The UK fusion programme

Ian Chapman

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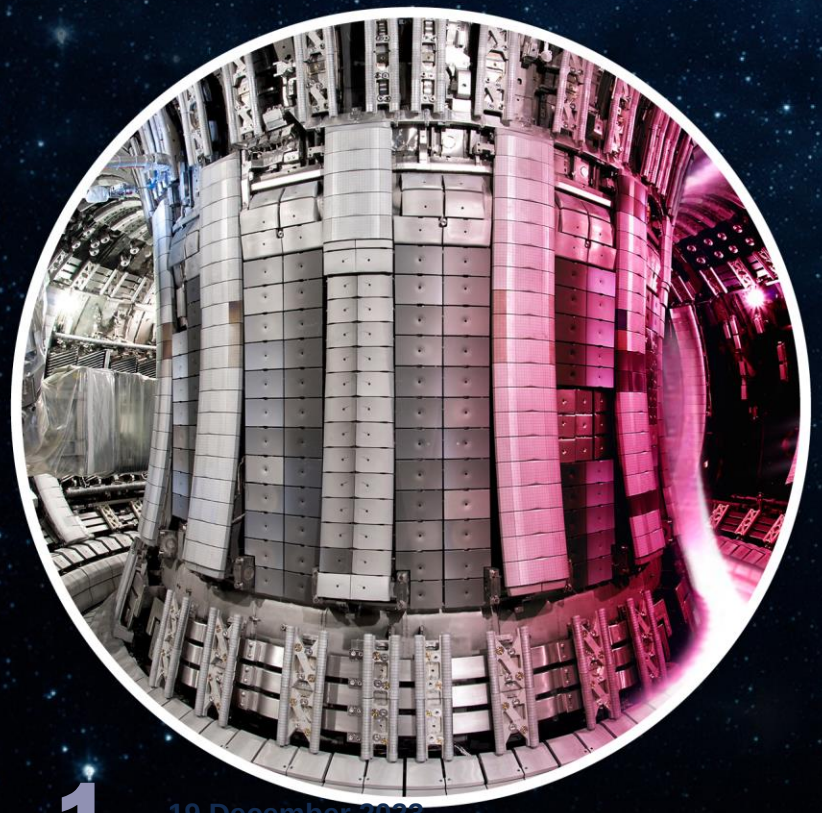

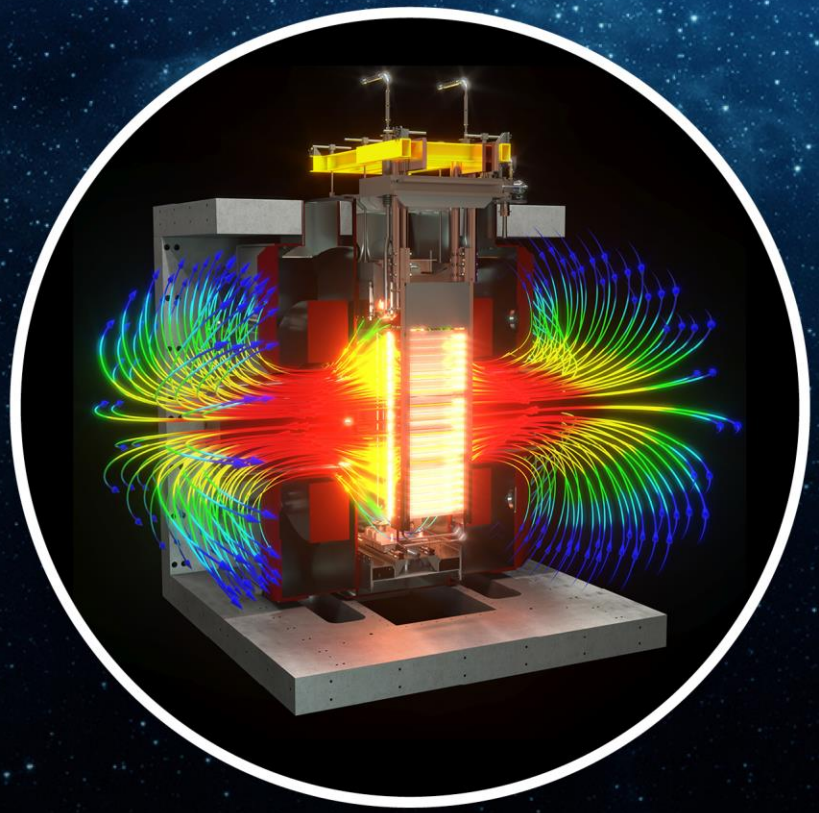

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Policy and Politics
Technical Challenges
STEP Programme
Other UKAEA issues

