



Orbit Fab Refuelling Interface and Service Mission Development Progress in Europe

Sebastian Hill

Clean Space Industry Days
October, 2024



OUR MISSION

To Build the In-Space
Propellant Supply Chain

OUR VISION

A Bustling In-Space
Economy Supporting
Permanent Jobs In Space



ORBITFAB

- Founded in 2018 to build the in space propellant supply chain
- 60+ FTE & growing globally; Colorado, USA HQ + UK office (Harwell)
- VC-backed, raised \$30m+ from investor including Lockheed Martin & Northrop Grumman
- Two successful space flight missions conducted
- First private commercial company to resupply the ISS with water
- RAFTI baselined on 100+ gov't & commercial satellites
- UK office operating since 2022, growing European capability



HQ - CO, USA

- 56,000 Sq. Ft. of office, manufacturing, assembly, integration, and test space
- Prototyping, Electronics Lab, Machine Shop
- Clean Rooms (ISO-7 rated)

UK Office - Harwell, UK

- 15-person team – Mech, System, Fluidics and Test Engineering
- Rapid Prototyping, Robotics and Fluidics testing Lab
- ESA, UKSA and commercial project backlog



Key Milestones - Global



2018-19

Furphy

First privately-owned mission to resupply water to the ISS



2020-21

Tenzing

First commercial fuel depot in space



2023- 2024

RAFTI Qualified

Hydrazine and LP propellants

Podracer

Rendezvous and proximity ops testbed



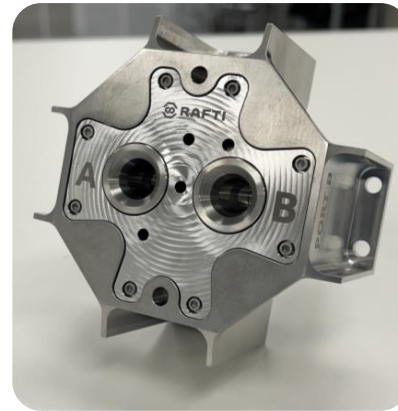
2025-26

First Refuelling

First commercial fuel depot offering self-service refuelling

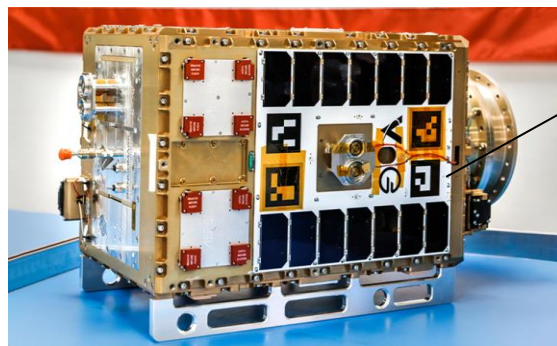
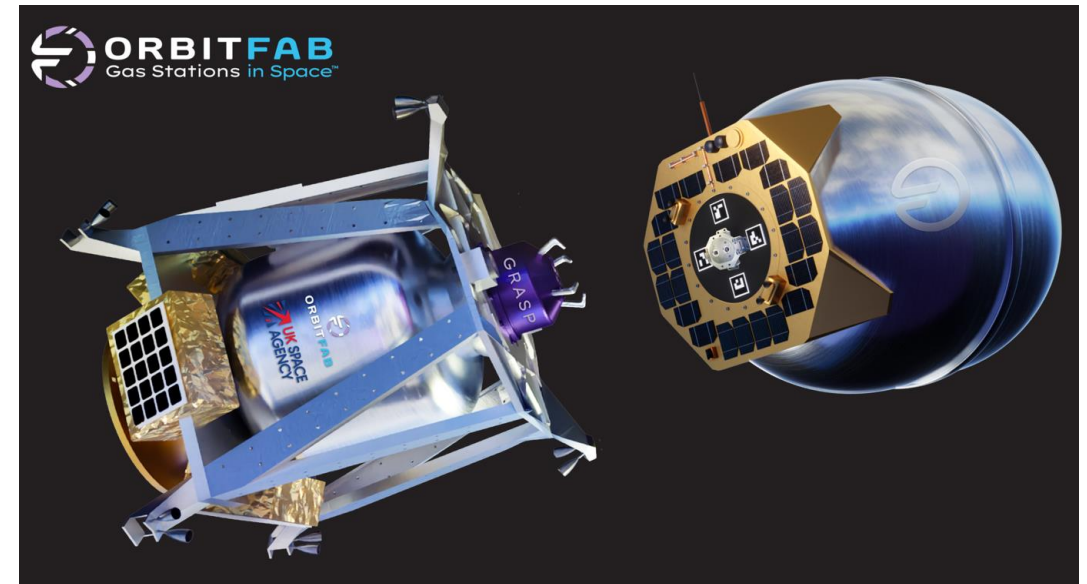
Client Mounts RAFTI & Fiducials

