



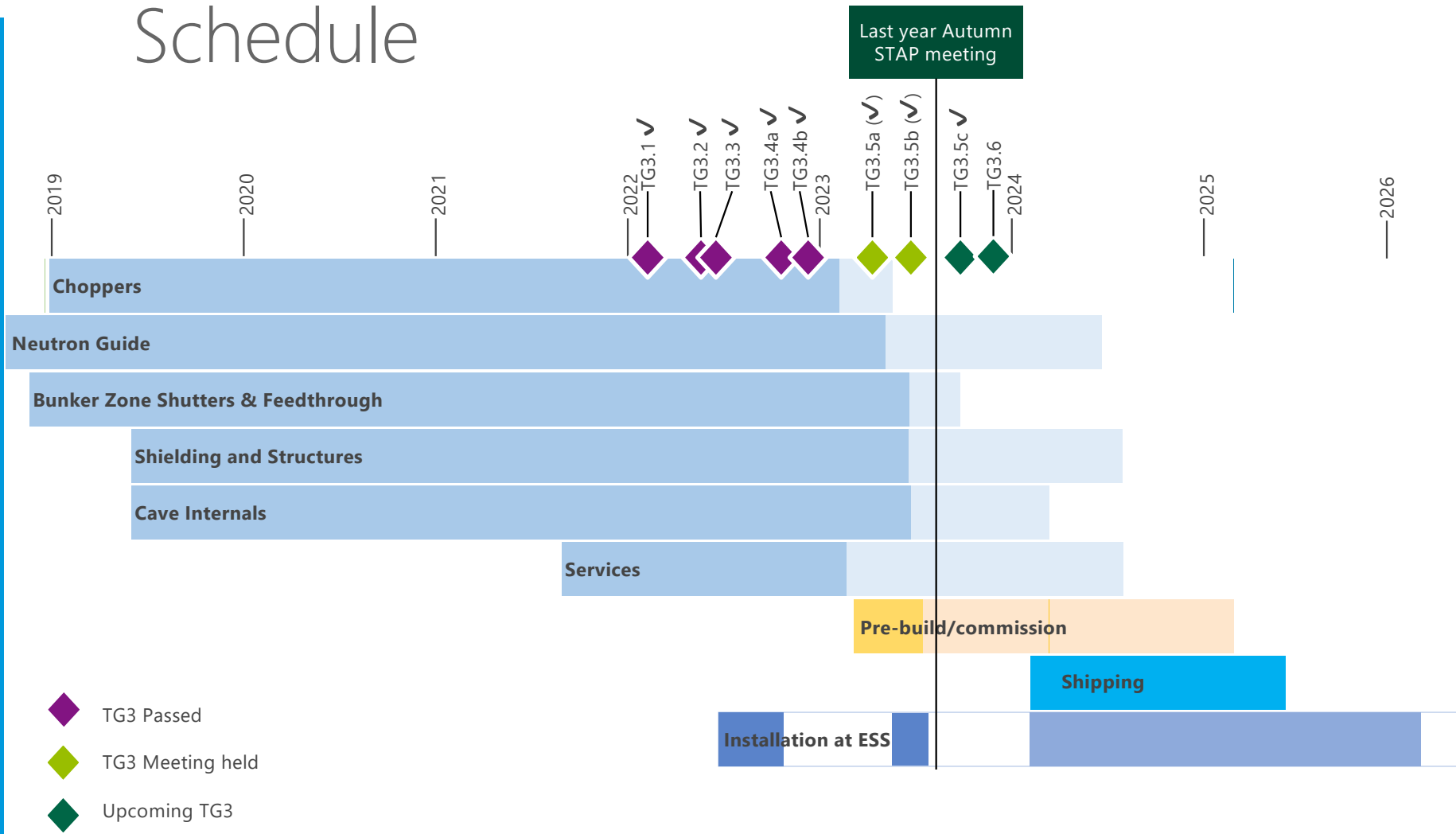
FREIA Project Update

Reflectometry STAP

PRESENTED BY TOM ARNOLD

2024-10-14

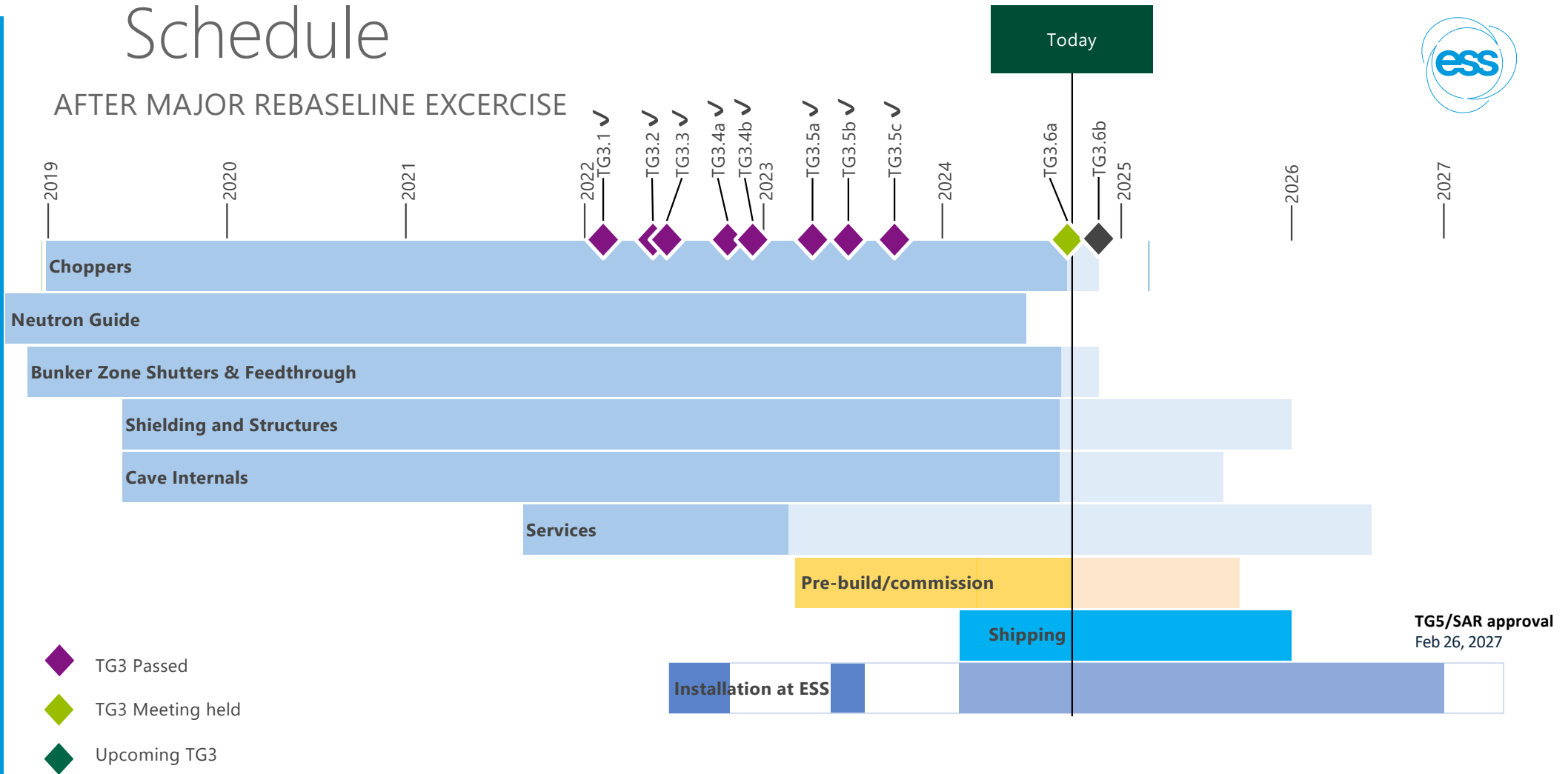
Schedule



- ◆ TG3 Passed
- ◆ TG3 Meeting held
- ◆ Upcoming TG3

Schedule

AFTER MAJOR REBASELINE EXERCISE



Freia Critical Paths

Data from P6 August 2024 lockdown

Final TG3
Oct 29, 2025

Start of CC
Sep 28, 2026

TG5/SAR approval
Feb 26, 2027

2027

2024		2025		2026		2027
Q1	Q3	Q1	Q3	Q1	Q3	Q1

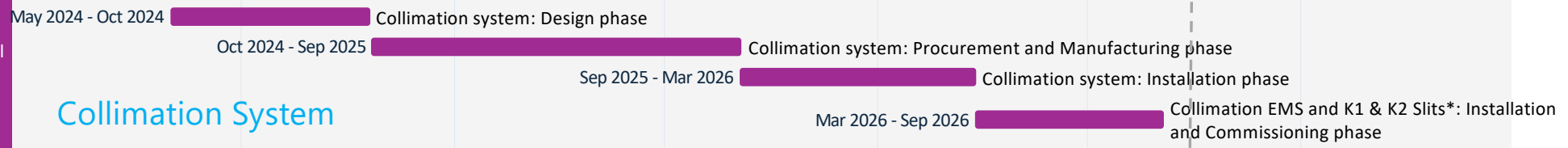
No. 1 - Critical Path
(0 days TF)

Beam Monitors



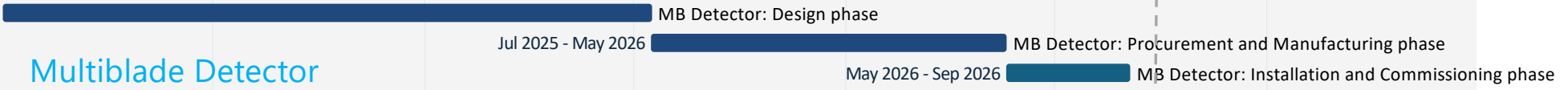
No. 2 - Critical Path
(14 days TF)

Collimation System



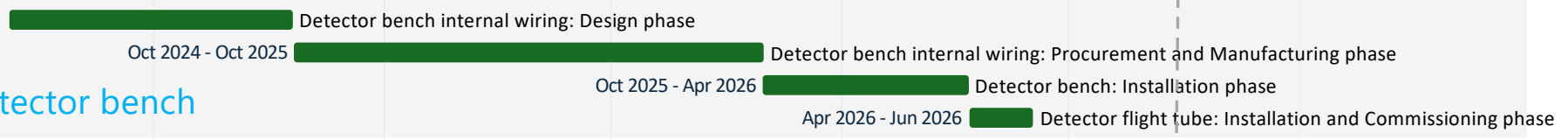
No. 3 - Critical Path
(14 days TF)

Multiblade Detector