Futures

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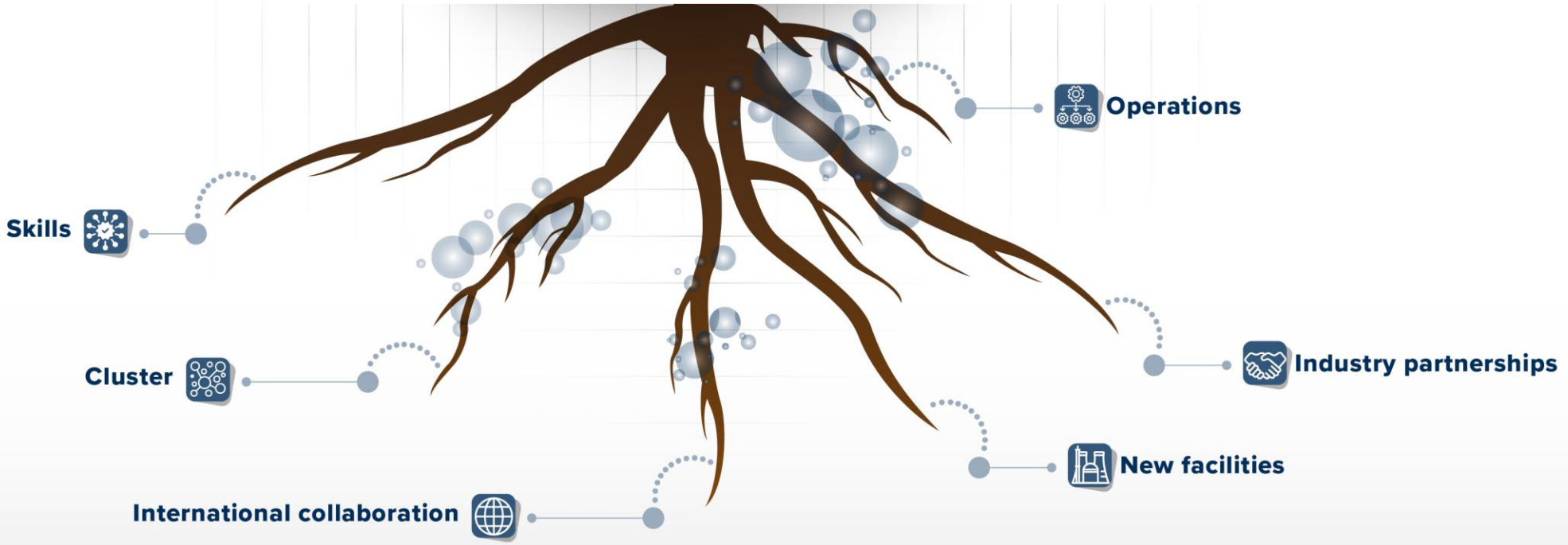

Objectives for UK fusion

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Towards Fusion Energy 2023

The next stage of the UK's fusion energy strategy

October 2023

1. For the UK to demonstrate the commercial viability of fusion by building a prototype fusion power plant in the UK that delivers net energy

2. For the UK to build a world-leading fusion industry that supports different fusion technologies and is capable of exporting fusion technology in subsequent decades

Energy Security Act

The Energy Security Act has now received Royal Assent

These new laws make the UK the first country to legislate for fusion regulation, enabling developers to plan with confidence and encourage investment into fusion

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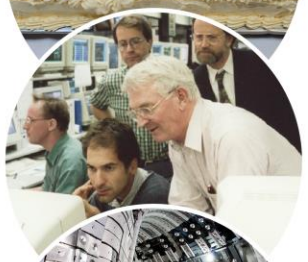
1983 First Plasma