- RAFTI – Mount RAFTI on Client spacecraft according to user guide
- Fiducials – Incorporate LWIR compatible fiducial ArUco markers on the same face of the spacecraft as RAFTI (offered by Orbit Fab).



Qualified for Hydrazine!

Refuelling Performed By Orbit Fab Vehicles



Fiducials

Example fiducial mounting on Orbit Fab's Tenzing spacecraft

Refuelling Missions Optimised by UMPIRE



UMPIRE

Universal Mission
Planner to Investigate
Refueling Effectiveness

Shuttle-Depot Architecture

Orbit Fab Interfaces:



RAFTI

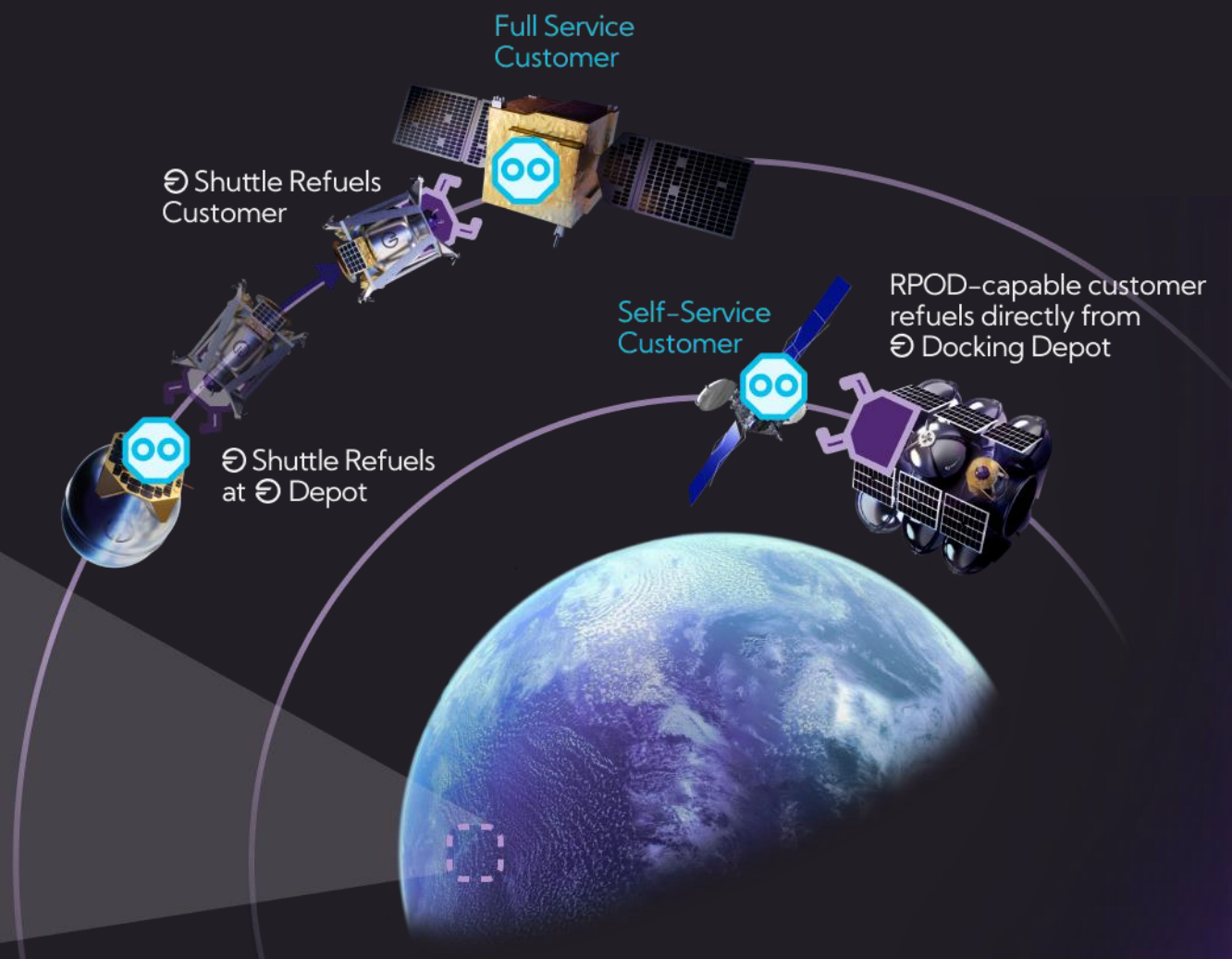


GRIP/GRASP

Manual Ground Fueling with RAFTI Ground Coupling



