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# From a shaky start to the mass production of choppers

The past and present of chopper delivery at ESS

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ESS NEUTRON CHOPPER GROUP

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# Content

What is this presentation about?

How did we go from here



To here?



- 12 years of chopper development – what have I learned
- Focus on our own capacity – Disc chopper centric
- Some mistakes we have made and how it has affected us

# Choppers at ESS

## Quick overview Scope and Supply

### 84 chopper axis in construction scope

- 37 axis supplied by NCG – including 4 T0 choppers
- 26 supplied by in-kind partners
- 21 supplied by commercial partners

### 44 control racks.

- 38 supplied by NCG
- 6 supplied by commercial partners

### Development and deployment of control systems

- CHIC hardware and software development
- EPICS integration and support

### Support to in-kind and commercial chopper systems

- Design reviews and assistance
- Integration, installation and commissioning support
- Full or partial commissioning of systems
- Control integration and support



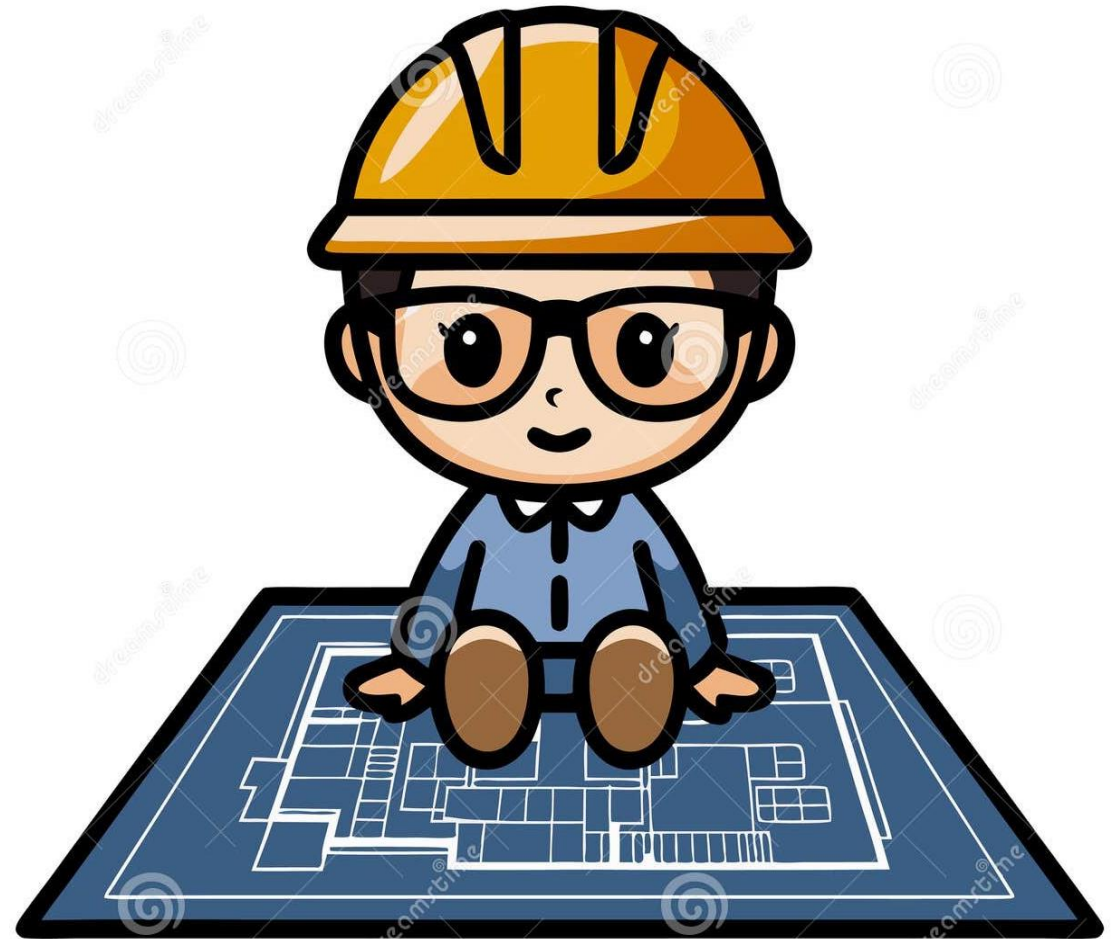
### Current status (2025-10-17)