1984 Official opening by Her Majesty Queen Elizabeth II

1991 First deuterium-tritium plasma
World record 1.8 MW



1997 First deuterium-tritium experiments
World record 16.1 MW & 21.7 MJ

2011 ITER-like metal wall installed

2021 Second deuterium-tritium experiments
World record 59 MJ over 5 seconds

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EUROfusion

JOINT EUROPEAN TORUS 40TH ANNIVERSARY

1983 - 2023

JET 40 YEARS
1983 - 2023

2023 40th anniversary

JET moves to next phase of lifecycle

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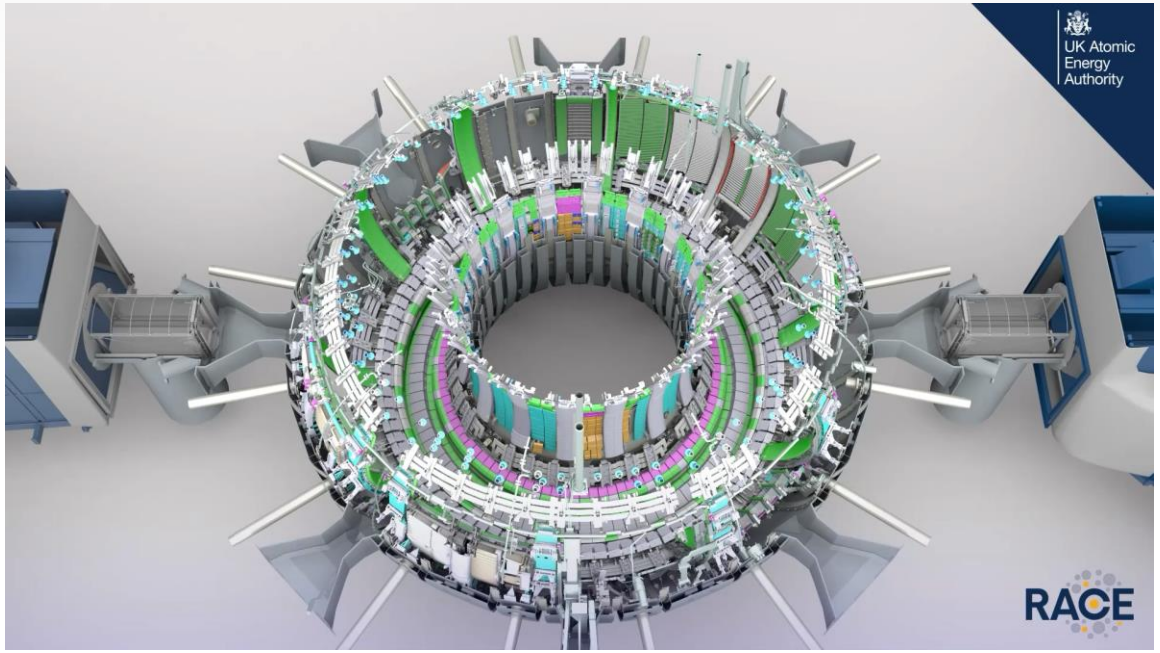
Teams from industry involved in D-T operations and design

Commonwealth Fusion Systems

AtkinsRéalis



- Tritium is fusion fuel not fusion waste, so we plan to detritiate the in-vessel components
- In-situ ‘hands-off’ size reduction to empty the vessel

UK Programme has unique breadth

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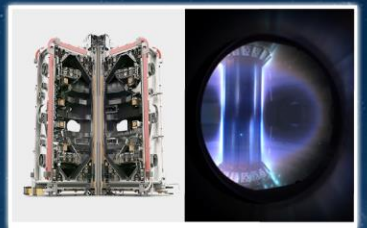
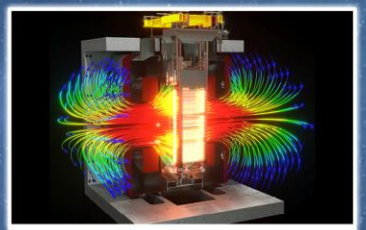
HIGH PERFORMANCE FUSION