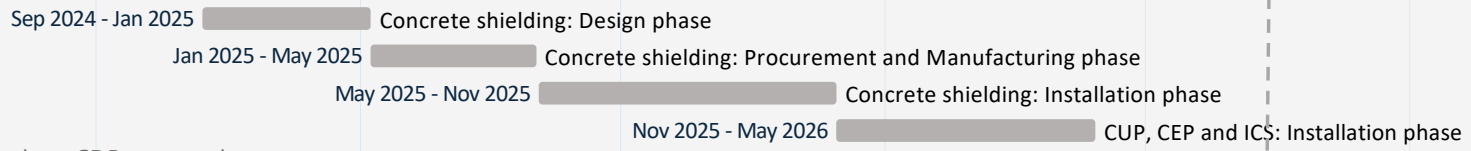
No. 4 - Critical Path
(60 days TF)

Detector bench



No. 5 - Critical Path
(64 days TF)

Cave



Design phase ends at CDR approval
Procurement and Manufacturing phase ends at FAT closure of open points
Installation and Commissioning phase ends at SAT approval
TF: number days of **total float** to Instrument's TG5

*Dependency to beam monitor project
Note: Beam Monitors 3-6 are not included in the above critical paths. Plans are under evaluation

FREIA Status

WFM Choppers

- Quality issues resolved
- Testing in progress

Collimation System

- Collimation vessel delivered to STFC
- Collimation translation stages assembly & wiring complete
- Kinetics slits assembled
- Guides and support structure designs complete

