



Fusion for the Future

Japanese Industry Involvement in Fusion

Kyoto Fusioneering

Director CTO Keishi Sakamoto
Director COO Kiyoshi Seko

Self-Introduction (Keishi Sakamoto)

Plasma Heating Technology (1981-2015)

- [Gyrotron Research and Development](#) for Electron Cyclotron Heating

[IFMIF EVEDA Project](#) (April.2015-Mar.2021)

(Collaboration between EU and JA)

Project Manager for Japan Team

(Project Leader of IFMIF/EVEDA: J.Knaster (2013-2018), P.Cara (2019-2022))

[Kyoto Fusioneering Ltd](#) (April.2021-)

Startup company for Fusion Technology



Ceremony of
 “Installation of Major components of IFMIF”
 at Rokkasho (April 2016)



Kyoto Fusioneering LTD.

Diverse and experienced members come together at KF for Nuclear Fusion. (including Spanish member)
University (including new graduate)

Kyoto U., U. of Tokyo, Nagoya U., etc.

Institute

QST (JAEA), ITER IO, National Institute of Fusion Science (NIFS), KIT(Germany), etc.

Manufacturing company

Toshiba, Hitachi, Mitsubishi, Canon Electron Tube&Devices, Furukawa, NEC, and many.

Trading company/Investment company

Mitsubishi Corporation, Mistui&co, Sumitomo Corporation, etc.

KF is a unique company that connects Japanese (and world) fusion technology to the worldwide.

Example: Gyrotrons developed in Japan will be delivered to world major devices by KF.

For MAST-U(UK), ST-40(UK), KFE(Korea), DIII-D(US), and more.

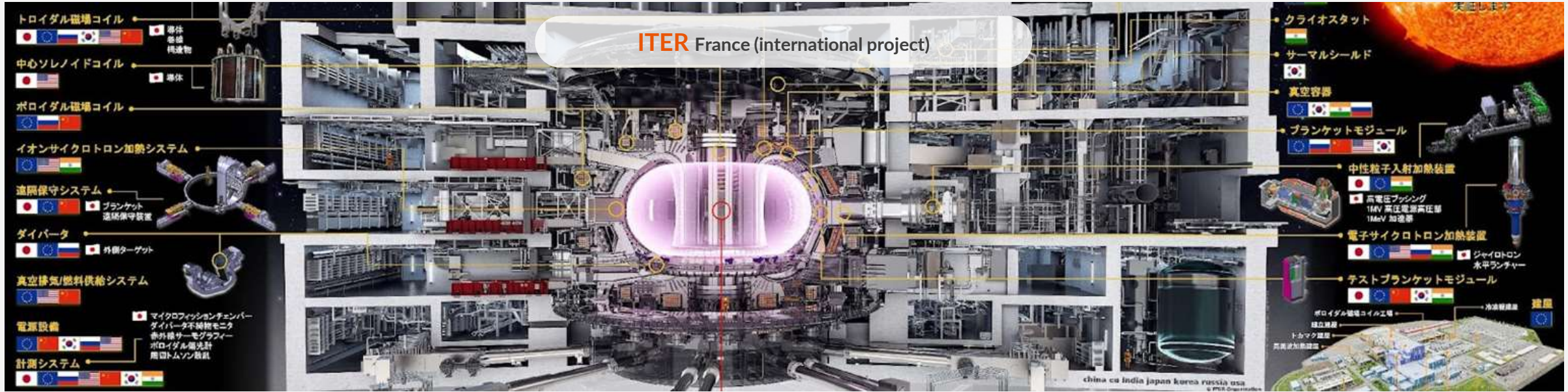
“Core part of Kyoto Fusioneering’s activities” is presented by Kiyoshi Seko, COO, (in partly Spanish).

Japanese Industry Involvement in Fusion

1. Commercializing Fusion: A New Paradigm
2. Kyoto Fusionneering: A Closer Look
3. Japanese Industry: Action

1. Commercializing Fusion: A New Paradigm

Fusion development has been led by the public sector



ITER France (international project)



Joint European Torus UK



National Ignition Facility U.S.



JT 60SA Japan

Commercializing Fusion: A New Paradigm

Governments developing national strategies to promote private fusion through public-private-partnerships.



Nov 2020 – The UK government: **“Ten Point Plan for a Green Industrial Revolution”**

“Aims to build the commercially viable fusion energy plant in the UK by 2040”

15 sites are shortlisted for the UK fusion energy plant (June 2021)



Mar 2022 – US government: **“Bold Decadal Vision for Commercial Fusion Energy”**

“Accelerate the viability of commercial fusion energy in coordination with the private sector”

NASEM “Have a viable design by 2028 and initial pilot plant operation in 2035~2040”



Apr 2023 – Japanese government: **“Fusion Energy Innovation Strategy”**

“Our strategy for the next 10 years is to ‘industrialize fusion energy,’ ... the world’s next-generation energy source. It is necessary to promote further participation of Japan’s private sector and cooperation between industry, academia, and government, and to develop a national strategy that includes specific actions that will attract private investment.”

Startups lead Deeptech innovation through Public-Private-Partnership (PPP)

COTS Program (NASA+SpaceX) shall be replicated for the fusion industry by The White House and the U.S. Department of Energy (DoE).



Public Program

Strategic project based on Long-term vision



Public Private Partnership

Innovation that combines a long-term vision with an agile approach



Private (Startups)

