



Post-BOT planning Status March 2023

Science Away Days 2024

OLIVER KIRSTEIN

2024-05-13/14



1. Prerequisites
2. P6 schedule implementation
3. A closer look at SOUP
4. Estimated resource requirements
5. Summary




Prerequisites



BOT and beyond planning


Technical Commissioning ESS-52150 Early Operations ESS-0420218 (r4)



**EUROPEAN
SPALLATION
SOURCE**


Document Type Verification Plan
 Document Number ESS-5215012
 Date Mar 28, 2024
 Revision 3
 State Released
 Confidentiality Level Internal
 Page 1 (7)

TECHNICAL COMMISSIONING OF THE ESS FACILITY




| | Name | Role/Title |
|-----------------|-------------------|--------------------------------------|
| Owner | Andreas Jansson | ESS Global Commissioning Coordinator |
| Reviewer | Ciprian Plostinar | Accelerator Project Manager |
| Reviewer | Rikard Linander | Target Project Leader |
| Reviewer | Robert Connatser | NSS Project Leader |
| Reviewer | Henrik Carling | ICS Project Leader |
| Reviewer | Oliver Kirstein | Science Project Leader |
| Reviewer | Peter Rådahl | Chief Engineer |
| Approver | Kevin Jones | Technical Director |
| Approver | Giovanna Fragneto | Science Director |

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Template: Plan (ESS-1554921 Rev: 2, Active date: Feb 20, 2020)



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Document Type Report
 Document Number ESS-0420218
 Date Mar 22, 2024
 Revision 4
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 Confidentiality Level Internal
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**EARLY OPERATIONS OF ESS AND PREREQUISITES FOR FIRST
SCIENTIFIC RESULTS**



| | Name | Role/Title |
|-----------------|-------------------|---|
| Owner | Helmut Schober | Director General |
| Author | Andreas Jansson | Global Test and Commissioning Coordinator |
| Author | Oliver Kirstein | Science Project Leader |
| Reviewer | Carlo Bocchetta | Operations and Infrastructure Director |
| Reviewer | Kevin Jones | Technical Director |
| Reviewer | Giovanna Fragneto | Science Director |
| Approver | Helmut Schober | Director General |

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Template: Report (ESS-0060987 Rev: 4, Active date: Feb 20, 2020)

BOT and beyond planning

Technical Commissioning ESS-52150 Early Operations ESS-0420218 (r4)



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3. COMMISSIONING ACTIVITIES

All subsystems undergo required testing prior to start of full facility commissioning with proton beam to target. The readiness of all individual subsystems is verified through a series of reviews leading up to the Facility RBOT (Ready for Beam on Target) milestone, which is preceded by the Facility Safety Readiness Review (SRR5) [1]. See Figure 1 for an overview of how these reviews are connected.

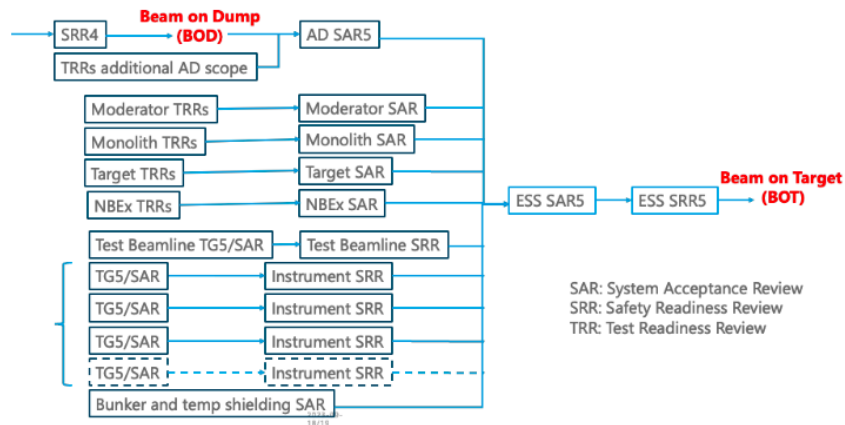


Figure 1 Reviews leading up to Beam on Target. The Facility Ready for Beam on Target (RBOT) milestone precedes the beam on target milestone (BOT).