- 12 axis ready for hot commissioning
- 18 axis currently in cold commissioning
- 5 axis awaiting cold commissioning
- 10 axis awaiting installation
- 22 axis in construction or testing
- 17 axis in development

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# Childhood

2013-2019



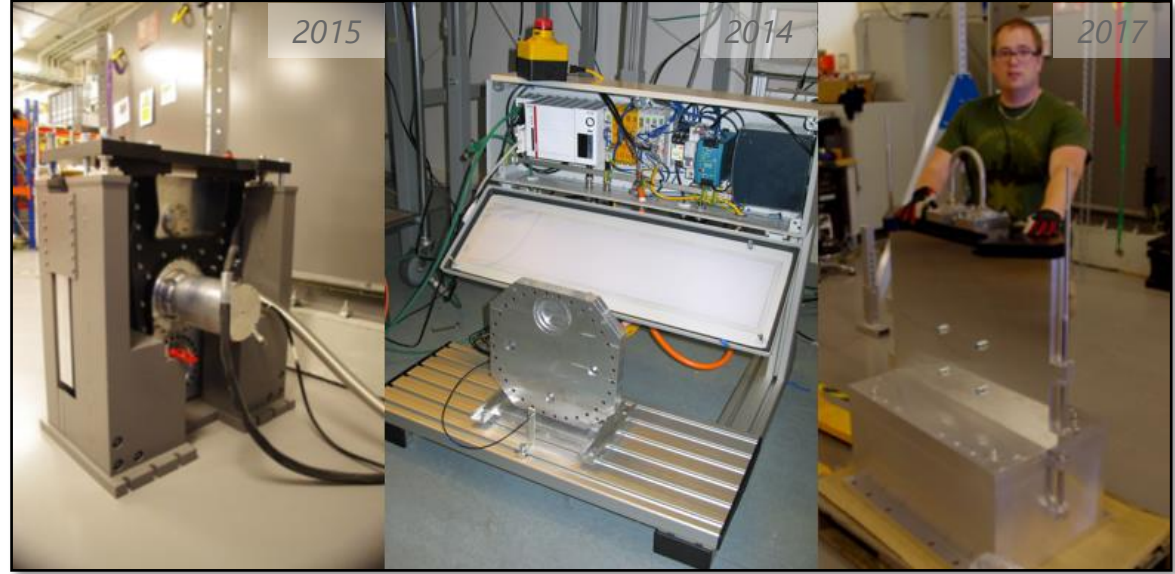


# Early learning lessons and team set up

## Childhood



- Team with mixed background
- Little or no chopper knowledge
- Constant scope changes.
- No site activity or access for most of this period



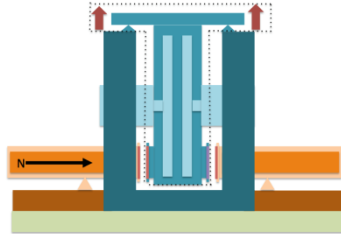
- Set up of joint workshop
- Technology demonstrator
- Mini-chopper for control integration tests
- Mock-ups for handling
- Design - Build – Fail – Learn - Repeat



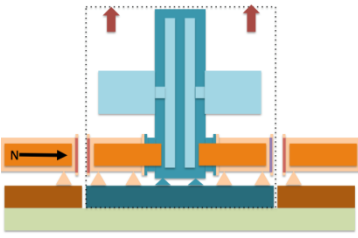
# Variant exploration

## Childhood

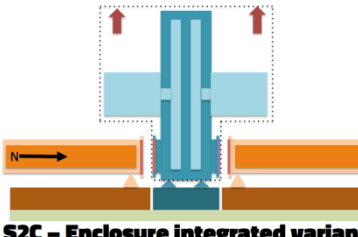
**S1A – Pillar variant**  
No sub-variant