SPHERICAL TOKAMAKS

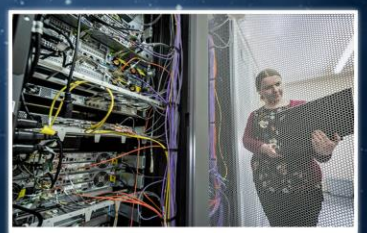
MATERIALS RESEARCH



FUSION TECHNOLOGY

ROBOTICS

TRITIUM



ADVANCED DIGITAL COMPUTING

POWERPLANT DESIGN

INDUSTRY DEVELOPMENT

SKILLS DEVELOPMENT

TECHNOLOGY TRANSFER

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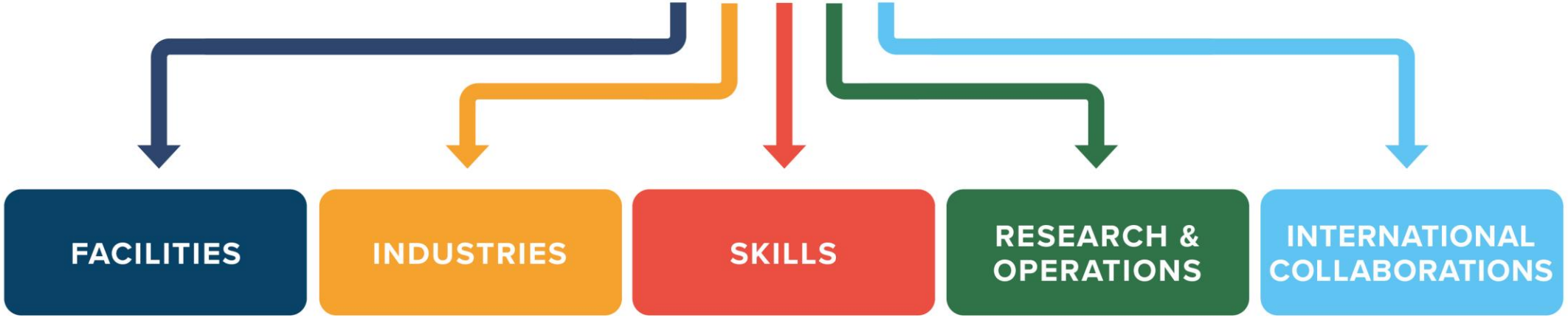
$800M FUSION FUTURES PROGRAMME



LIBRTI: ~$250M Testbed Programme

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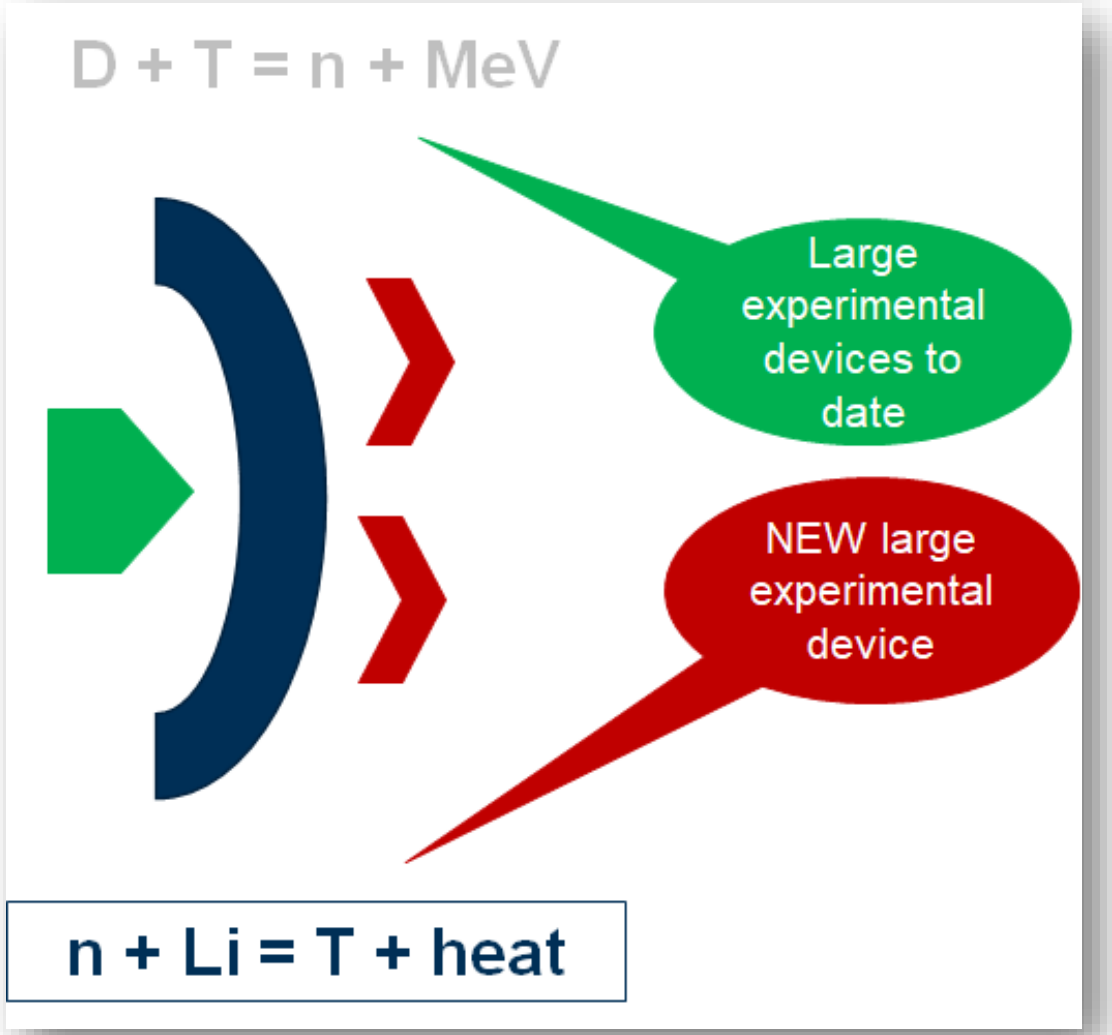