Automated Ground Fueling





UK Technology Development

- Architecting future UK + European refuelling mission designs
- Development of Refuelling Vehicles (Shuttles and Depots)
- High pressure, ITAR free interface solutions (RAFTI and GRASP) are being qualified in the UK
- Development of efficient RPOD systems (with partners)
- Advanced Mission Concepts for ISRU and circular space economy

UK Business Development

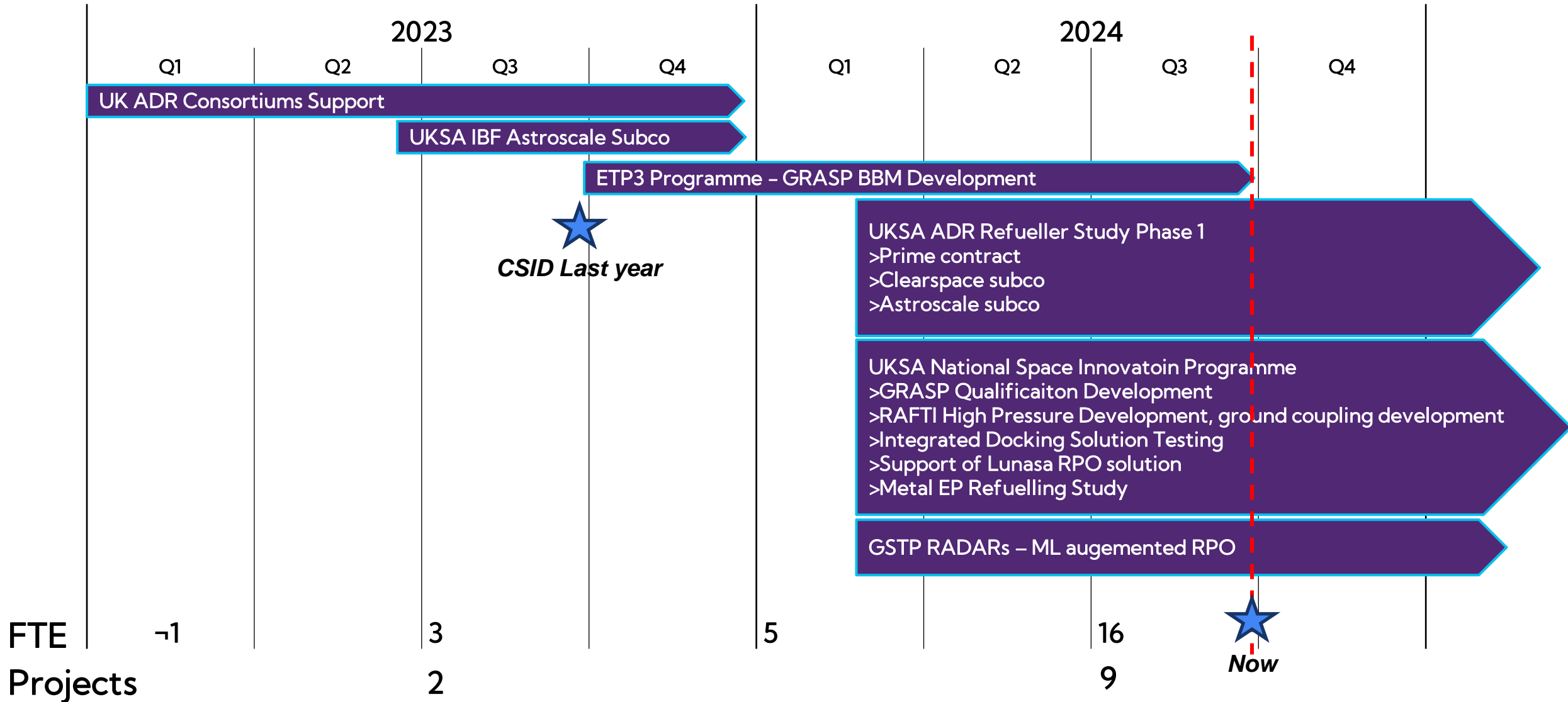
Existing Contracts

- UKSA UK Refueller Study - Prime
- Multiple UKSA National Space Innovation Programme contracts
- GSTP Development Contracts
- UKSA Enabling Technology Programme