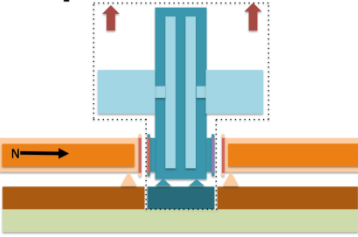
**S2A – Enclosure integrated variant**  
Module sub-variant



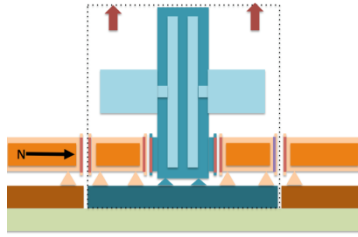
**S2B – Enclosure integrated variant**  
Unit extraction sub-variant



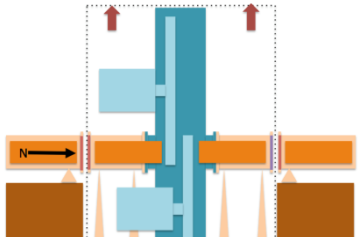
**S2C – Enclosure integrated variant**  
Base-plate extraction sub-variant



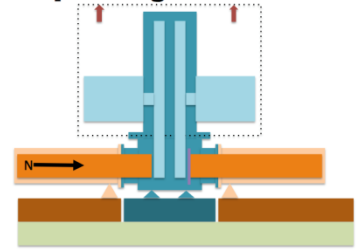
**S2D – Enclosure integrated variant**  
Module & window sub-variant



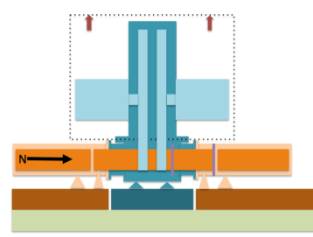
**S2E – Enclosure integrated variant**  
Over/Under sub-variant



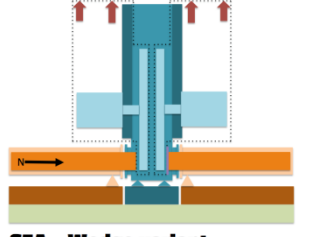
**S3A – Horizontal split variant**  
Independent guide sub-variant



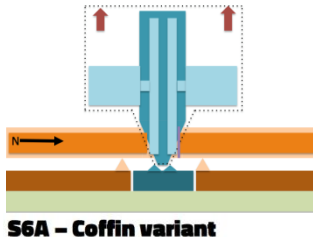
**S3B – Horizontal split variant**  
Guide cut-out sub-variant



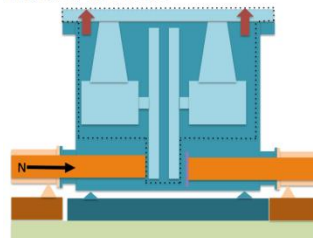
**S4A – Tower variant**  
No sub-variant



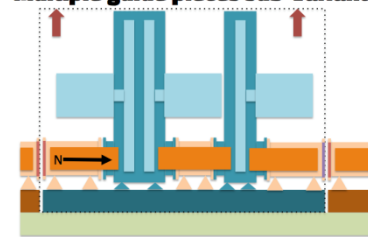
**S5A – Wedge variant**  
No sub-variant



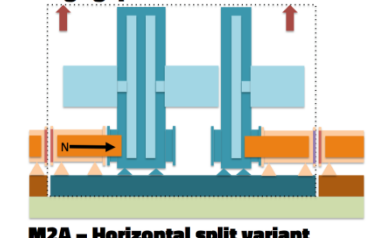
**S6A – Coffin variant**  
No sub-variant



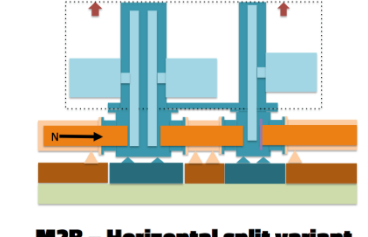
**M1A – Module variant**  
Multiple guide pieces sub-variant