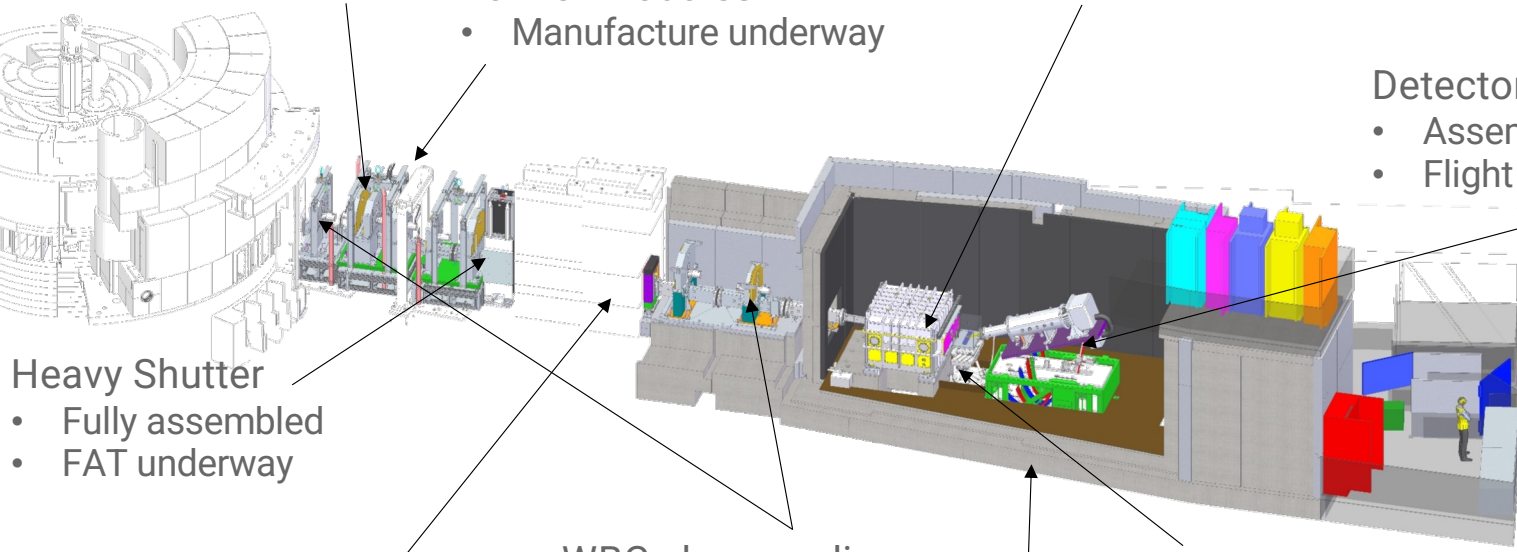


Bunker Modules

- Manufacture underway

Detector Bench

- Assembly of motion system in progress
- Flight tube design complete



Heavy Shutter

- Fully assembled
- FAT underway

Bunker Wall Feedthrough

- Installed!

All guides

- Delivered to ESS

WBC chopper discs

- Manufacture complete
- Coating in progress

Sample Positioning System

- Delivered to ESS

Shielding

- Concrete contract placed
- Neutronics contract underway at UKAEA



Hutch furniture delivered!

FREIA Pre-build at STFC

Chopper assembly

Chopper testing

Bunker modules

Vacuum housings

Lifting frames

Bases

Translation stages

Collimation vessel

Heavy shutter:

Mechanism

Walls

Detector bench

Disc Summary



	Disc status	Progress
WBC1 (14Hz)	Disc manufacture complete, ready for coating.	Metrology of re-worked spindles satisfactory. Coating trials in progress.
WFM1 (56Hz)	Disk reworked by ADSF. Re-balanced using CF/epoxy to free up balancing holes.	Mounted to spindle, awaiting final spin.
WFM2 (56Hz)	Disk reworked by ADSF. "Tilt" balance weights added.	Successfully operated at 56Hz.
FOC1 (56Hz)	Disk reworked by ADSF. "Tilt" balance weights added.	Successfully operated at 56Hz.
WBC2 (14Hz)	Disc rebalanced at ISIS	Metrology of re-worked spindles satisfactory. Ready for operation testing
FOC2 (42Hz)	Disc reworked by ADSF. Balancing carried out.	
FOC3 (28Hz)		
WBC3 (14Hz)	Disc manufacture complete, ready for coating.	Coating trials in progress.

Chopper Commissioning

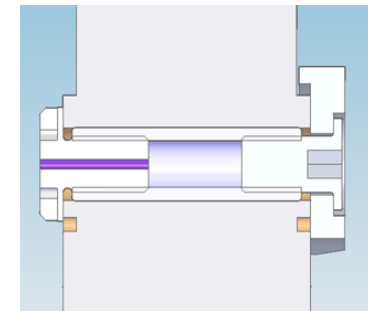
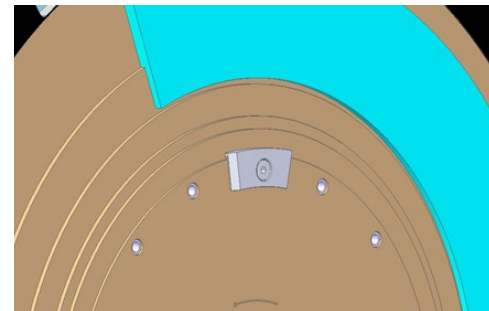


Initial testing of the three 56Hz chopper assemblies identified quality issues with both the ADSF carbon-fibre chopper discs and SKF spindles, which were returned for rework as detailed previously.

The last batch of reworked spindles have been delivered and are awaiting metrology. Tighter quality checks are being placed on the spindles to reduce the risk of further delays to spindle availability.

The WFM2 and FOC1 discs has been successfully tested over recent weeks. The identified "out-of-plane" or "tilt" imbalance has been greatly reduced with the addition of offset balance weights. Both discs exhibit a harmonic near to operating speed, as seen in testing last year, which we expect to change when the discs are assembled into modules. Testing of WFM1 is next up.