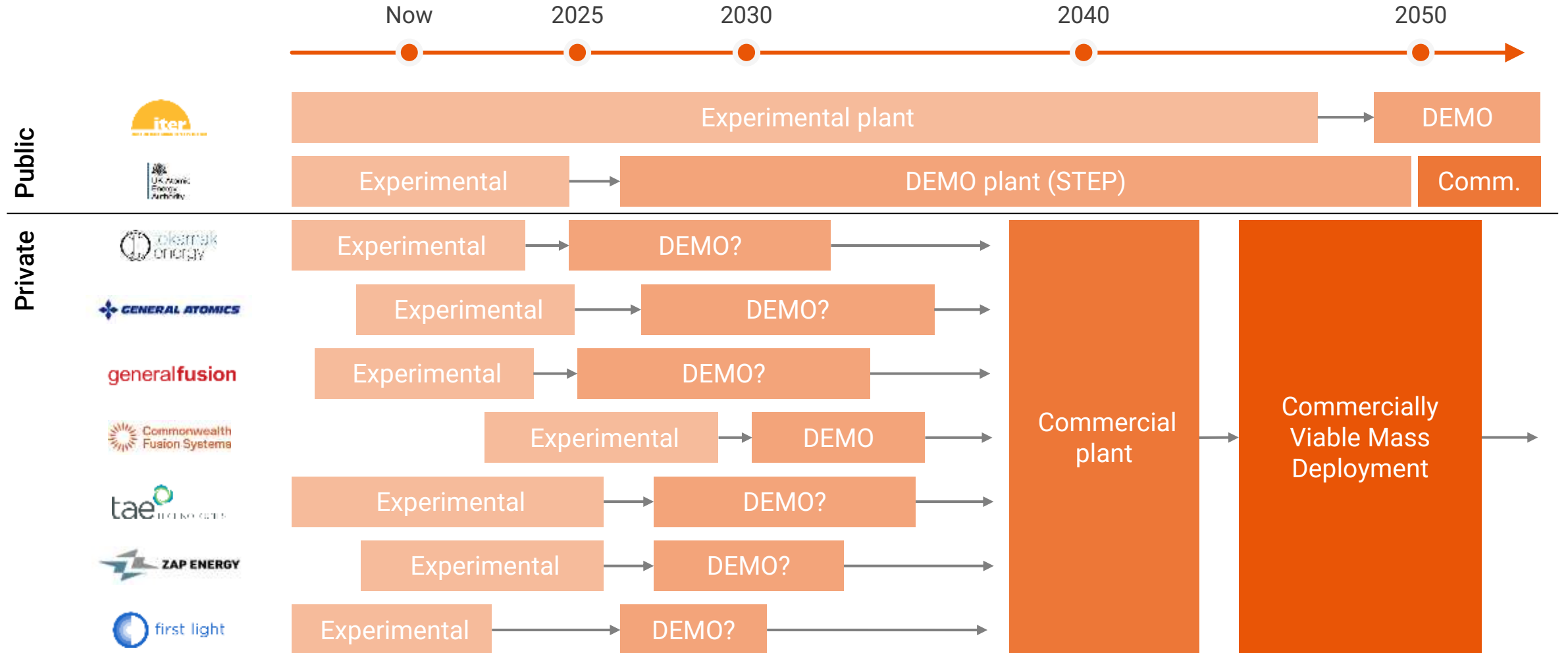
Agile approach based on private funding

Startup companies boosting Fusion Energy market

U.S.A				Europe		Great Britain
				France	Germany	
		Princeton Stellarators		Italy	Spain	
Asia & Pacific				Middle East		Canada
Australia	China	India	Japan		Israel	
			Helical Fusion			Presented by

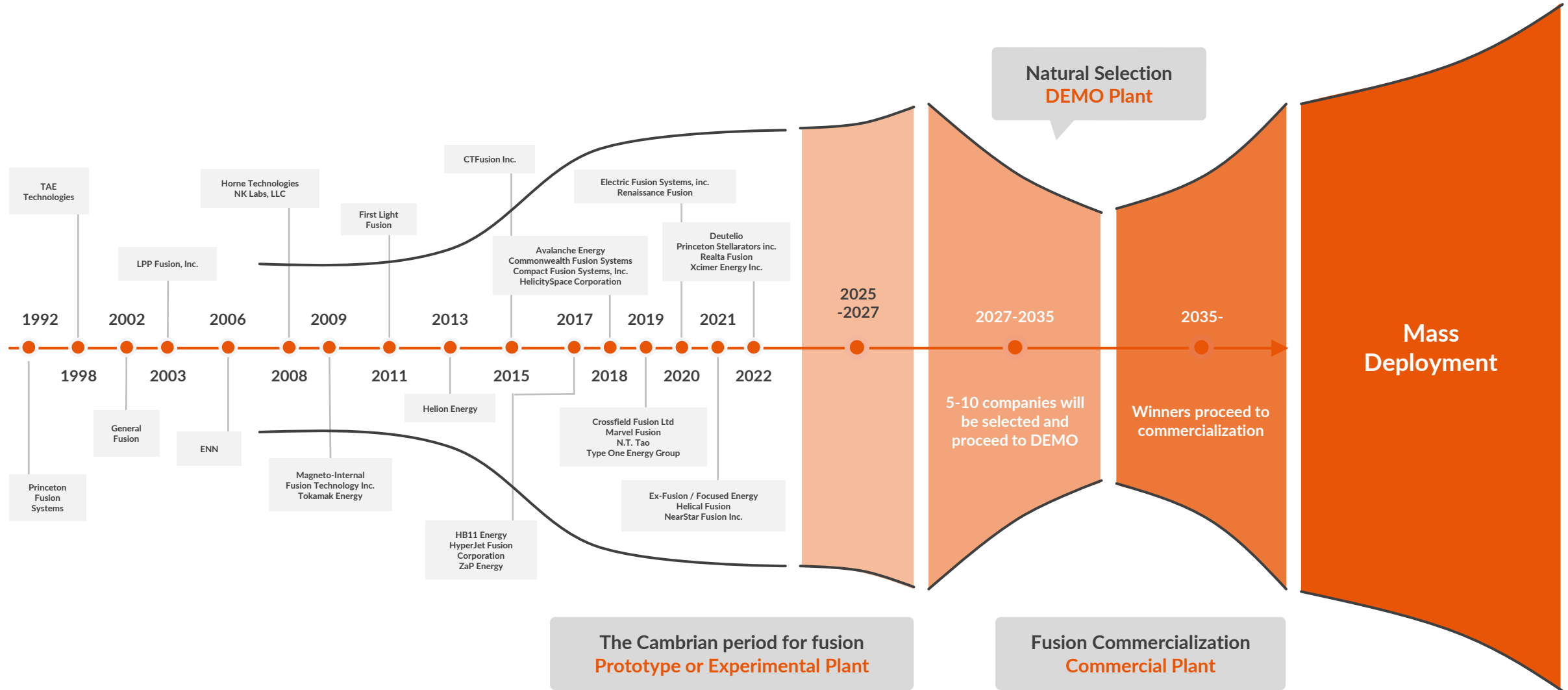
4. Commercializing Fusion: A New Paradigm

Private programs have much more accelerated timelines in exchange for higher risk on a per-company basis.



4. Commercializing Fusion: A New Paradigm

There will be a period of contraction as the industry matures. However, it will expand again with the deployment of the approaches that succeed.