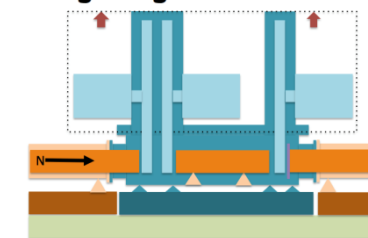
**M1B – Module variant**  
Large gap sub-variant



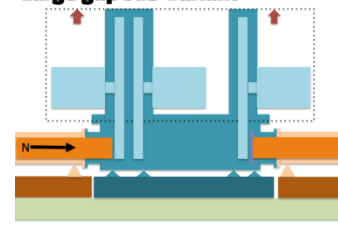
**M2A – Horizontal split variant**  
Independent guide sections sub-variant



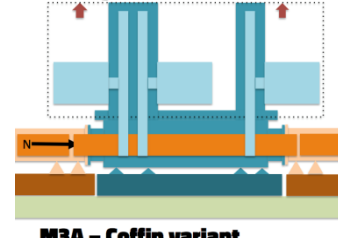
**M2B – Horizontal split variant**  
Integrated guide sub-variant



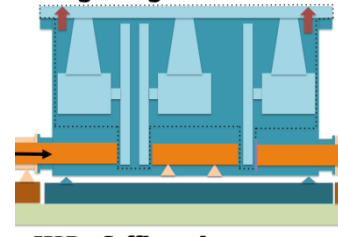
**M2C – Horizontal split variant**  
Large gap sub-variant



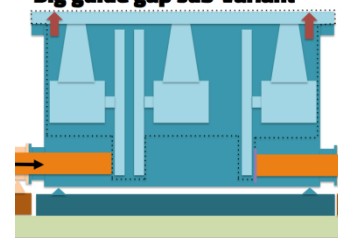
**M2D – Horizontal split variant**  
Cut-out guide