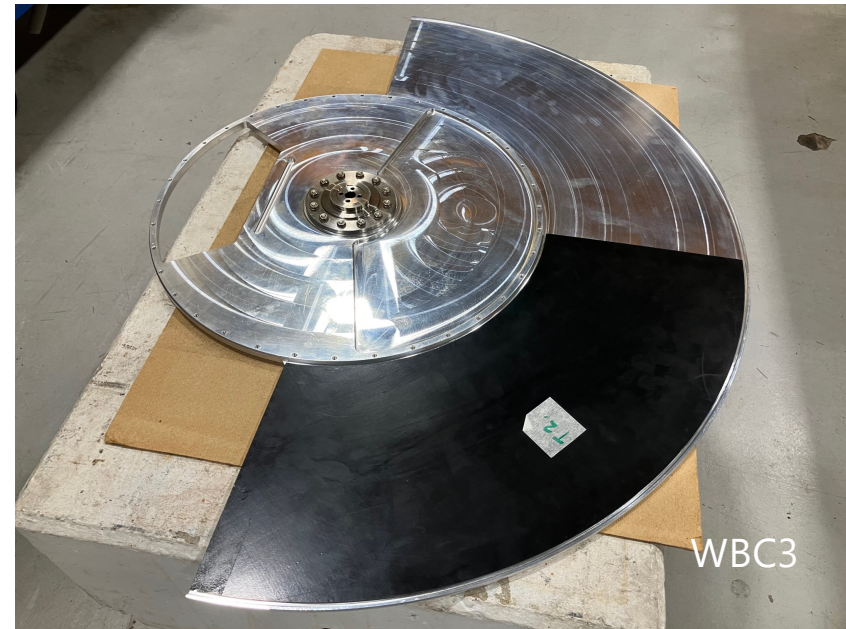
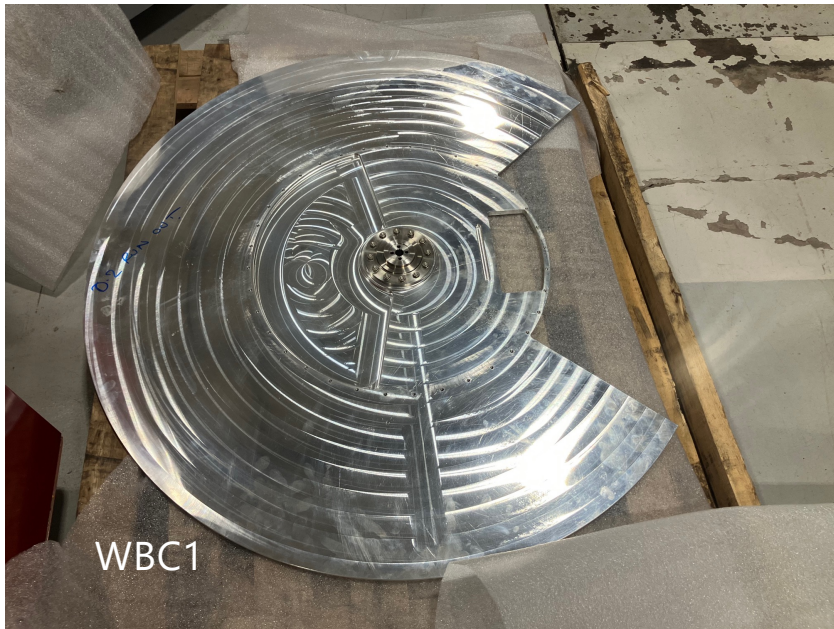
Additional ports have been added to the upper housings to aid installation of balancing weights from either side.



WBC Choppers



After some difficulties the Aluminium choppers are delivered and ready to have the absorbing B4C tiles bonded on. Test piece tile shown below on WBC3
Slight issue on WBC1 window shape (6us <math><0.2\%</math> wavelength error) => deemed acceptable

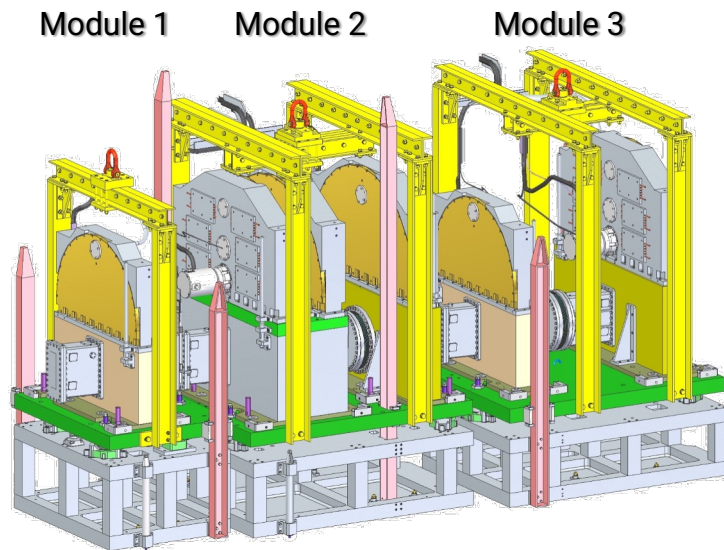


Bunker Modules

All components have now been delivered to RAL.

Assembly of the modules is progressing well, including installation of the module 2 choppers

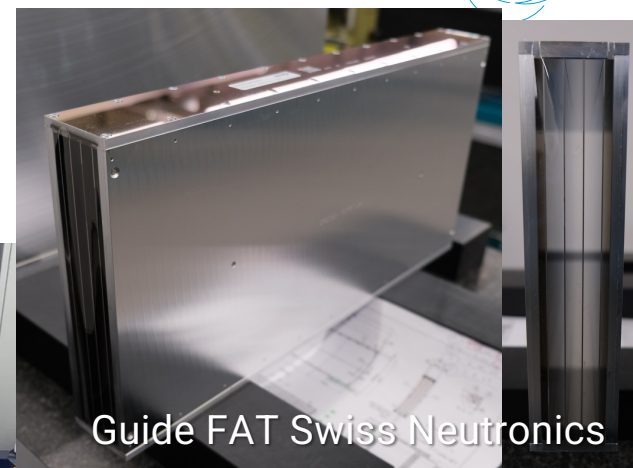
Intermediate vacuum tests identified some issues with some leaking ports. A solution has been found which is now being implemented on the relevant parts.



