinghouse LFR





★ Active in multiple jurisdictions or countries.

Design organisation	Westinghouse Electric Company
Thermal power (MWth)	950
Outlet temperature (°C)	Phase 1: 530; Phase 2: 650
Spectrum (thermal/fast)	Fast
Fuel type	UO_2 pellets or MOX, interchangeably, as near-term fuel; nitride pellets as longer-term advanced fuel
Fuel (LEU/HALEU/HEU)	HALEU for UO_2 pellets, otherwise plutonium-uranium oxide for MOX

Assessment of Westinghouse LFR's progress to deployment

Licensing

Westinghouse Lead Fast Reactor (LFR) is a 950 MWth lead-cooled fast spectrum reactor. At the time of assessment, there was no information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

At the time of assessment, no information related to siting was readily available from a site owner.

Financing

In 2020, the Westinghouse LFR received GBP 10 million (USD 13.7 million) in public funding as it entered phase 2 of the UK's government Advanced Modular Reactor programme. In addition, between 2017 and 2022, Westinghouse received a total of USD 1.225 million through four awards from the US Department of Energy Technology Commercialization Fund to advance critical modelling activities in partnership with Argonne National Laboratory (ANL).

Note: The exchange rate applied is the currency relevant average for 2021. In this case, the price of GBP 0.727 equals the price of USD 1.000.

Supply chain

Under the United Kingdom Advanced Modular Reactor Research, Development & Demonstration Programme, Westinghouse worked with engineering, procurement and construction companies including Ansaldo Nucleare. R&D was advanced with UK universities as well as national laboratories, including l'Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA) (Italian National Agency for New Technologies, Energy and Sustainable Economic Development). Westinghouse has received two vouchers under the United States Department of Energy Gateway for Accelerated Innovation in Nuclear initiative for R&D at ANL and Oak Ridge National Laboratory. In 2022, Westinghouse and Ansaldo Nucleare signed a co-operation agreement on lead fast reactor development.