**M3A – Coffin variant**  
Integrated guide sub-variant

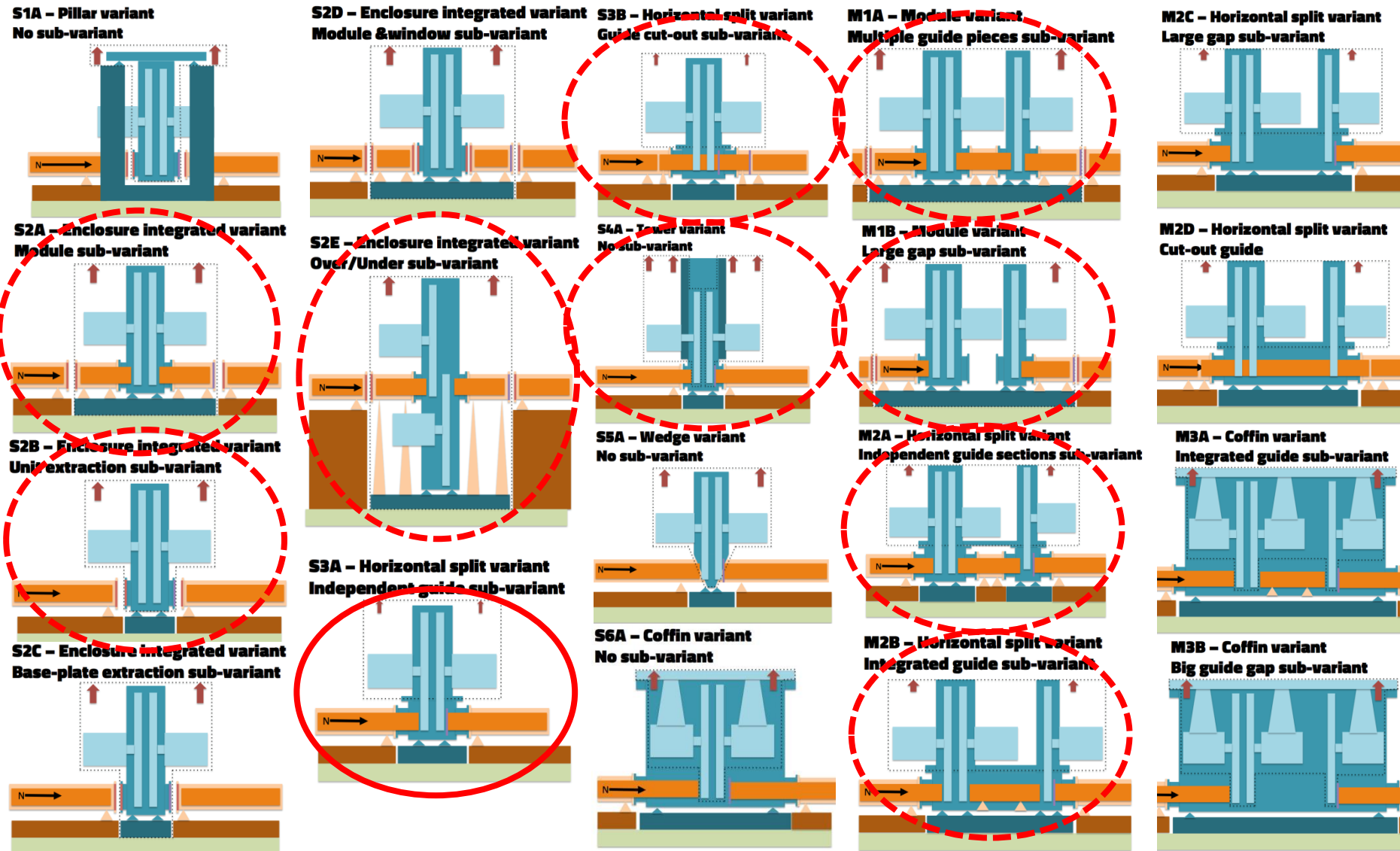


**M3B – Coffin variant**  
Big guide gap sub-variant



# Variant exploration – outcome

## Childhood





# Absorbing knowledge and experiance

## Childhood



- Chopper Technical Advisory Panel
- Supplier Jamborees
- Learning – Stealing – Discussing
- DENIM participation and hosting



- Opportunity to travel to operating facilities
- Understanding of operational constraints
- Observing and participating in maintenance and operational activities