Major Contracts



- NBOA (Monolith Insert) – S-DH – contract completed
- Carbon Fibre Chopper Discs – Airbus – contract completed
- Guide – Swiss Neutronics
 - All guides Delivered to ESS
- Collimation Vessel – AVS-ES
 - Delivered to STFC
- Slits – JJ X-ray
 - Delivered to STFC
- Sample Positioning System – Symétrie
 - Delivered to ESS
- Concrete shielding
 - Design/manufacture/installation contract started: PDR in Oct



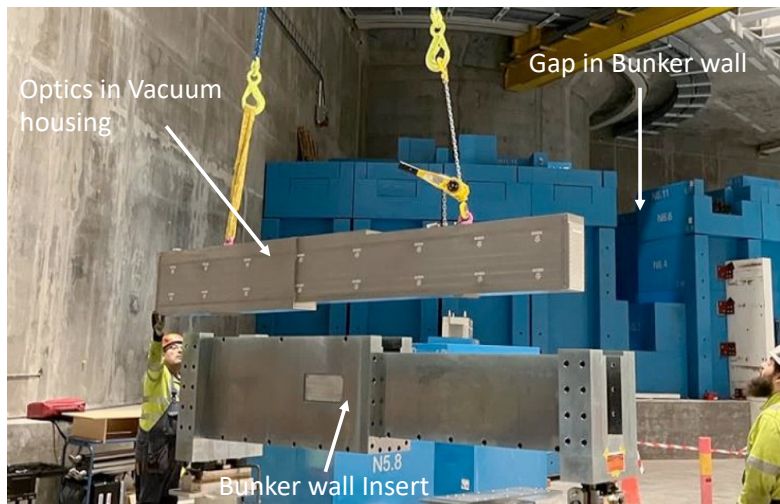
Bunker Wall Feedthrough and Light Shutter



The bunker wall feedthrough: Alignment bases (STFC), Shielding insert (PureNetwork) and Vacuum vessel & guide (Swiss Neutronics)

Light Shutter Assembly (ESS), Vacuum vessel (STFC) and guide (Swiss Neutronics)

All components fully installed at ESS!



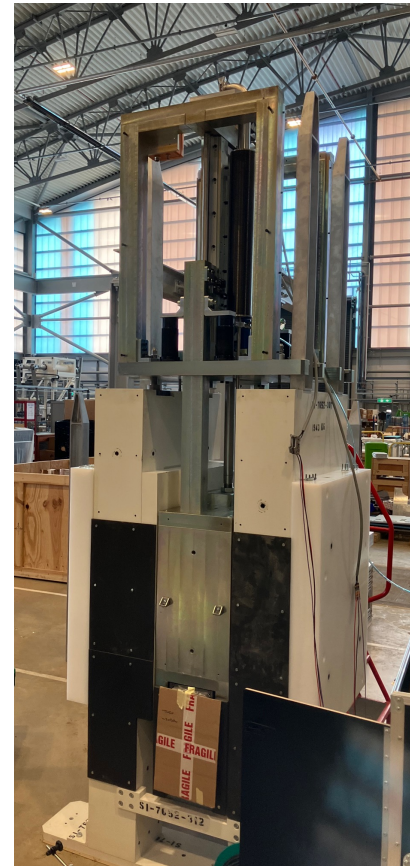
Heavy Shutter



All parts have been delivered, and pre-build is well underway.

First movement of the shutter under manual control was carried out in June, though the speed and smoothness of the motion were somewhat limited by the flow rate due to the large cylinder volume. Larger pipework and flow control valves have been installed, which has solved this issue.

The FAT, including endurance testing is underway.



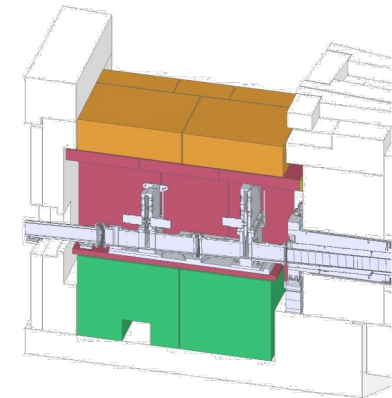
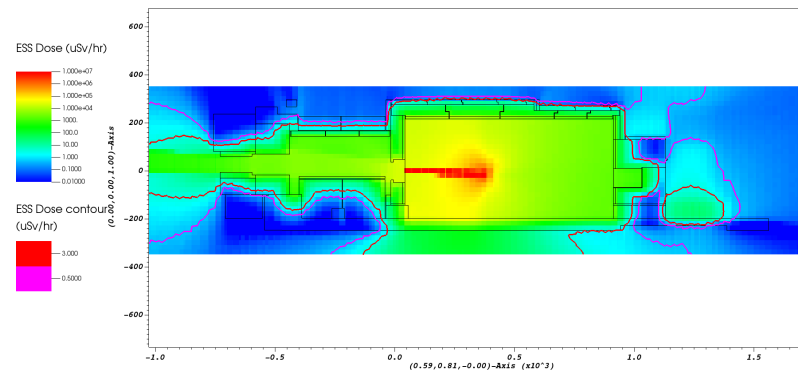
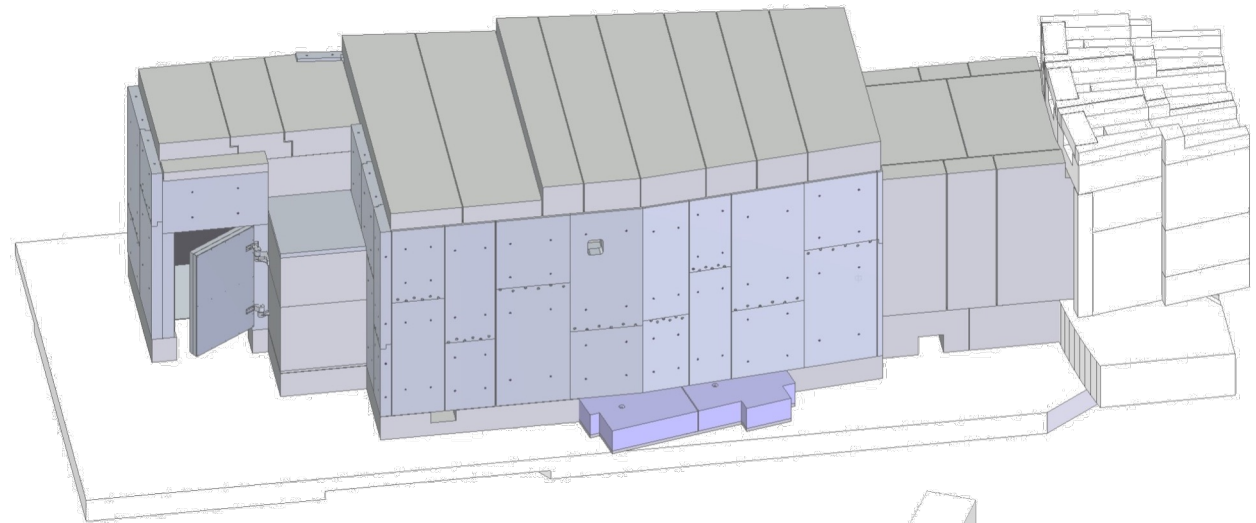
Chopper Pit & Cave Shielding



Shielding is on the critical path for delivery of the instrument. A design review was held with ESS on 12/03.