- ✓ Predict and reproducibly achieve known quantity of tritium out for known quantity of neutrons in
- ✓ Across a given lithium substrate (liquid, solid, anything in-between)
- ✓ LEARN BY DOING
- ✓ PHYSICAL INTEGRATION
- ✓ IN SILICO REPLICATION

Fusion Skills

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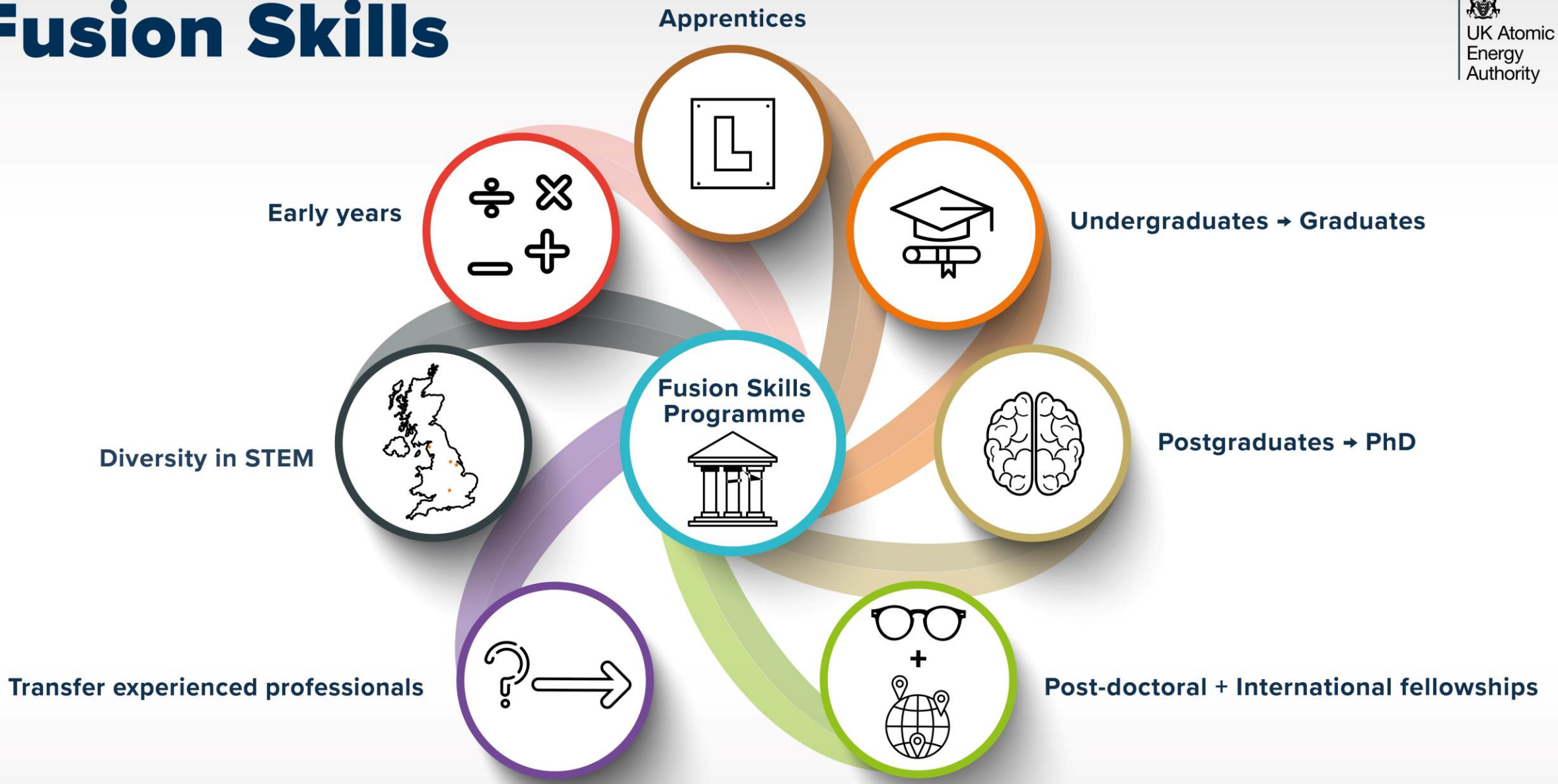