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# Adolescence

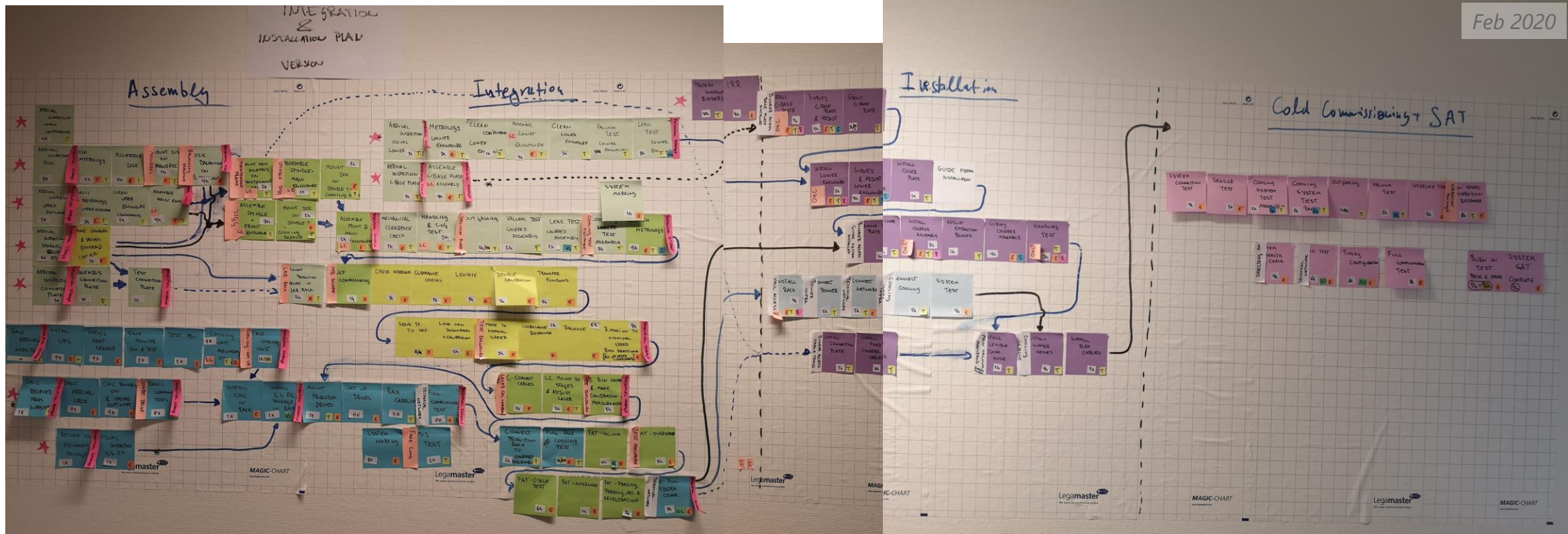
2019-2022





# Planning exercise

## Adolescence



- Internal exercise Mechanical / Electrical / Control.
- Helped to understand all the moving parts.
- Resource loaded (type and duration) – definitely not correct, but not that bad.
- Performed just before outbreak of COVID.
- Allowed detailed discussions with other stakeholders (ICS, Vacuum etc.) during lockdown.

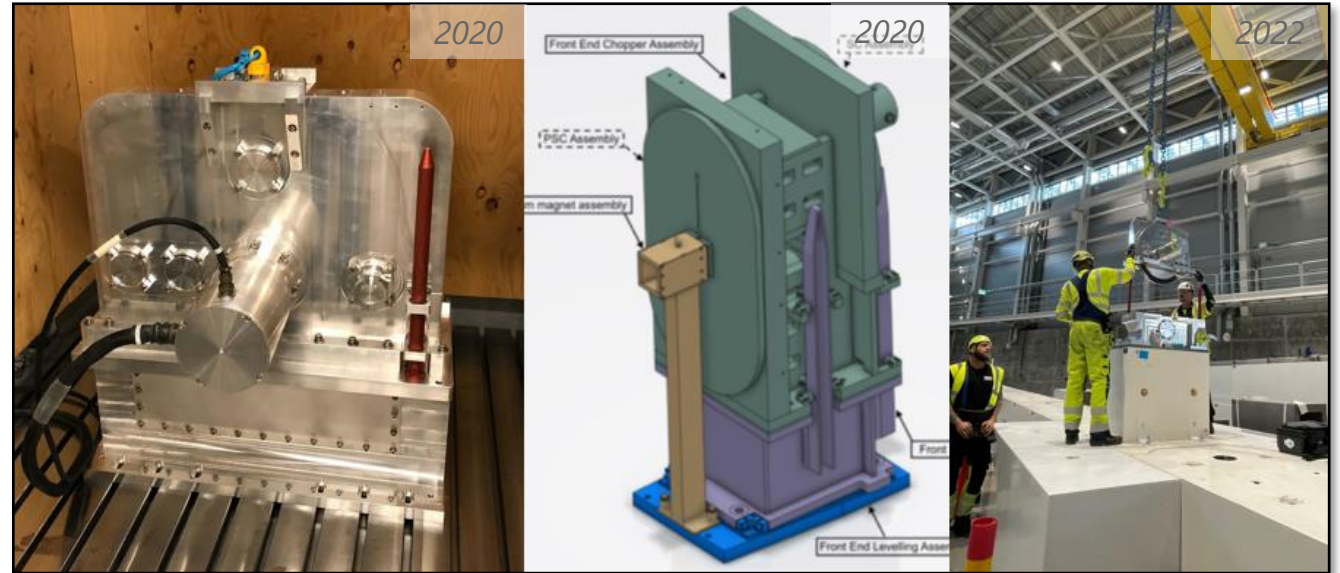


# Project ramp-up

## Adolescence



- Global change of pace in the project.
- Budget and resource constraints.
- Launch of the common chopper project.
- Team expanding – especially on the electrical side.