Findings from UKAEA neutronics analysis have been incorporated into the shielding design.

A contract for the detailed design, manufacture and installation of the concrete bulk shielding has now started... PDR this month



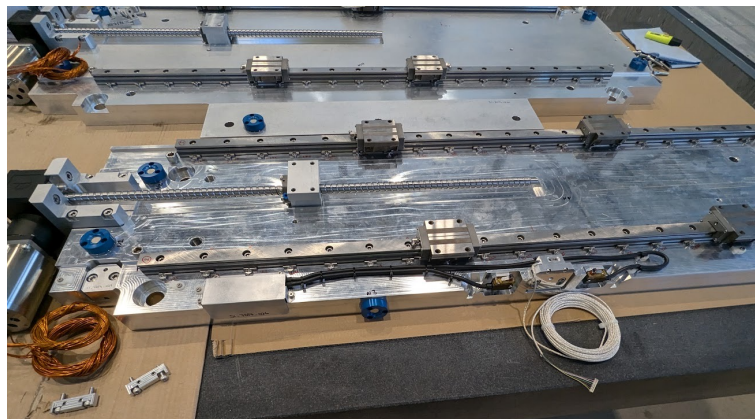
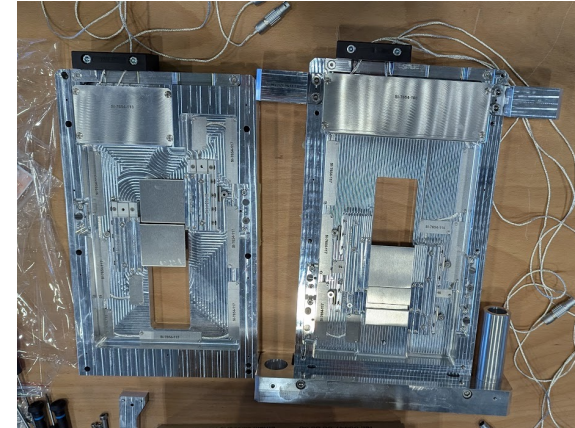
Collimation System



The translation stages have been wired and are ready for final assembly and motion testing.

Kinetic Slit 1 has been assembled using dummy blades. Preliminary testing of the piezo actuators has been carried out. Kinetics Slit 2 is awaiting assembly.

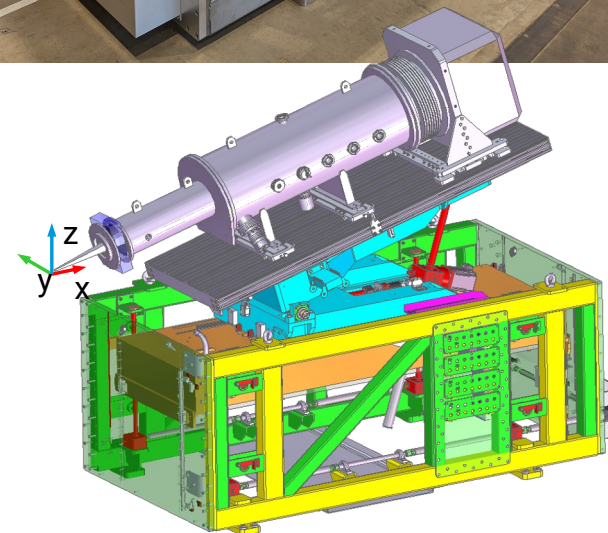
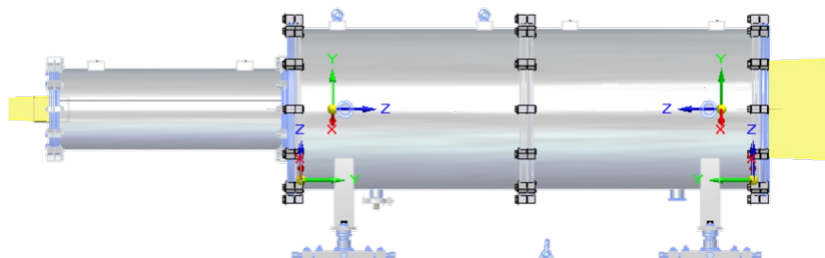
Manufacture of the guide supports, slit alignment mechanisms, and other internal components are nearing completion. Preparation for pre-build of the internal components is underway.



Detector Bench

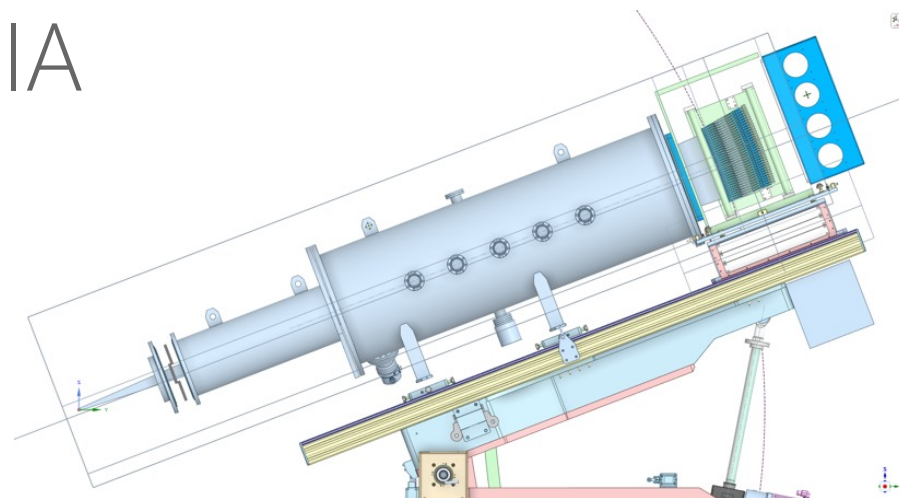
Assembly of the detector bench is well underway, with the installation of the tilting table now complete.