#FusionGeneration

Controlling the Exhaust in MAST-U

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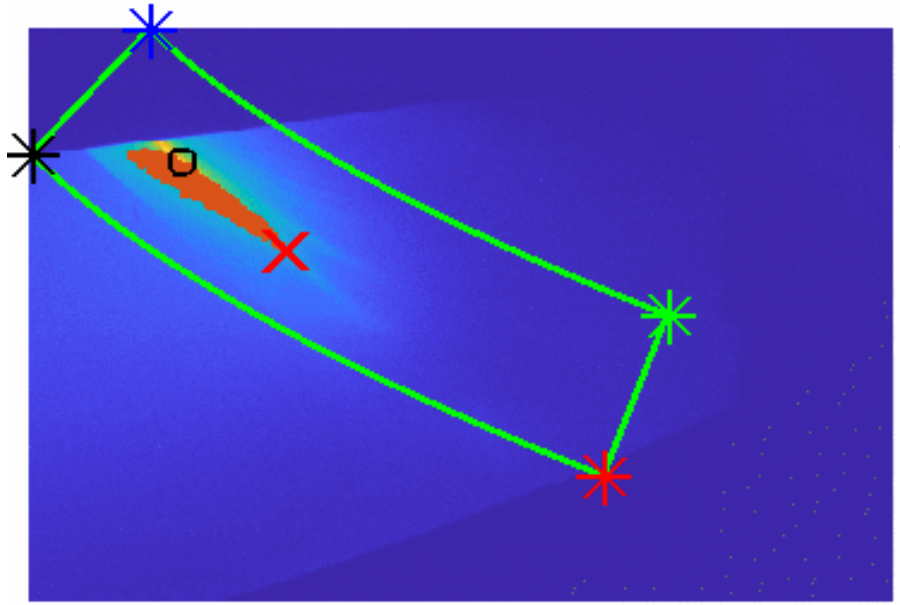
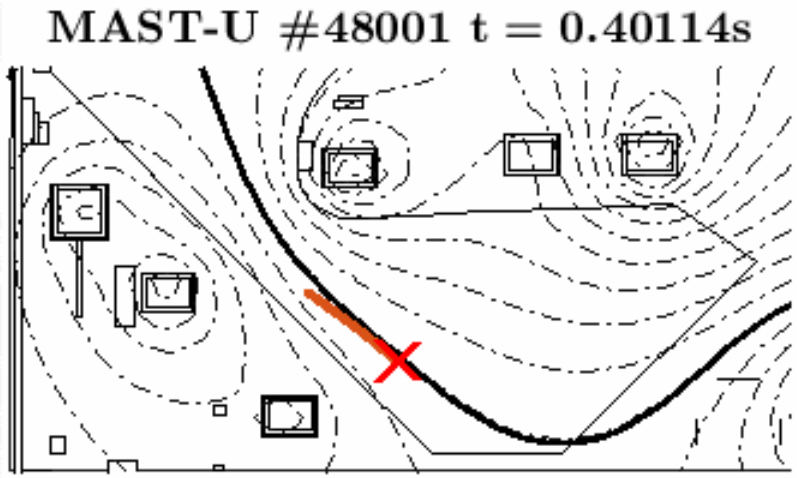
Control of the plasma temperature in the MAST-U Super-X divertor demonstrated for the first time, in collaboration with the DIFFER institute.