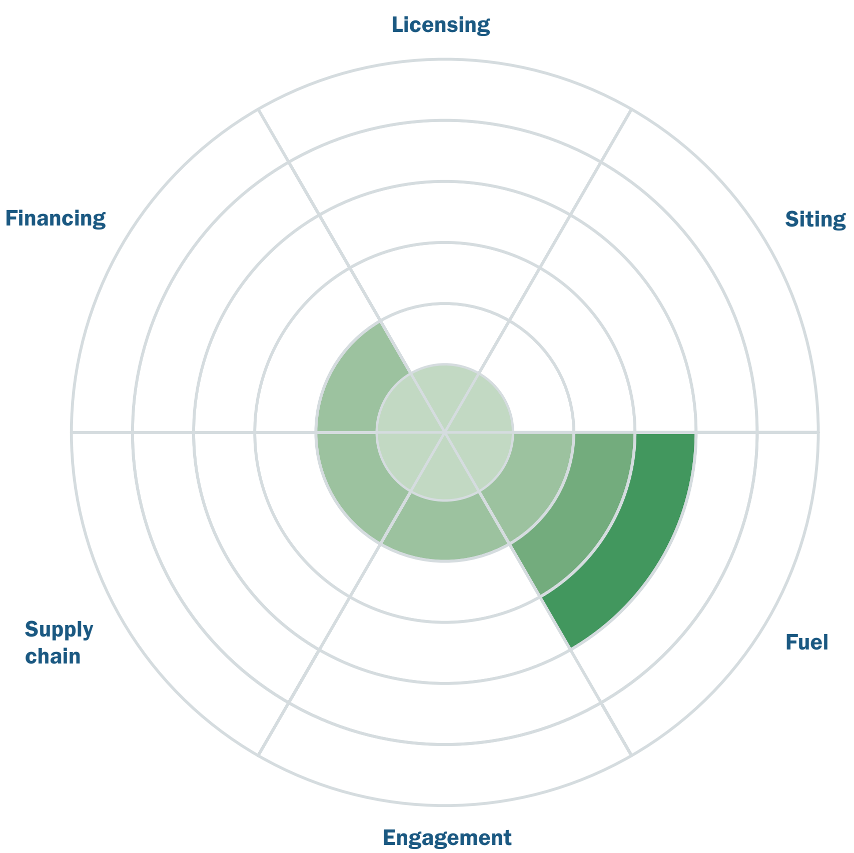
Engagement

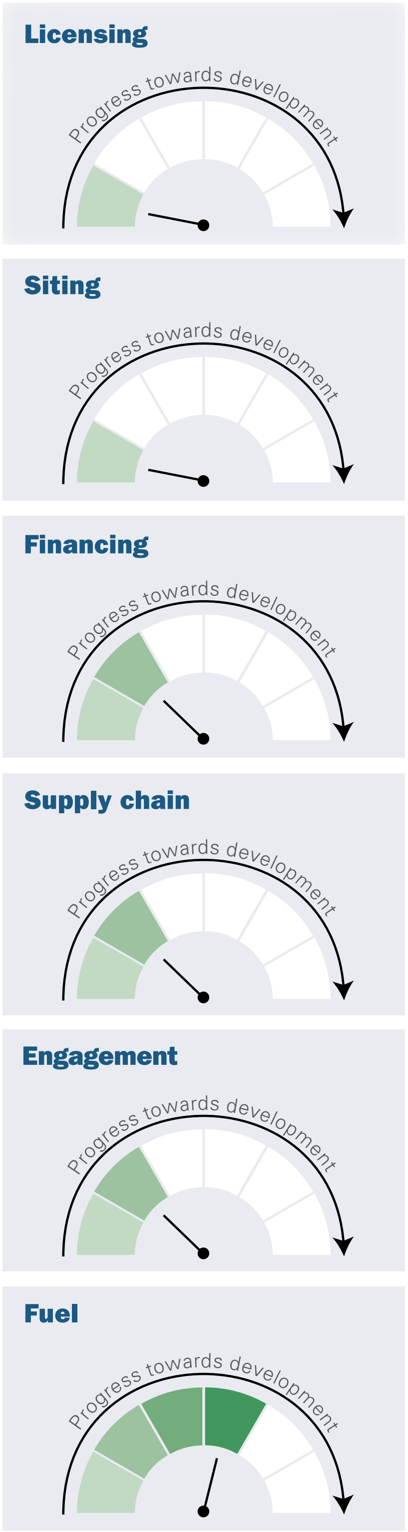
At the time of assessment, no information was readily available from verifiable public sources related to engagement activities.

Fuel

For its LFR, Westinghouse plans to use uranium oxide (UO2) pellets or mixed plutonium-uranium oxide fuel. For uranium-based fuel, Westinghouse aims to use High-Assay Low-Enriched Uranium (HALEU). HALEU is a technically proven fuel type; however, there is presently no commercial supply available from OECD countries. MOX is also a technically proven fuel type; however, there are presently limited suppliers in particular for fast reactors. Westinghouse is a leading nuclear fuel supplier worldwide. Starting in 2021, under phase two of the UK Advanced Modular Reactor Research, Development & Demonstration Programme, Westinghouse worked with UK National Nuclear Laboratory and the University of Manchester to advance R&D on the LFR fuel system, including fuel development and testing.

TEPLATOR





★ Active in multiple jurisdictions or countries.

Design organisation	Západočeská univerzita v Plzni (ZČU) and Czech Technical University in Prague (CIIRC CTU)
Thermal power (MWth)	170
Outlet temperature (°C)	180
Spectrum (thermal/fast)	Thermal
Fuel type	Spent nuclear fuel (SNF) assemblies from LWRs (VVER, BWR or PWR) or natural uranium.
Fuel (LEU/HALEU/HEU)	SNF, natural uranium

Assessment of TEPLATOR's progress to deployment

Licensing

The TEPLATOR design is a low temperature, low pressure and low power density heavy water reactor. The TEPLATOR proposes to use spent fuel assemblies from VVER, boiling water reactor (BWR) or pressurised water reactor (PWR) power plants. The TEPLATOR design may also accept natural uranium as fuel. At the time of assessment, there was no information readily available from verifiable public sources related to licensing or pre-licensing activities.

Siting

At the time of assessment, no information related to siting was readily available from a site owner.

Financing

Invest & Property Consulting (IPC), based in the Czech Republic, is the primary investor in TEPLATOR.

Supply chain

The TEPLATOR is being advanced in a partnership with the Czech Technical University in Prague and the University of West Bohemia in Pilsen, Czech Republic.

Engagement

Development of the TEPLATOR design is taking place in partnership with the Czech Technical University in Prague and the University of West Bohemia in Pilsen, which creates opportunities for engagement with students.

Fuel

It is proposed to use spent nuclear fuel assemblies from VVER, BWR or PWR reactors as fuel in the TEPLATOR design. While contracts have not been signed to procure the spent fuel assemblies, the current fleets of operating reactors could provide the supply of fuel required for the TEPLATOR.

References

The references used to compile the SMR information (pages 30 to 71) are available at: www.oecd-nea.org/dashboard-vol2-ref.

NEA (2023), *The NEA Small Modular Reactor Dashboard*, OECD Publishing, Paris, www.oecd-nea.org/nea-7650.

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The NEA Small Modular Reactor Dashboard: Volume II

All low-carbon solutions will be required to achieve the world's net zero targets. Nuclear energy has a role to play in meeting this need. A wave of innovation in small modular reactors (SMRs) is advancing quickly with the potential to help decarbonise hard-to-abate sectors. Progress is real and is positioned to accelerate pathways to net zero. SMRs could replace coal on-grid, fossil fuel cogeneration of heat and power for heavy industry, diesel at off-grid mines, as well as producing hydrogen and synthetic fuels.

Looking beyond technical feasibility, *The NEA Small Modular Reactor Dashboard* defines new criteria for assessing real progress in six additional dimensions of readiness: licensing, siting, financing, supply chain, engagement, and fuel. The first volume of *The NEA Small Modular Reactor Dashboard* assessed the progress of 21 SMRs. This second volume tracks the progress of an additional 21 SMRs around the world.

Nuclear Energy Agency (NEA)
46, quai Alphonse Le Gallo
92100 Boulogne-Billancourt, France
Tel.: +33 (0)1 73 21 28 19
nea@oecd-nea.org www.oecd-nea.org

NEA No. 7657