Detailed design of the flight tube is complete – TG3 in October







Multi-Blade progress for FREIA

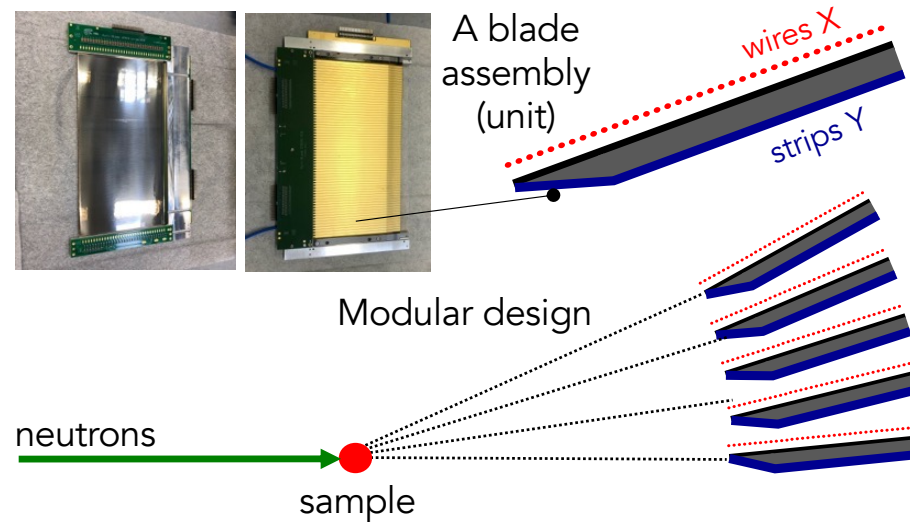
- Finalizing electrical details
- Preliminary design done
- Blades already manufactured and in Utgard
- Master rack available and components
- E-plan very similar to ESTIA (ESTIA e-plan completed)



Blades identical across instrument

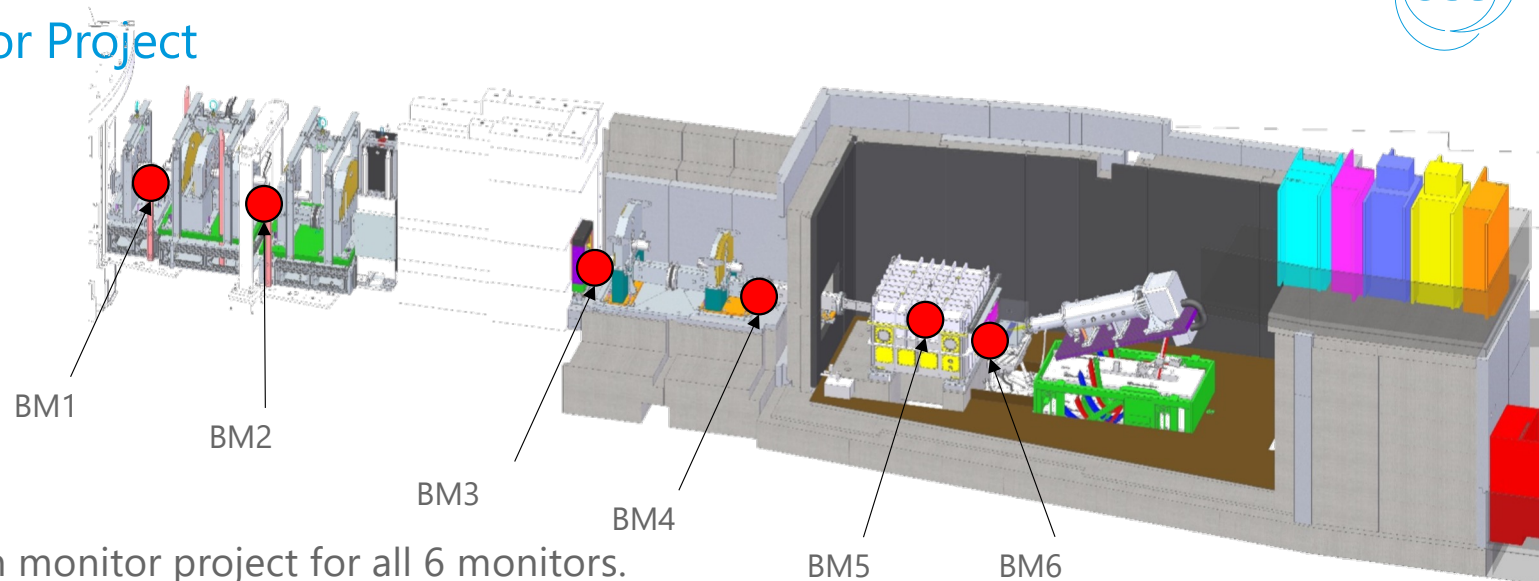
Instrument type	Instrument		Units	Active area (mm x mm)
Test Beamline	TBL		14	260 x 100
Reflectometer	ESTIA		48	480 x 260
Reflectometer	FREIA		32	260 x 320
Reflectometer	AMOR		14	260 x 140

Total 108, readily available 140



Beam Monitor Progress

Common Monitor Project



FREIA is part of common monitor project for all 6 monitors.

- In-bunker monitors
 - BM1 chopper diagnostic
 - BM2 chopper diagnostic
- Out of bunker – delayed due to prioritization of monitor project
 - BM3 chopper diagnostic
 - BM4 chopper diagnostic
 - BM5 in-collimation diagnostic
 - BM6 normalisation

Beam Monitor Progress

Common Beam Monitor Project



In bunker

- Compensation ionisation chamber for gamma discrimination
- ESS driven development by CDT
- Long purpose made cable to connect monitor and amplifier outside of high radiation fields
- Current mode operation
- Large dynamic range
- Low material budget for low beam attenuation
- Compatible with ESS DAQ system