Future

- More projects TBA
- OFL building towards IODs of critical technology

2023 - 2024 Progress (UK Team)

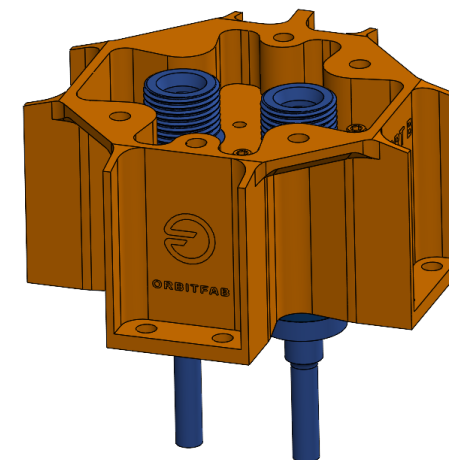


- Low pressure version qualified and being delivered to first customers to support near-term hydrazine / CP refuelling
- UK team developing the high pressure version suitable for nitrous biprop and EP systems
- Key de-risking and breadboard testing already conducted (proof, leak, actuation)
- EM build and test campaign planning ongoing



RAFTI Block 3

- 2 x Passive Valve Cores
- Passive Grapple Fixture
- Not ITAR Controlled
- MEOP of 27 Bar
- Qualified and fulfilling orders
- Suitable for ground and space fuelling of hydrazine



RAFTI-High Pressure

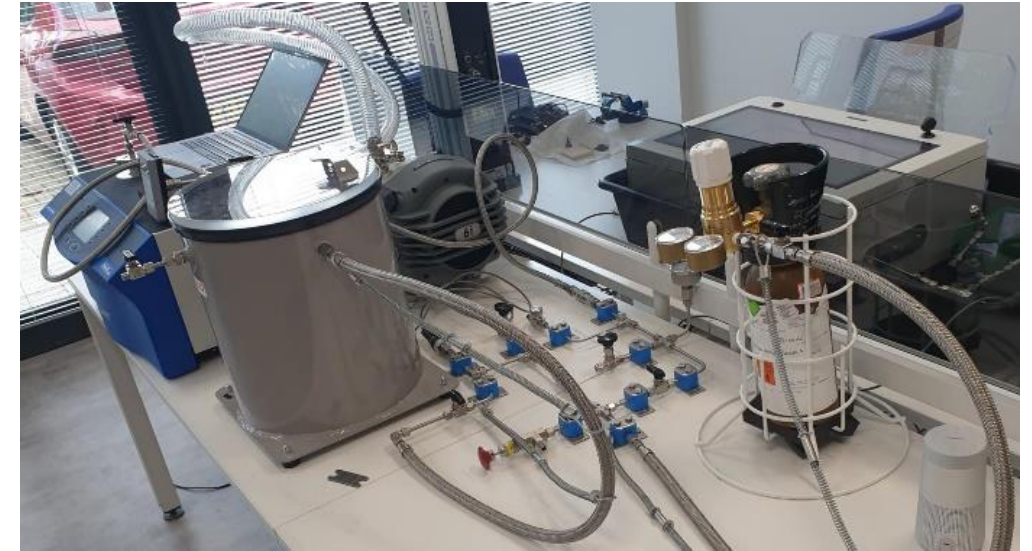
- 2 x Passive Valve Cores
- Passive Grapple Fixture
- Not ITAR Controlled
- MEOP of 300 Bar
- TRL5, Qual expected Q3 25
- Suitable for ground and space fuelling of N2O, Ethane, Xe, Kr++

RAFTI Progress Cont.