- Development of QA-chopper – later CE-marked and installed on TBL.
- MAGIC being the first instrument to sign up for common chopper project.
- BIFROST BWC first chopper installed at ESS, NMX soon after.
- *Choppers are easy!* – some moments of hubris in this period.





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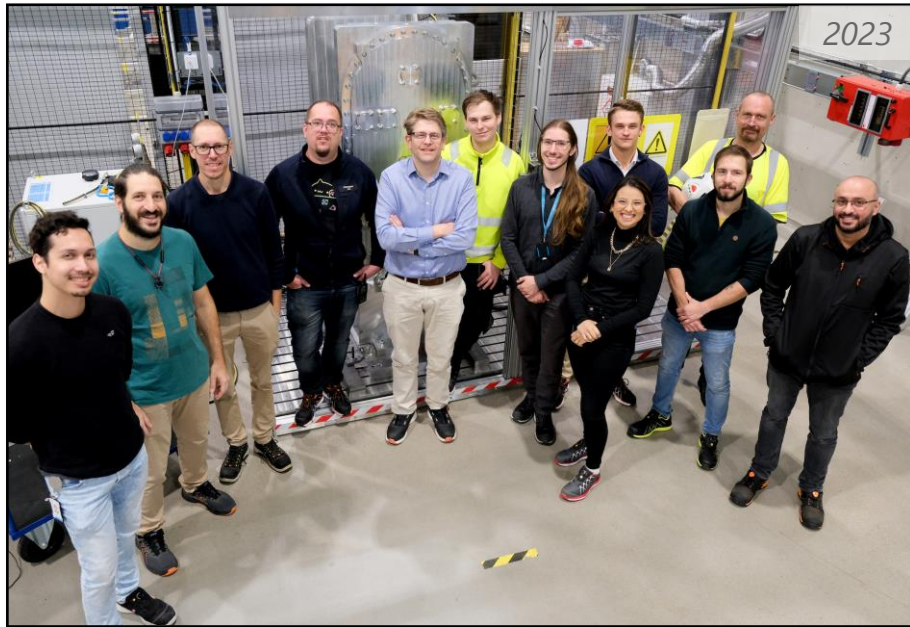
# Adulthood

2023 onwards



# Scope delivery

## Adulthood



- High schedule pressure.
- Prioritisation and view-point challenges – keep communicating and adapt.
- Design – build – commissioning at the same time.
- Mix of expert and generalist resources.



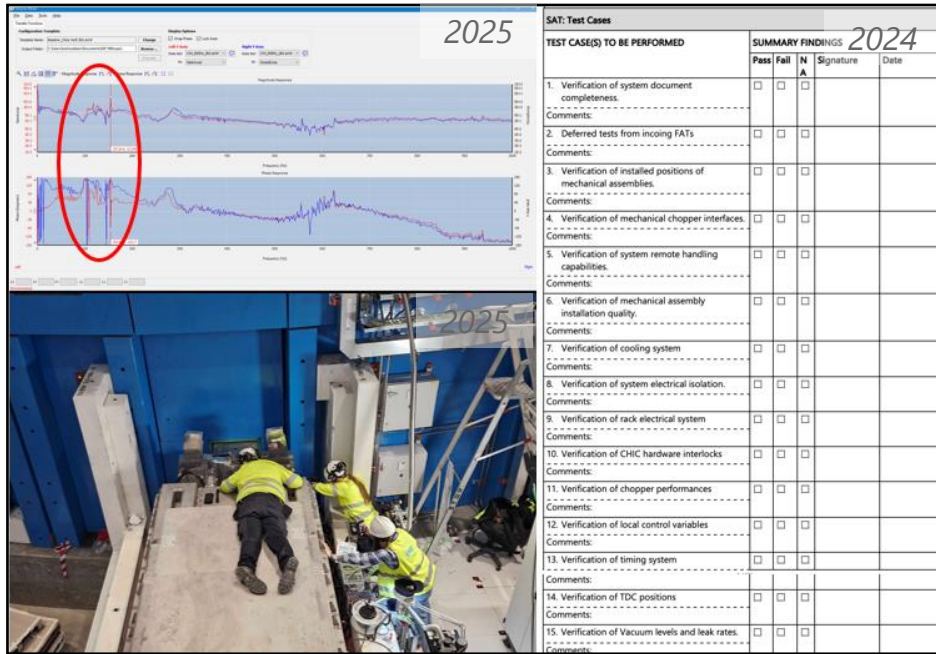
- Possibility for large scale procurements.
- Decreased design and delivery time due to common if not standard designs.
- Short time for lessons learned between projects.