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6.2. Hot commissioning period 1

(BOT + 3 months) to (BOT + 7 months):

- o **Main activities:** The key performance challenges of the neutron source (accelerator, target and moderators) should have been identified, in part with data provided by the test beamline, and will begin to be addressed. Meanwhile several more instruments will commence hot commissioning. Emphasis shall be on availability¹ and reliability of beam over beam power, when operating in neutron production mode. Unscheduled access into the bunker and other irradiated areas may be needed for corrective work on beamline components. The repetition rate can be adjusted to ramp up the accelerator power
- o **Overall objectives:** An increase in the availability and reliability of neutron beams. Consolidation of hot commissioning process of the first 5 instruments [2], while installing more instruments in the experimental halls.
- o **Neutron pulse parameters:** Pulse length: 2.86 ms stable current throughout the pulse.
- o **Proton Beam parameters for hot commissioning** (indicative): Current ~6 mA (ramping up to 12 mA) and beam energy between 570 and 870MeV.
- o **Proton Beam parameters for beam studies** (indicative): Current ~6 mA (ramping up to 12 mA) and beam energy in range 570-870 MeV.

¹ Here availability refers to the percentage of neutron production delivered relative to planned neutron production, whereas reliability refers to percentage of neutron production delivered on schedule.

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- o **Operating cycle for the neutron scattering instruments:** 2 consecutive days (6 shifts) per week at minimum power (0.14MW) with possible ramp-up at no expense to availability). More shifts will be needed for the neutron source itself: their planning will have to be properly coordinated between all stakeholders.
- o **Shutdowns:** Weekly planned maintenance stops of 1 shift.
- o **Radiation Protection (RP) & Occupation Health Safety (OHS):** Control and support (trouble-shooting) for the NSS instruments in terms of RP and OHS.

BOT and beyond planning



Technical Commissioning ESS-52150 Early Operations ESS-0420218 (r4)

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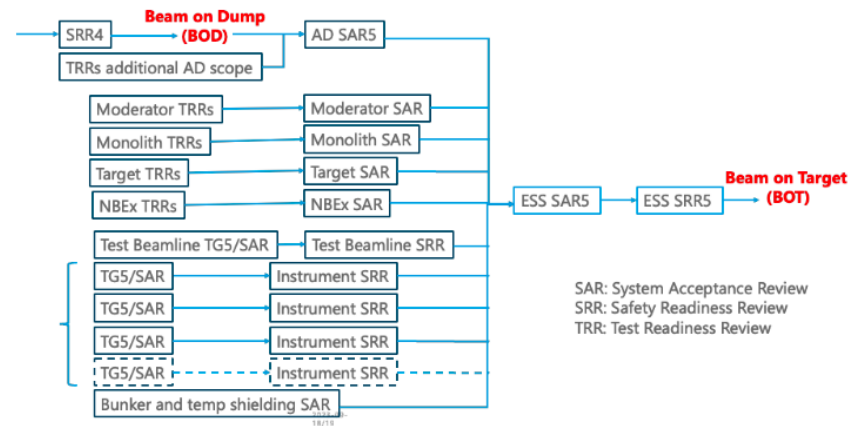


Figure 1 Reviews leading up to Beam on Target. The Facility Ready for Beam on Target (RBOT) milestone precedes the beam on target milestone (BOT).

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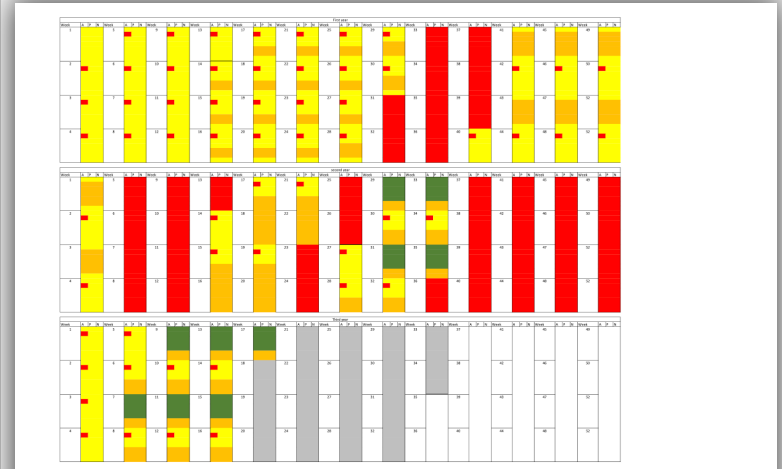