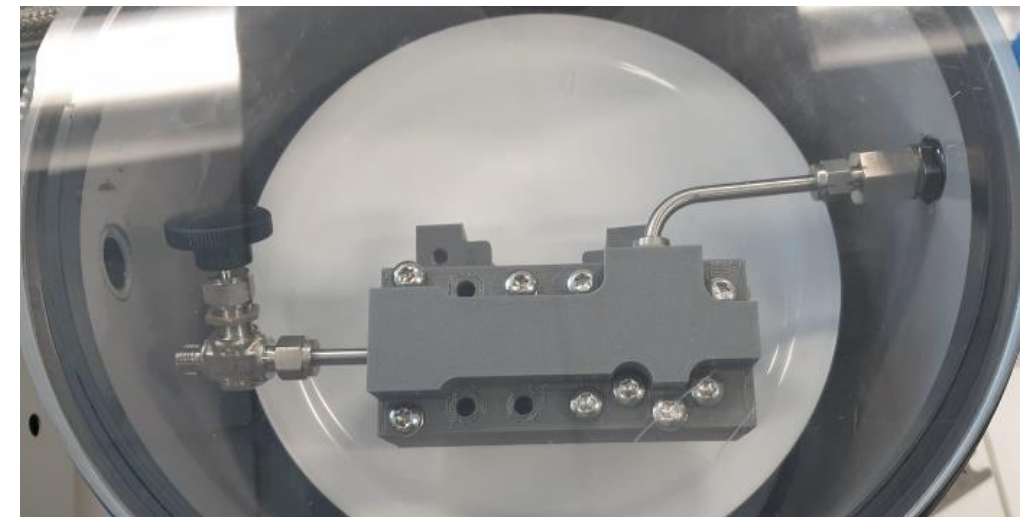
- High pressure de-risk testing with development models and BBMs under way in multiple campaigns
- End to end testing with GRASP to be conducted before qual campaign



Hydrostatic proof and burst testing of components to ensure safety and structural integrity

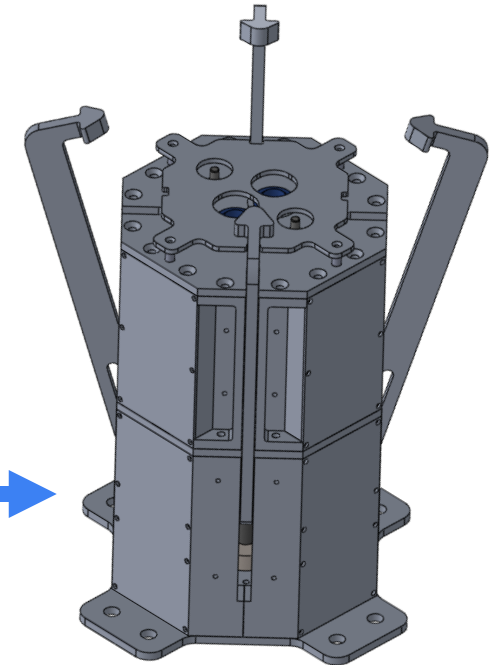
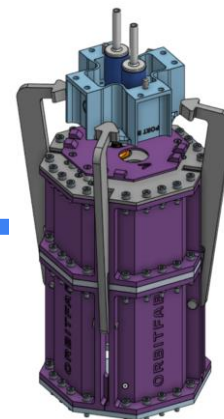
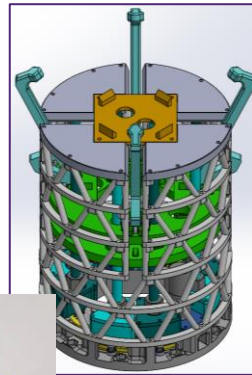
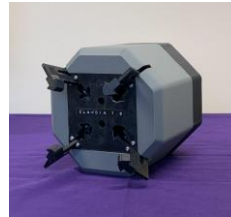


Helium leak testing of refuelling coupling concepts and active/ passive valve cores