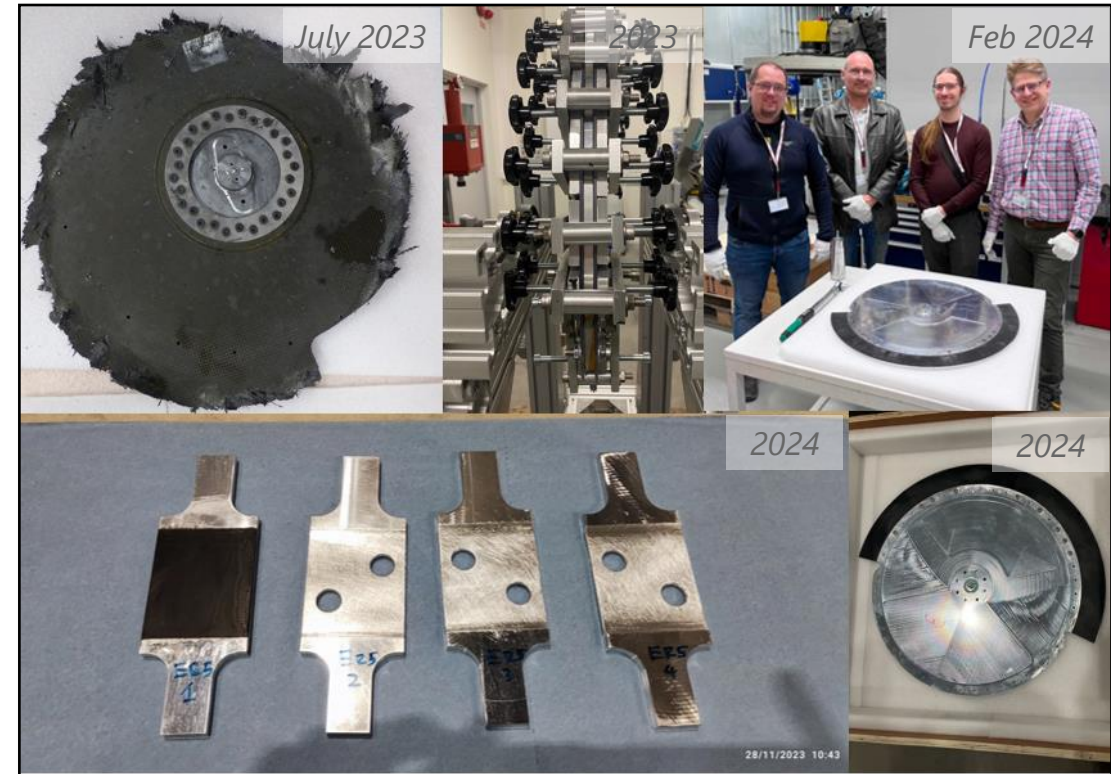


# Operational readiness and response

## Adulthood



- Development and execution of FAT / SAT structure.
- Gaining operational experience.
- In-house system knowledge and spares to minimise instrument downtime



- Handling failures and setback
- Supplier disc failure allowed for development of aluminium replacement.
- Coating procedure development – now inhouse coating capabilities.



# Some final thoughts

## Thoughts after 12 years of chopper work

- Build and train your team and keep nurturing it.
- Get hands-on experience as fast as possible.
- Make mistakes – but own your mistakes and make sure you learn from them.
- Allow sufficient time for testing and commissioning.
- Try to understand different viewpoints and adapt.
- At some point will the “things I can solve later” be now.







Extra special thanks to:

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Wataru Kambara

Peter Galsworthy

Michael Butzek

Commercial and In-kind partners

ESS Chopper Group

**Questions?**  
**Thank You!**