Delivery: By the end of the year

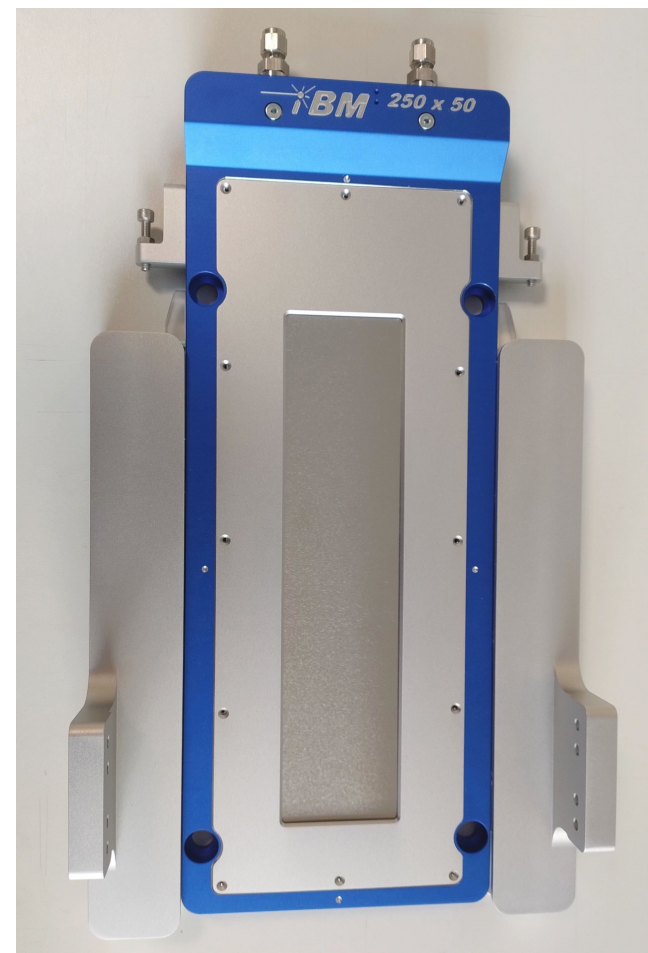
Testing: February 2025 (Tentative)

Out of bunker

BM3: Same as in-bunker to be ordered after first test

BM4-6: Design phase to start Q4 2025

Working on backend electronics integration (RMM, EFU, DMSC) for all positions

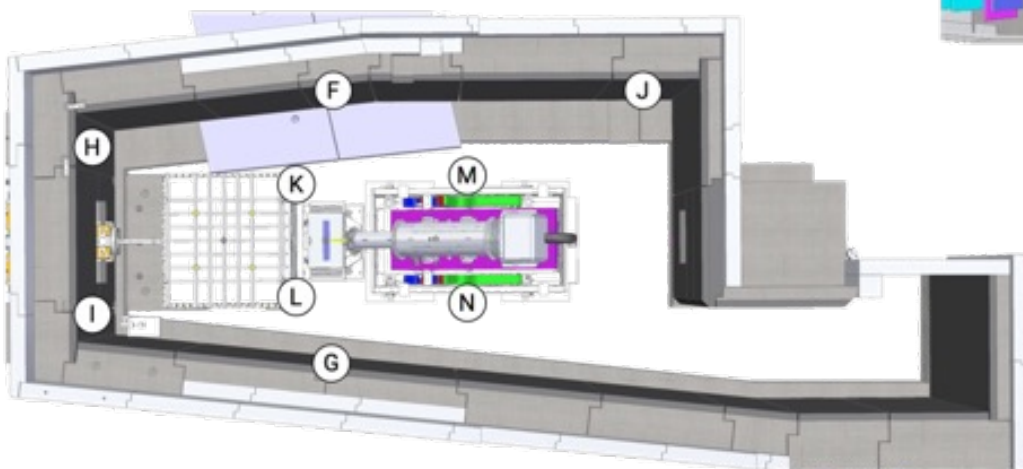


Services

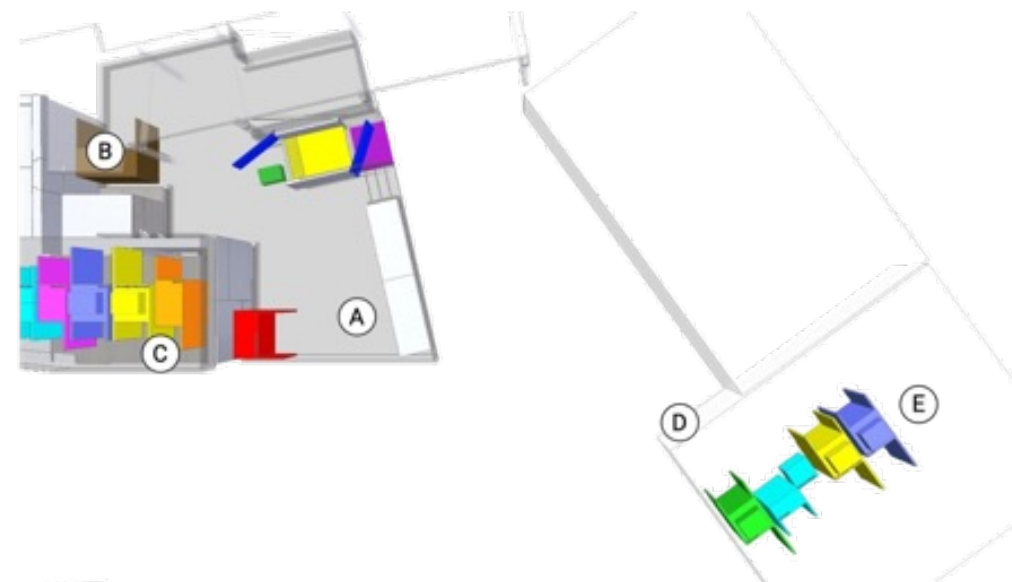


Following replanning the services design is on hold due to prioritisation of other instruments. Hopeful of getting budget offers this year with full design starting in the spring

Services – Cave Internals



Services – External



Current Project Risks & Issues



Top 5 Risks

Overall, the risk level is fairly static, with some long-standing risks that have reduced as the project progresses

Top 5 Risks				
Title	Rating	Category	Partner	Treatment
Loss of key instrument team specialist	16	Schedule	ISIS	Observe
Fire safety requirements and responsibilities	12	Schedule	ESS	Reduce
Delays to the ESS construction project	12	Schedule	ESS	Observe
ESS document review process lag	9	Schedule	ISIS	Reduce
Quality Gate process takes longer than expected	9	Schedule	ESS	Observe

Current Project Risks & Issues



Top 5 Issues

Choppers remain the dominant issue but progress has been good so, from here the impact has mostly been accounted for in the replanning

Top 5 Issues						
Title	Rating	Category	Partner	Cost	Delay	Quality
Large chopper discs may not work	25	Quality	ISIS	100-300k€	7-12 months	The science case of the instrument/system is jeopardized
ESS floor capacity limit	4	Cost	ISIS	25-100k€	<1 month	N/A