2. Kyoto Fusionneering: A Closer Look

Founded in
2019

100+
Team members

\$90m+
Raised

3
Countries

JP

US

UK

KF's shareholders: Global companies support KF and Fusion

INPEX


SMBCベンチャーキャピタル




関西電力グループ
power with heart


京都大学イノベーションキャピタル株式会社
KYOTO-iCAP
KYOTO UNIVERSITY INNOVATION CAPITAL COLLEGE


CORAL
CAPITAL

JAFSCO


VENTURE
GROWTH
INVESTMENTS

大和企業投資
Daiwa Corporate Investment

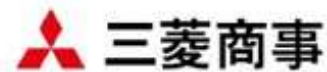

DBJ DBJキャピタル株式会社
日本政策投資銀行グループ


JPOWER


JGC

**global
brain**


MITSUI & CO.


三菱商事


MUFG
三菱UFJキャピタル


MUFG
三菱UFJ銀行



Kyoto Fusioneering: The Leadership Team

Prof. Satoshi Konishi

Co-founder CEO, Chief Fusioneer



Prof. Satoshi Konishi co-founded Kyoto Fusioneering in 2019 and serves as the Chief Fusioneer, steering its technological vision. With a Ph.D. from the University of Tokyo, his 40-year expertise spans fusion technology, nuclear design, and tritium engineering, especially the ITER project. A tenured professor at Kyoto University, he's chaired the Test Blanket Program for ITER since 2009. Prof. Konishi leads Kyoto's Institute of Sustainable Science and holds affiliations with multiple atomic and fusion societies. His insights bolster Kyoto Fusioneering's trailblazing ambition.

Prof. Keishi Sakamoto

CTO, Director, Head of Technical Development



Prof. Keishi Sakamoto, joining Kyoto Fusioneering in 2021 as Executive Officer, has decades of R&D experience in plasma heating, notably at Japan's National Institute for Quantum Science. He significantly advanced gyrotrons, achieving a world-first in output energy and efficiency. Recognized with awards from MEXT Japan and the European Physical Society Plasma Division, Keishi now serves as a Special Professor at Kyoto University's Institute of Advanced Energy and holds a Ph.D. from Kyushu University.

Mr. Kiyoshi Seko

COO, Director



Kiyoshi boasts a comprehensive background in strategic investments and business development. Formerly with Mitsubishi Corporation, he orchestrated significant M&As and JVs, such as alliances with Princes, Alfa Group, and Toyo Tire, cumulatively worth billions. An MBA from IE Business School, Spain, and with dual M.S. degrees from Kyoto University and the University of Tokyo, he transitioned to Coral Capital, executing venture investments in diverse tech sectors before joining Kyoto Fusioneering. He's an avid reader and tech enthusiast.

Dr. Colin Baus

Vice President of Plant Technology

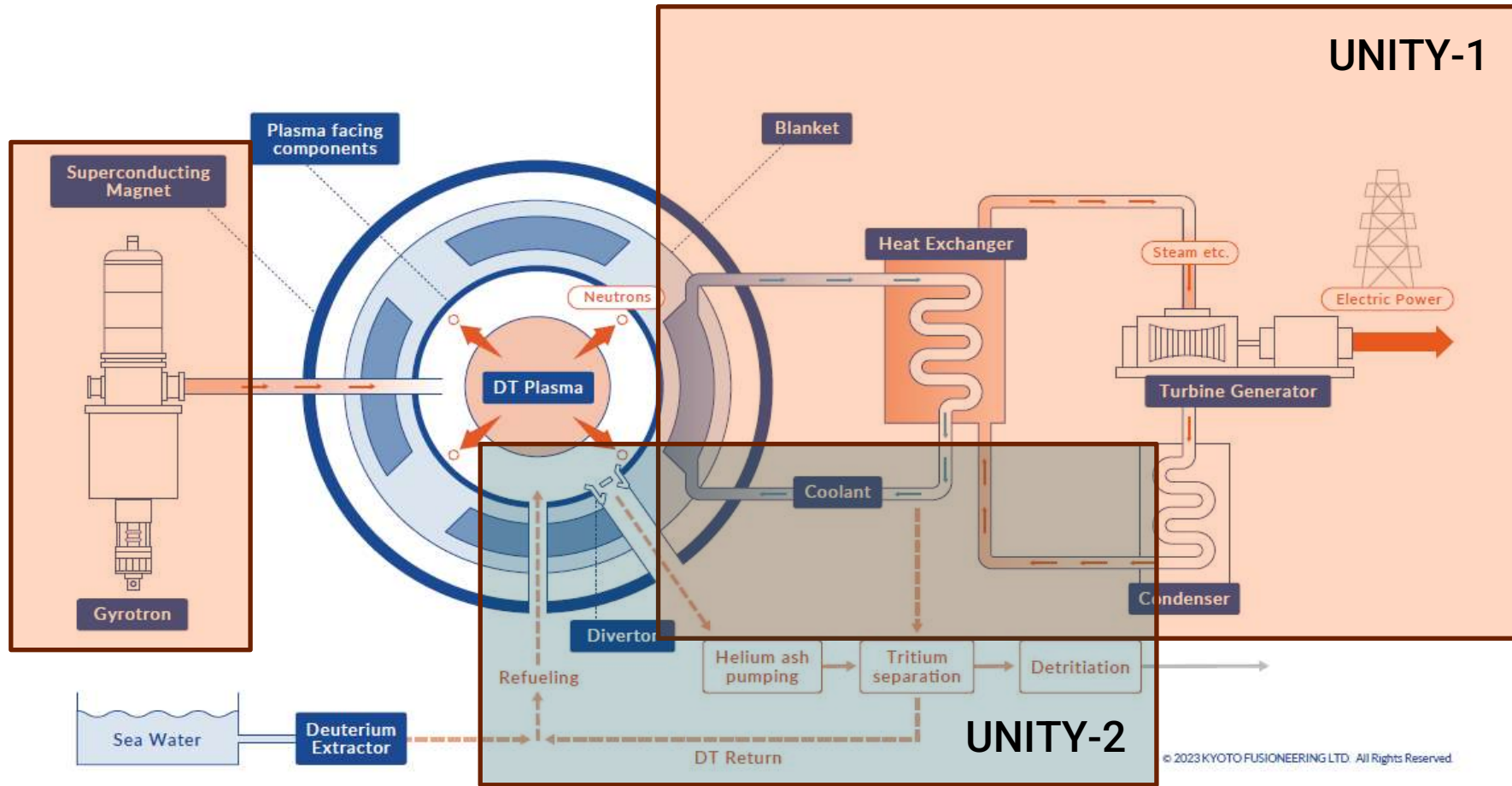


Colin is a physicist with a PhD at the Large Hadron Collider at CERN (CMS experiment) on heavy-ion cross sections and the connection to astroparticle physics. As co-author of the hadronic interaction tool CRMC, he has deep knowledge in nuclear physics. After several years in the private industry, Colin joined Kyoto Fusioneering. Here, he is author of the high-temperature fusion blanket SCYLLA design and currently oversees technical development of the UNITY programme for fusion thermal cycle and fusion fuel cycle in Japan. He is also a visiting researcher at Kyoto University.