Figure 2. Tentative post-BOT weekly shift schedule indicating the distribution of shifts allocated to different activities. 24/7 operation with 3 shifts/day are assumed. Yellow indicates accelerator commissioning, orange indicates dedicated beam for instrument hot commissioning, green indicates user operation, and red indicates maintenance stop or shutdown

| # | Activity ID | Activity Name | Activity % Complete | Start | Finish |
|-----|---|---|---------------------|-----------|-----------|
| 531 | Infrastructure Operations & Maintenance | | | 29-Aug-25 | 31-Dec-27 |
| 532 | OID-A3214280 | Accelerator & Test beam line, no HC | 0% | 29-Aug-25 | 05-Nov-25 |
| 533 | OID-A3214290 | Hot Commissioning - 1st | 0% | 06-Nov-25 | 04-Mar-26 |
| 534 | OID-A3214300 | Shutdown (Instrument install in Bunker - 1) | 0% | 05-Mar-26 | 24-Apr-26 |
| 535 | OID-A3214310 | Hot Commissioning - 2nd | 0% | 27-Apr-26 | 17-Sep-26 |
| 536 | OID-A3214320 | Shutdown (Instrument install in-bunker - 2) | 0% | 18-Sep-26 | 04-Nov-26 |
| 537 | OID-A3214330 | Hot Commissioning - 3rd | 0% | 05-Nov-26 | 21-Dec-26 |
| 538 | OID-A3214340 | Shutdown (Instrument install in-bunker - 3) | 0% | 22-Dec-26 | 03-Feb-27 |
| 539 | OID-A3214350 | Users - 1st | 0% | 04-Feb-27 | 31-Mar-27 |
| 540 | OID-A3214360 | Shutdown (CM install, Instrument install in-bunker - 4) | 0% | 01-Apr-27 | 23-Aug-27 |
| 541 | OID-A3214370 | Recommissioning | 0% | 24-Aug-27 | 17-Sep-27 |
| 542 | OID-A3214380 | Users - 2nd | 0% | 20-Sep-27 | 19-Nov-27 |

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Post-BOT planning

From ESS-5146219

to ESS-1108651 (LOKI)



EUROPEAN
SPALLATION
SOURCE

Document Type Validation Plan
Document Number ESS-5146219
Date Feb 17, 2024
Revision 2
State Released
Confidentiality Level Internal
Page 1 (15)

GENERIC ESS INSTRUMENT COMMISSIONING PLAN



| | Name | Role/Title |
|-----------------|-------------------|--|
| Owner | Oliver Kirstein | Technical Sub-project Leader for Science |
| Author | Robin Woracek | TBL Instrument Scientist |
| | Esko Oksanen | Instrument Scientist and NSS Licencing Coordinator |
| | Oliver Kirstein | Technical Sub-project Leader for Science |
| Reviewer | Pascale Deen | Head of Spectroscopy Division |
| | Günter Muhrer | Group Leader for ESS Spallation Physics |
| | Robert Conatser | Head of Neutron Scattering Systems Division |
| | Per Roos | Group Leader Radiation Protection Operations Team |
| Approver | Giovanna Fragneto | Director for Science |

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<https://bess.ess.eu/external/ESS-5146219.2.21.208.51168.54810.01.068>



EUROPEAN
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Document Type Validation Plan
Document Number ESS-1108651
Date Mar 8, 2023
Revision 0.3 (10)
State Draft
Confidentiality Level Internal
Page 1 (33)

LoKI Instrument Verification and Validation plan

| | Name | Role/Title |
|-----------------|-----------------------|--|
| Owner | Judith Houston | LoKI Lead Scientist (ESS) |
| Author | Richard Heenan | LoKI Instrument Scientist (STFC) |
| | Jim Nightingale | UK-ESS Instruments Project Manager (STFC) |
| | William Halcrow | LoKI Lead Engineer (STFC) |
| | Clara Lopéz | Instrument Integration Engineer (ESS) |
| | Wojciech Potrzebowski | SANS data scientist (ESS) |
| Reviewer | Andrew Jackson | Head of Neutron Instruments Division (ESS) |
| | Peter Sångberg | Systems Engineer (ESS) |
| Approver | Gabor Laszlo | NSS Lead Instrument Engineer (ESS) |

Post-BOT planning

From ESS-5146219

to ESS-1108651 (LOKI)