GRASP Progress

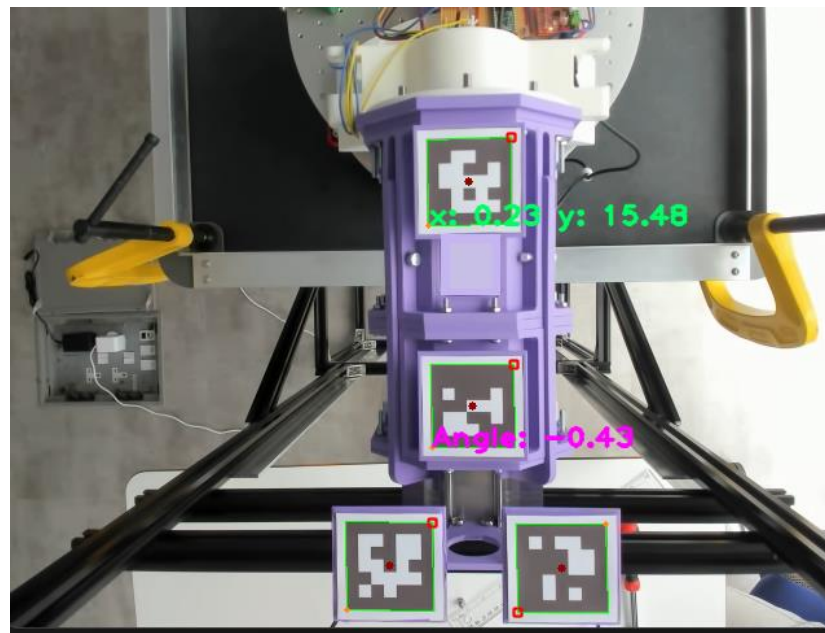
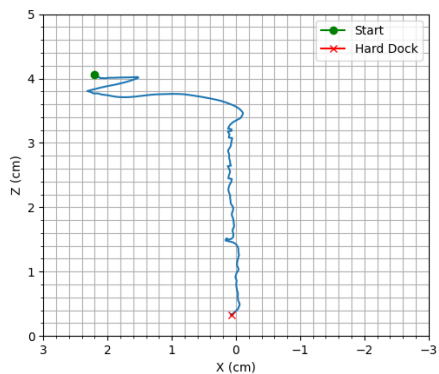
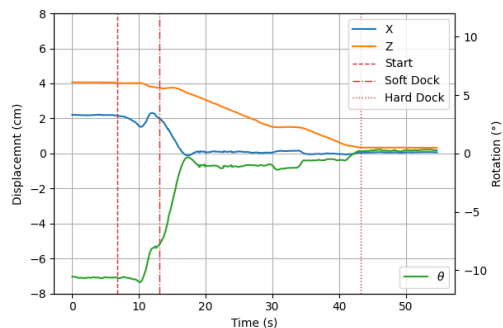
- Active interface for high pressure propellants being developed to qualification in the UK under NSIP SPITFIRE project
- Breadboard testing already performed with many iterations, including air bearing testing and coupling tests. **Currently building EMs**, with higher level docking tests to be conducted with RAFTI, sensors and drive electronics in the loop



GRASP

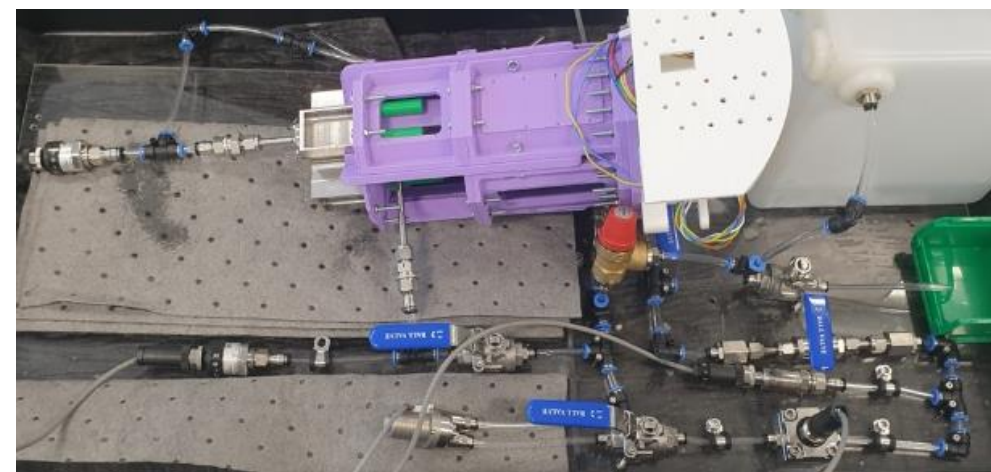
- Contains 2x Active Valve Cores
- Active Grappling Mechanism
- Not ITAR Controlled
- For use on any OF vehicles
- Pressure Agnostic
- TRL4 , Qual Expected Q4 25

GRASP Progress Cont.