Kyoto Fusion's Role in the Fusion Industry

Parallel development of critical path systems.

KF's mission is to accelerate the development of high performance, commercially viable, and confinement concept-agnostic fusion plant systems. These include **Plasma Heating and Current Drive (PHCD)**, **Fuel Cycle (FC)**, and **Thermal Cycle (TC)**.



KF Depth of Expertise



We operate across various levels in our areas of focus.

Pilot Plant Design & Development

For several Milestone-Based Fusion Development Program awardees and other fusion developers, KF:

- Is **designing** the plasma heating, fuel cycle and thermal cycle system in conjunction with the overall plant.
- Will **supply components and systems** in these areas to the FPP and CPP programs during the construct phase.
- Will continue to **supply consumable components** (e.g., blanket) throughout operations.
- And more (see [2. FPP Development Support](#))

Clients/partners

Several, undisclosed

Integrated Testing

Designing and **overseeing EPC** of two integrated testing facilities to demonstrate thermal and fuel cycle systems.

UNITY-1 in Kyoto for **thermal cycle**:

- 1000°C Li-Pb, Li, FLiBe loops with blanket test.
- MHD testing with SiC_f/SiC insulators.
- 1st ever electricity gen from blanket module.
- DIR testing with proton conductor pump

UNITY-2 in Ontario for **fuel cycle**:

- ~40g of T, ~50L Li-Pb loop w/ VST T extraction
- Dual storage system (dU, ZrCo)
- Dual ISS (TCAP, CD), outer cycle (WDS, ADS)
- Centrifugal Pellet Injection

Plasma heating system test facility:

- Gyrotron
- Power Supply
- (Waveguide)
- (Launcher)

In partnership with



and delivery partners.

Engineering & Manufacturing

Designing and **developing** a suite of fusion-grade components and systems.

- **Plasma heating system** (see [gyrotrons](#))
- Self-cooled lithium-lead **blanket modules** (see [blankets](#))
- Tritium compatible metal diffusion, roughing, turbo molecular **pumps** (see [roughing pump](#))
- **Direct internal recycling** system

- Tritium **storage beds** (see [storage](#))
- TCAP and CD **isotope separation systems**
- Vacuum Sieve Tray for **Tritium extraction**
- Li, Li-Pb, FLiBe loops and technology
- And more (see [Components & Systems](#))

With dozens of the 100+ fusion-relevant suppliers in Japan, including:



and 70+ more.

Scientific Discovery & Experimentation

Developing fusion materials & manufacturing methods.

- New grade of **SiC_f/SiC** with liquid phase sintering and particle dispersion composite manufacturing process.
- New joining methods for similar and dissimilar material bonding with **SiC_f/SiC**
- **Mo alloys** for novel heat exchangers.
- **FLiBe** purification techniques & compatible materials.

- **Proton Conductor Pump** for DIR and selective pumping
- **RAFM steels** (F82H) as structural materials
- **New alloys** for storage beds.
- **Impurity and cold trapping** studies for Li-Pb
- And more (see [Material Development](#))

In collaboration with



and [more](#).



5. Kyoto Fusioneering: UNITY-1

UNITY-1 focuses on **developing and testing blankets and the power generation cycle**, and their integration with the fuel cycle.

Location: Japan



Thermal Cycle and Blanket System:

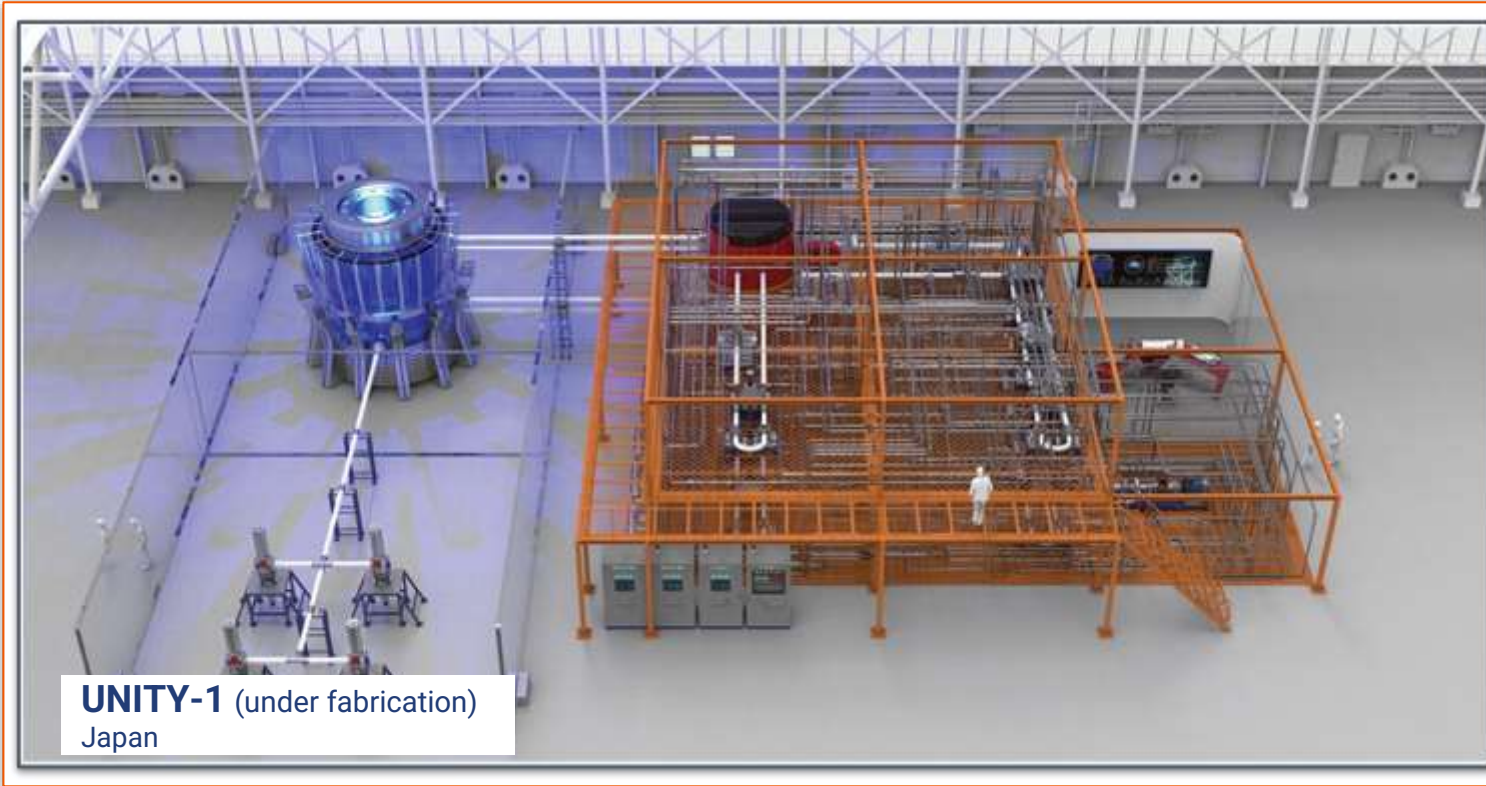
- Blanket test section (1000°C LiPb, Li, FLiBe)
- 250 L LiPb inventory
- 4T NbTi magnet
- IH heating and surface heating for blanket module 30x30x70 cm
- Two heat exchangers and power conversion (first electricity generation from a blanket module)