Document Type: Validation Plan
 Document Number: ESS-5146219
 Date: Feb 17, 2024
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GENERIC ESS INSTRUMENT COMMISSIONING PLAN

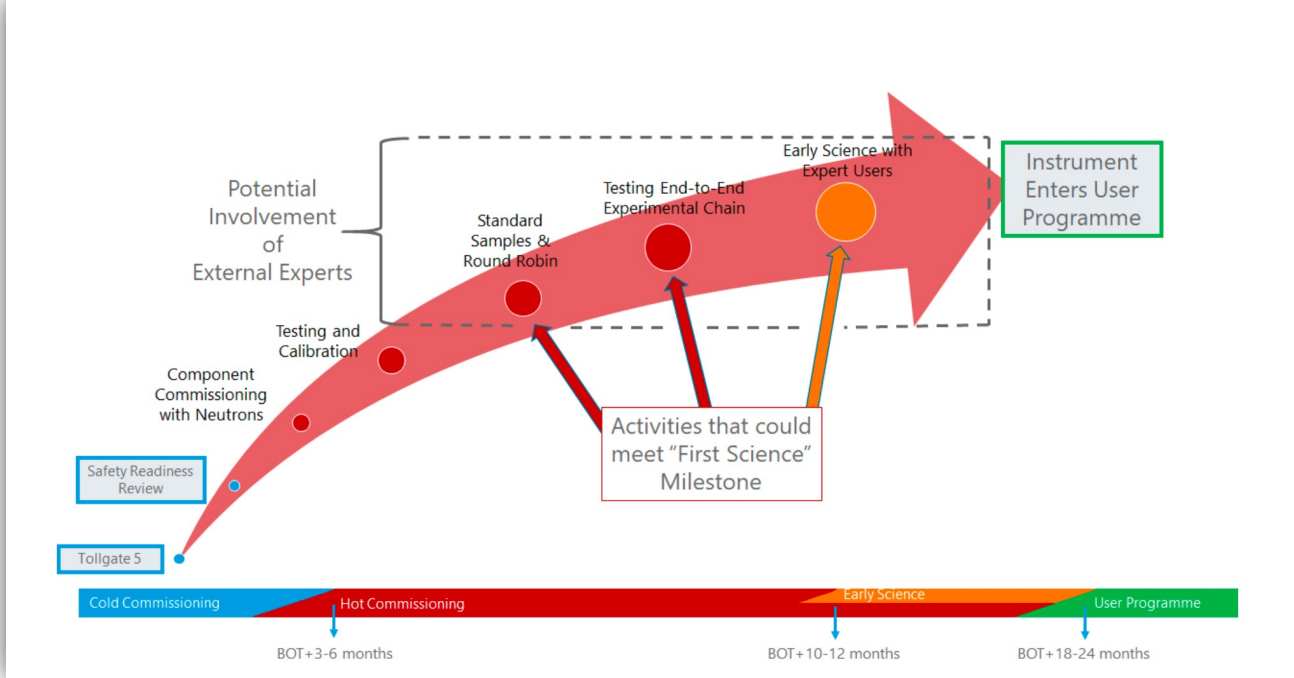
| | Name | Role/Title |
|-----------------|-------------------|--|
| Owner | Oliver Kirstein | Technical Sub-project Leader for Science |
| Author | Robin Woracek | TBL Instrument Scientist |
| | Esko Oksanen | Instrument Scientist and NSS Licencing Coordinator |
| Reviewer | Oliver Kirstein | Technical Sub-project Leader for Science |
| | Pascale Deen | Head of Spectroscopy Division |
| | Günter Muhrer | Group Leader for ESS Spallation Physics |
| | Robert Connatser | Head of Neutron Scattering Systems Division |
| Approver | Per Roos | Group Leader Radiation Protection Operations Team |
| | Giovanna Fragneto | Director for Science |



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Post-BOT planning

LOKI – System Validation and Verification Description (ESS-1108651)