Preliminary air bearing tests investigating coupling and de-coupling behaviour

Mechanical and fluidic coupling demonstration with flow vs pressure drop test

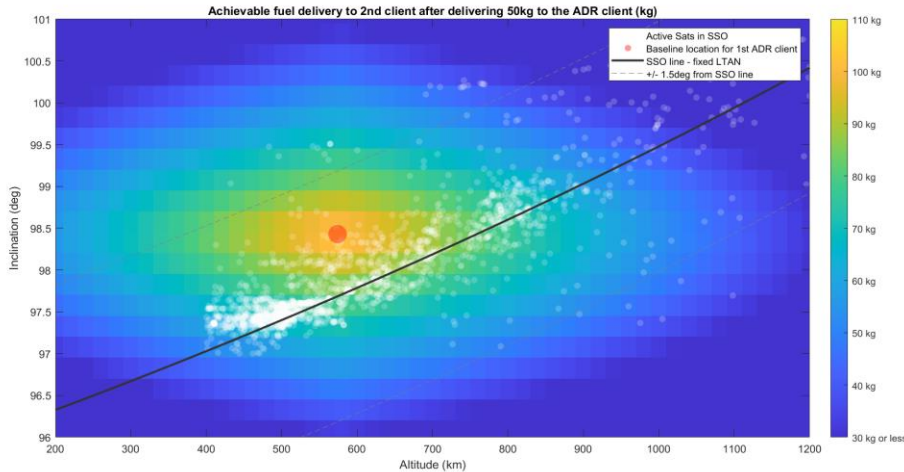


RAFTEA Mission Study

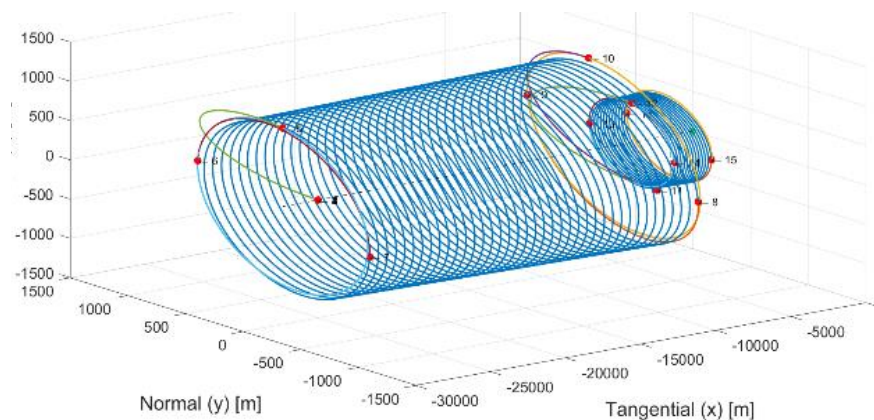
- Phase 1 study for UKSA to generate a mission concept to refuel the UK-ADR vehicle. Mission and vehicle design led by Orbit Fab in the UK.
- In Consortium with MDA, D-Orbit and Clearspace. Also supporting CS and AS as subco on their mission studies
- Objective is to refuel the **ADR vehicle** and a further **commercial refuelling client**
- Persistent refuelling service is being studied in LEO SSO – 100kg+ deliveries possible with driving earliest service date expected end of 2027



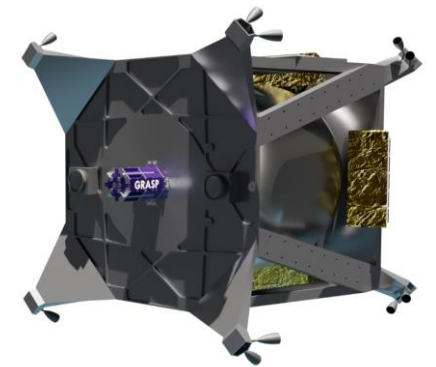
Mission Study Artwork



Fuel Delivery Capability Heat Map in SSO



Servicer- Client RPO Plan



Vehicle Preliminary Artist Concept

- Orbit Fab Ltd is now developing to qualification the enabling technologies for refuelling to support European missions, in the UK.
- RAFTI and GRASP are on track to be qualified next year for most spacecraft propellant use cases
- Orbit Fab is establishing refuelling mission concepts to support space sustainability efforts such as ADR
- The team is rapidly ramping up and fully executing on the technical roadmap
- Now that there is a path to qualifying the key technology on the ground, OFL is focusing towards building up options for IODs to de-risk refuelling operations in the space environment to lower barriers to adoption of commercial services



Q&A Discussion

- Want to talk about refuelling?
- Want to work on technology developments together?
- Get in contact!

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