Fuel Cycle:

- Deuterium injection as proxy for tritium
- Tritium extraction via VST, electrochemical
- Exhaust pumping from vacuum vessel (pump train)
- DIR testing with proton conductor pump

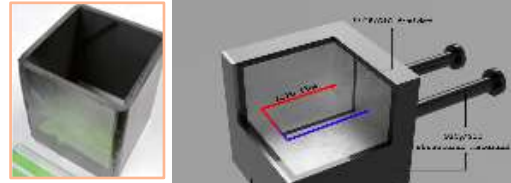
Materials:

- Compatibility in flow conditions (up to 50 L/min via 3 EMPs)
- FLiBe and Li piping material tests
- MHD testing with SiCf/SiC insulators



UNITY-1 (under fabrication)
Japan

What We Are Doing



Advanced Materials



FLiBe Loop



Li Loop



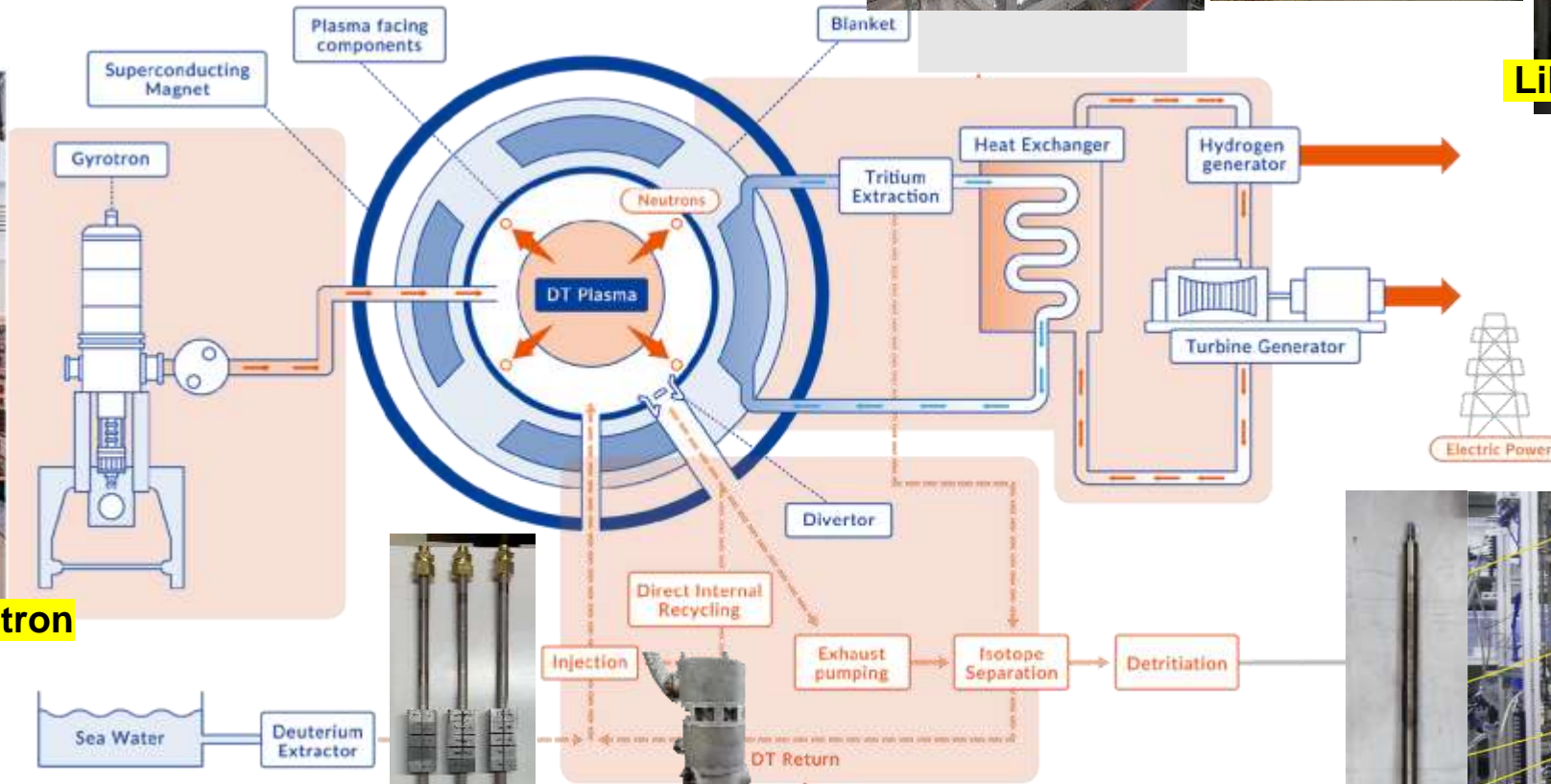
LiPb Loop



FLiBe Refining



Multi-Frequency Gyrotron



Divertor

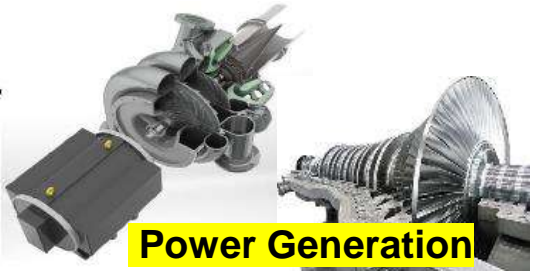
Roughing Pump

Tritium Extraction / Processing



H2 Generation

What Comes Next?