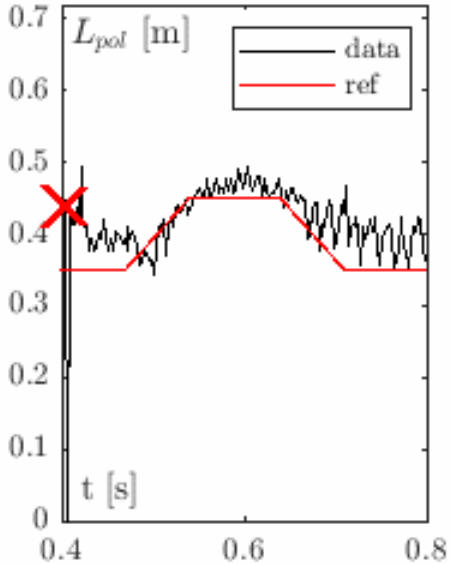
Movie of light from D_2 molecules



Projection of detachment “front” projected on MAST-U cross-section



Measured & demand front position



Nature paper in preparation on this innovative results

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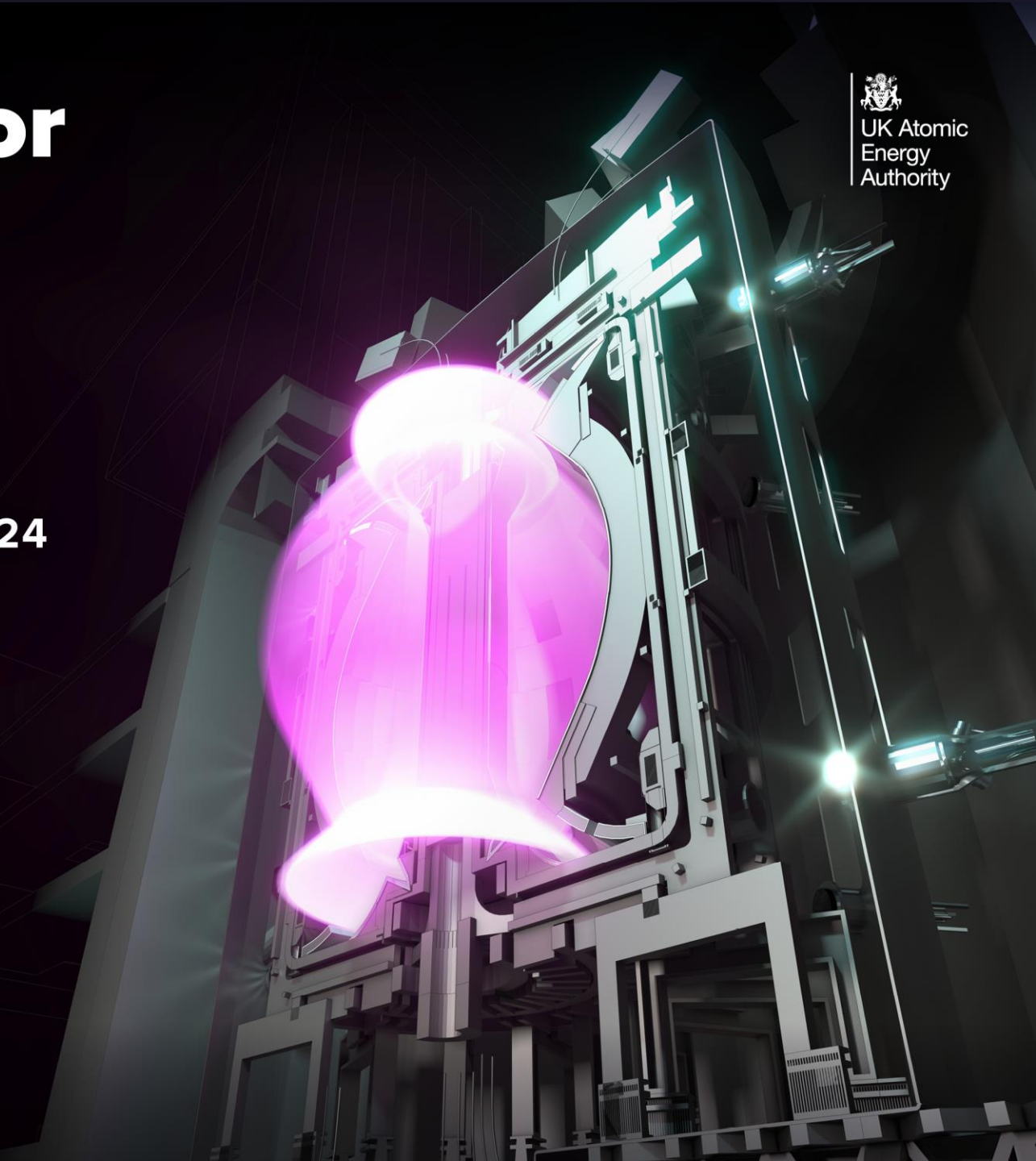
Spherical Tokamak for Energy Production

- Predictable net energy production
- Aim to minimise capital cost
- $380M investment for concept design by 2024



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STEP high-level schedule

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Concept (till 3/24)