Power Generation



Blanket Test System



Breeding Blanket Module



1000°C LiPb Heat Exchanger



LiPb Loop (scale-up)

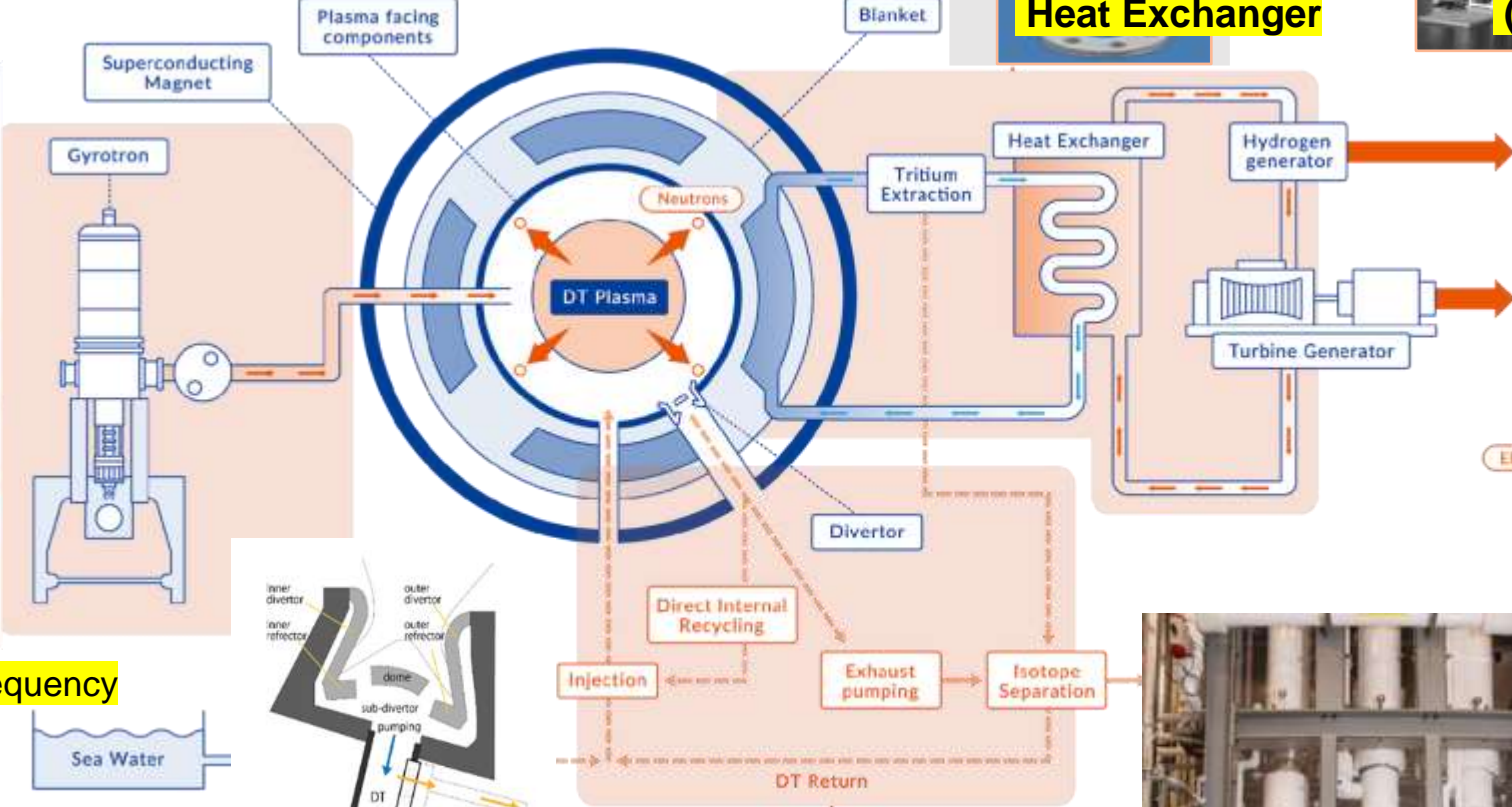


VST (scale-up)



Advanced Gyrotron

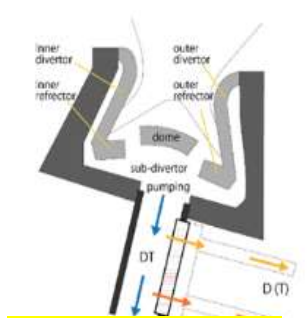
- High-power/efficiency/frequency
- Multi-frequency
- Advanced configuration



Hydrogen Sensor



Metal Diffusion Pump



Direct Internal Fuel Recycling



Tritium Handling System



Li Isotope Separation

KYOTO
FUSION



“Both CNL and KF are conducting cutting edge work in fusion, with each organization having built strengths in select areas. By working cooperatively, we can more effectively apply this knowledge and expertise, which will ultimately better serve the needs of the market.”

Dr. Jeff Griffin
Vice-President, Science & Technology, CNL

KF and CNL sign a Strategic Alliance Agreement to collaboratively accelerate the development and commercialization of fusion fuel cycle technology – with UNITY-2.

“Fusion energy holds transformative potential for global energy. Our partnership with CNL merges KF’s fusion technology with CNL’s tritium management expertise, positioning us to tackle some of commercial fusion power’s most critical challenges.”

Dr. Satoshi Konishi
Co-Founder & Chief Fusioneer, KF



Building B215 at Chalk River, Ontario
Licensed for 100g of Tritium

Testing and Demonstration Facilities – UNITY-2 Overview



A full deuterium-tritium fuel cycle test loop.



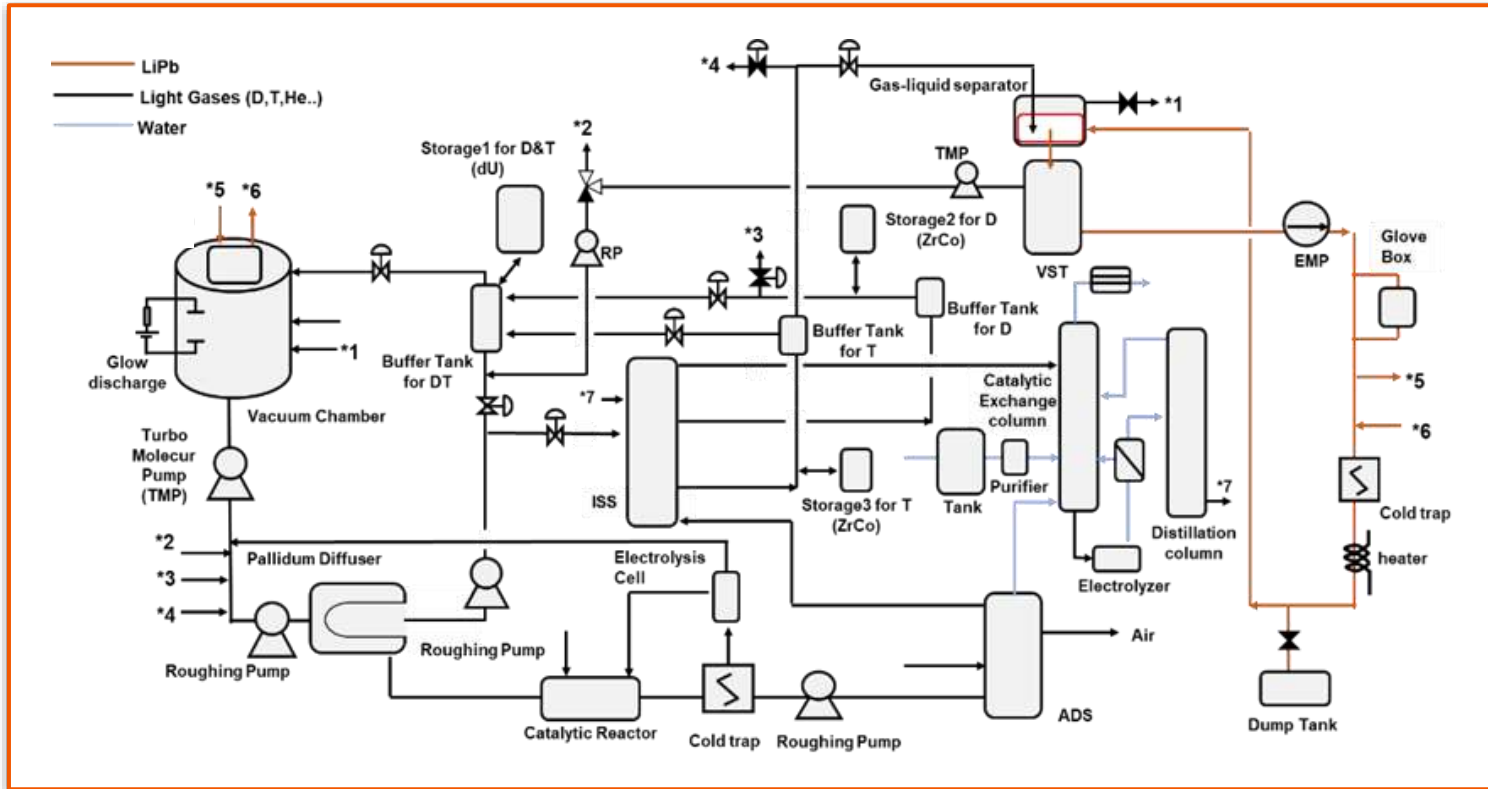
Location: Chalk River, Ontario

Components:

- Tritium Extraction System to be tested with Tritium (~50 L Li-Pb loop)
- Fusion reactor conditions for vacuum chamber (including PEG gases)
- Dual storage system (dU, ZrCo)
- Dual ISS (TCAP, CD)
- Outer cycle included (WDS, ADS)
- Centrifugal Pellet Injection

Tritium:

- **Under review, 10 to 40 g inventory**
- Fuelling of vacuum chamber at ~2.6 Pa m³ / s