- Concept/ reference plant design
- Regulatory Framework
- Site selection
- Transition to target operating model

Detailed design & mobilisation

- Engineering design
- Long lead procurement
- Early manufacture
- Site development

Main construction

- Full plant manufacture & assembly
- Full site development
- Equipment & System testing

Commissioning & operations

- Non-active & active commissioning
- Prototype ops

Build Public-Private Partnership

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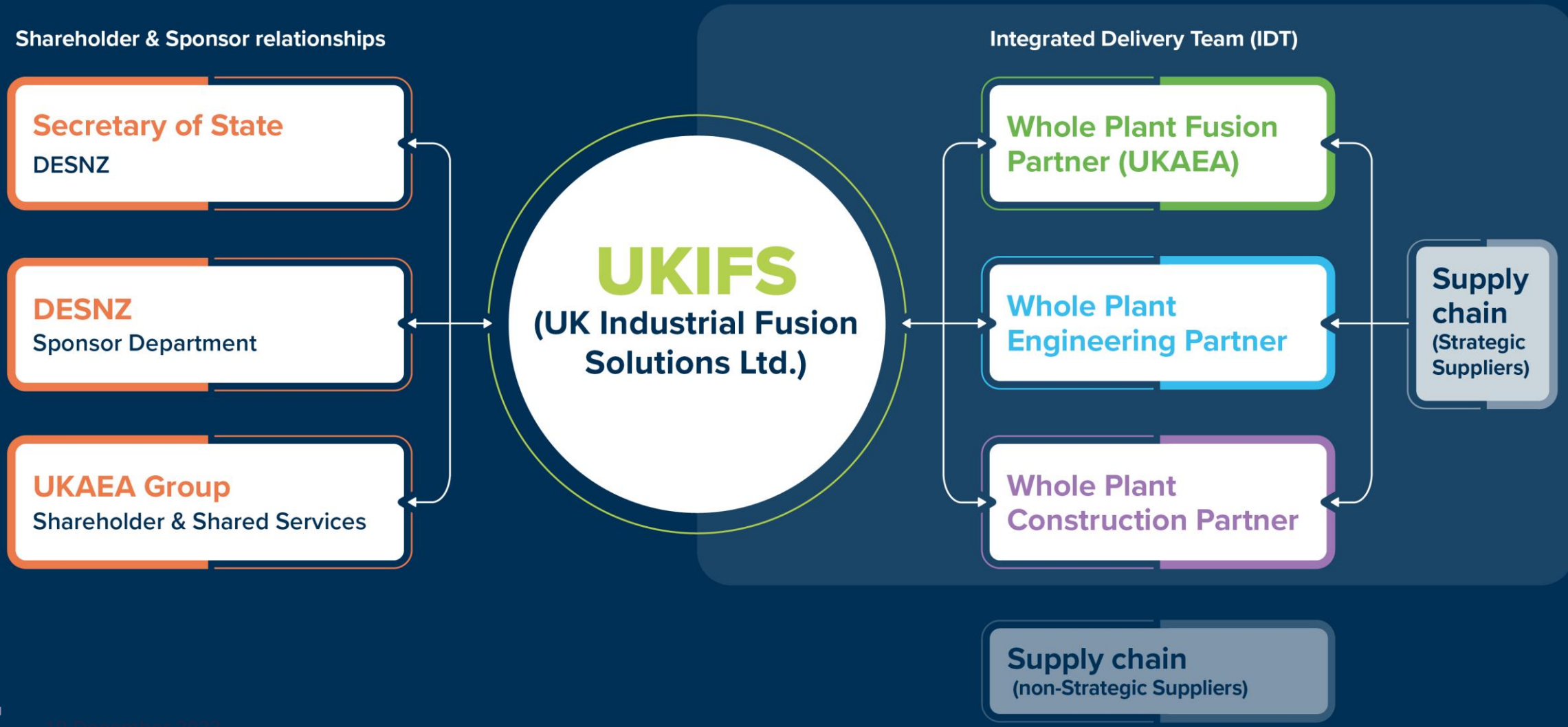

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Developing a fusion campus

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Skills - Apprentices

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460 learners from
35 organisations now in training
and aim to scale up to
1000 within **3** years

UK fusion is moving at pace

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- Major advances this year: JET D-T, new facilities, campus regeneration
- STEP progressing on track. Concept design by 2024
- Growing fast – now ~2600 people in UKAEA and >4000 people at Culham
- Major collaboration with industry and will see increasing support for this