2023

Initiation:
Design and individual component testing

2024

Procurement:
Key systems and components

2026

Installation:
Integration of systems.
Planned commissioning



3. Japanese Industry: Action



Function

Devices

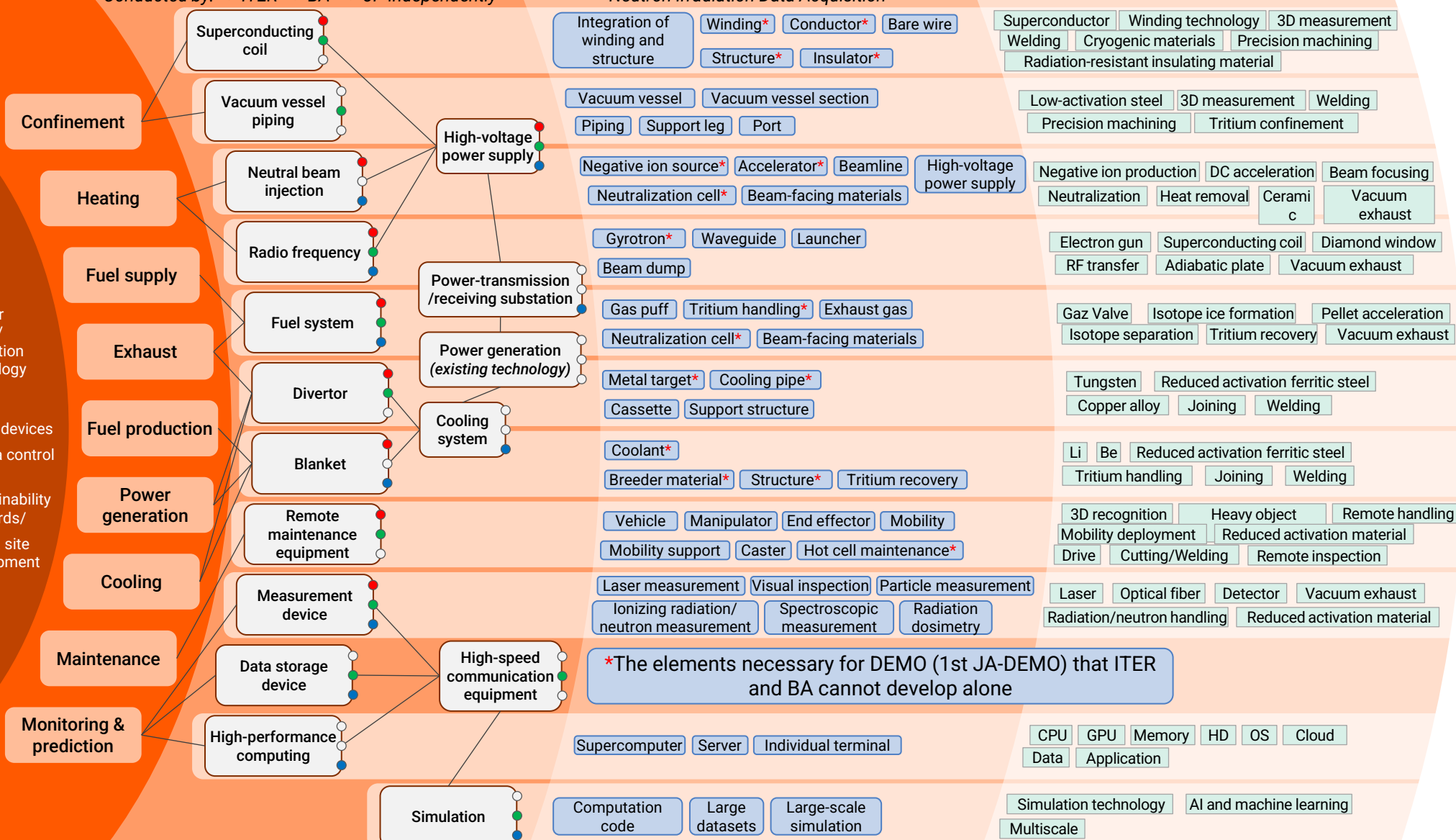
Components

Skills/Materials

Industrialization

Conducted by: ● ITER ● BA ● JP independently

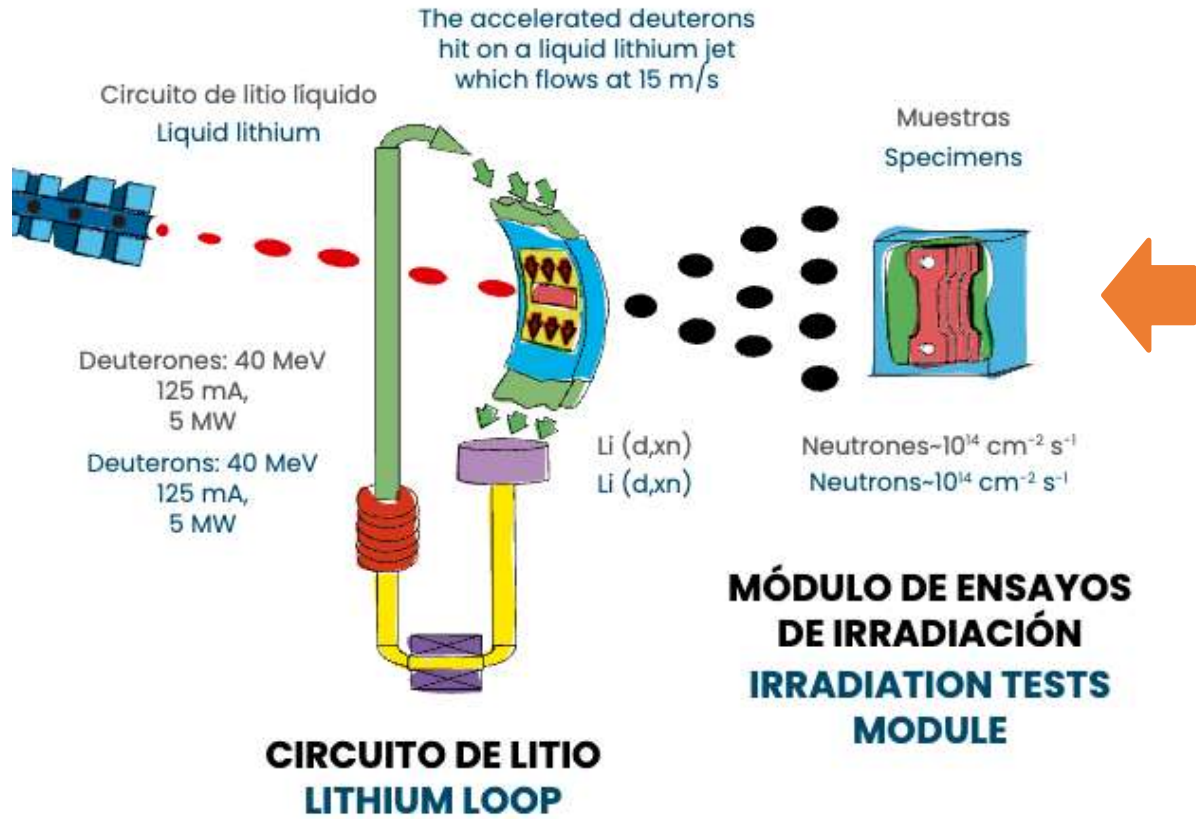
* Neutron Irradiation Data Acquisition



Fusion Plant

- Reactor design/ interaction technology
- Fusion devices
- Plasma control safety
- Maintainability standards/ Criteria site development

Missing Part: Neutron Source and Material Radiation Campaign



KF's fusion clients

Material Radiation Campaign for our clients

- Breeding blanket module radiation
- HTS magnet radiation
- Structural material radiation
- Other material radiation



KF Fusion Network

KF offers a window into a sophisticated and competent fusion ecosystem.

We **connect the global fusion sector to Japan's advanced, fusion-relevant ecosystem** of technology, knowledge, and institutions, complementing strengths in North America and Europe.

Our role is critical in integrating Japan's established fusion expertise into worldwide programs, a strategic step essential for the global commercialization of fusion.



Academia/National Institutions



Industrial Partners

Working with over 70 distinct fusion-relevant suppliers.

+ many more we are working directly with or will tap into when needed.

¡Muchisimas Gracias!

Thank you