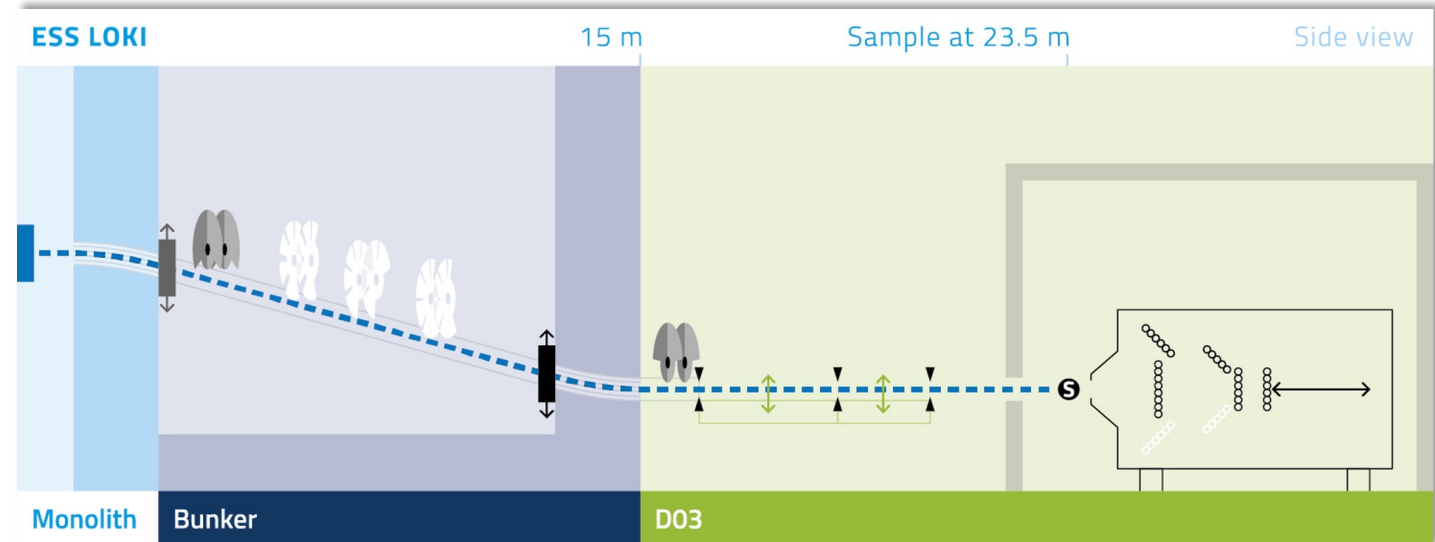


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LoKI Instrument Verification and Validation plan

Owner
 Author
 Reviewer
 Approver

| Task | Beam days required | Comments |
|---|----------------------------------|---|
| Fulfill radiation protection requirements | 5 days in (~0.5 day increments?) | Hold point before any further step can begin. Need to repeat if neutronic alignment and commissioning increases flux. |
| Gold foil measurements | 1 | Requires radiation protection group |
| Check monitor detectors M0 to M4 electronics with neutrons | 3 days | Needs detector group help |
| Check neutron beam profile | 3 days | |
| Chopper phasing verification | 5 days | May need the chopper group to help |
| Optimise collimation tube, guide and jaw set positions | 10 days | Reliant on availability of portable neutron cameras |
| Check neutron beam through all components in sample area | 5 days | Reliant on availability of portable neutron cameras |
| Collection of detector calibration mask data and silver behenate powder | 15 days | Perhaps collect data at night time during some other tasks. |
| Processing of calibration mask data, integration with survey results, check against reduced behenate powder data. | (~5 days) | Can be during "beam off". |
| Collection of data from standard samples for detector efficiency iterations. | 12 days | |



| Period | Sequence | Activity | Days | RP Technician | Instrument Scientist | Instrument Data Scientist | Detector scientist | CLS scientist | Chopper support (50/50 Scient/Tech) | DMS support (50/50 Scient/Tech) | MCA support (50/50 Scient/Tech) | MPS support (50/50 Scient/Tech) | Polarisation (MPS) support (50/50 Scient/Tech) | Hall coordination (Eng) | General lab support (CLS, MPS, SQU) (Tech) |
|-------------------|-----------------------------------|--|------|---------------|----------------------|---------------------------|--------------------|---------------|-------------------------------------|---------------------------------|---------------------------------|---------------------------------|--|-------------------------|--|
| Not commissioning | 1 | Shielding verification (RP) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | Hot commissioning / calibration of beam monitors | 5.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 3 | Beam profile characterisation | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 4 | Flight path calibration | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 5 | Beam spectrum calibration | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 6 | Gold foil measurements to determine absolute flux (sample, along beamline) | 3.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 7 | Phase verification of the choppers | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 8 | Verification of beam shaping components along the beam/motion systems | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 9 | Calibration of WFM system / HRM | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 10 | Background characterisation (incl TD chopper) | 2.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 11 | Gamma strikes/sensitivity | 2.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 12 | Characterisation/calibration of detector(s) position(s) | 20.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 13 | ToF and spatial characterisation of detector(s); E- / Q-resolution | 5.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 14 | Validation/round robin samples (First Science) | 15.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 15 | Commissioning of Sample Environment Systems | 10.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.2 | 0.1 |
| | 16 | Commissioning of Polarisation equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| 17 | Offline mode / offline activities | 0.0 | 0.0 | 2.0 | 1.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | |
| Ops | 18 | BAU => User Operation | 0.0 | 0.0 | 2.0 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |

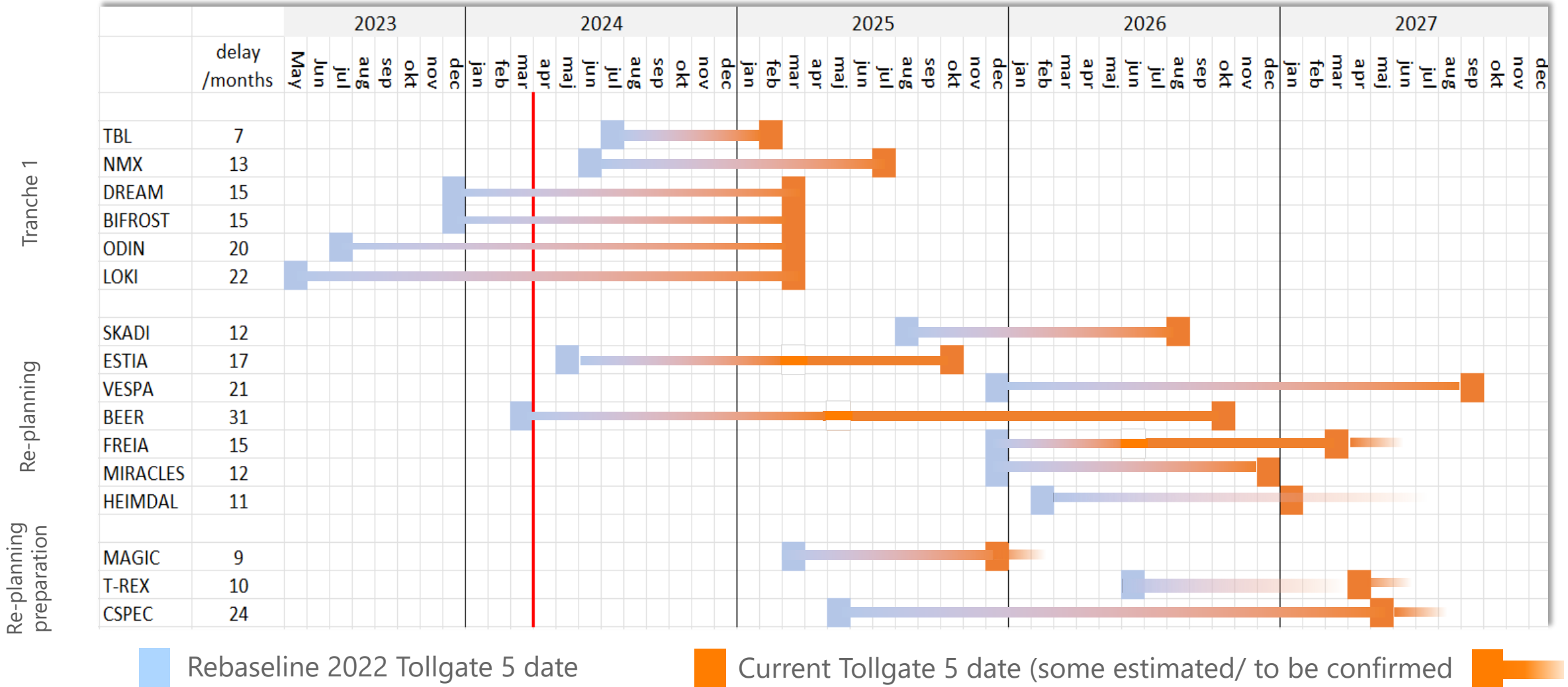


P6 schedule implementation



Re-planning of later instruments

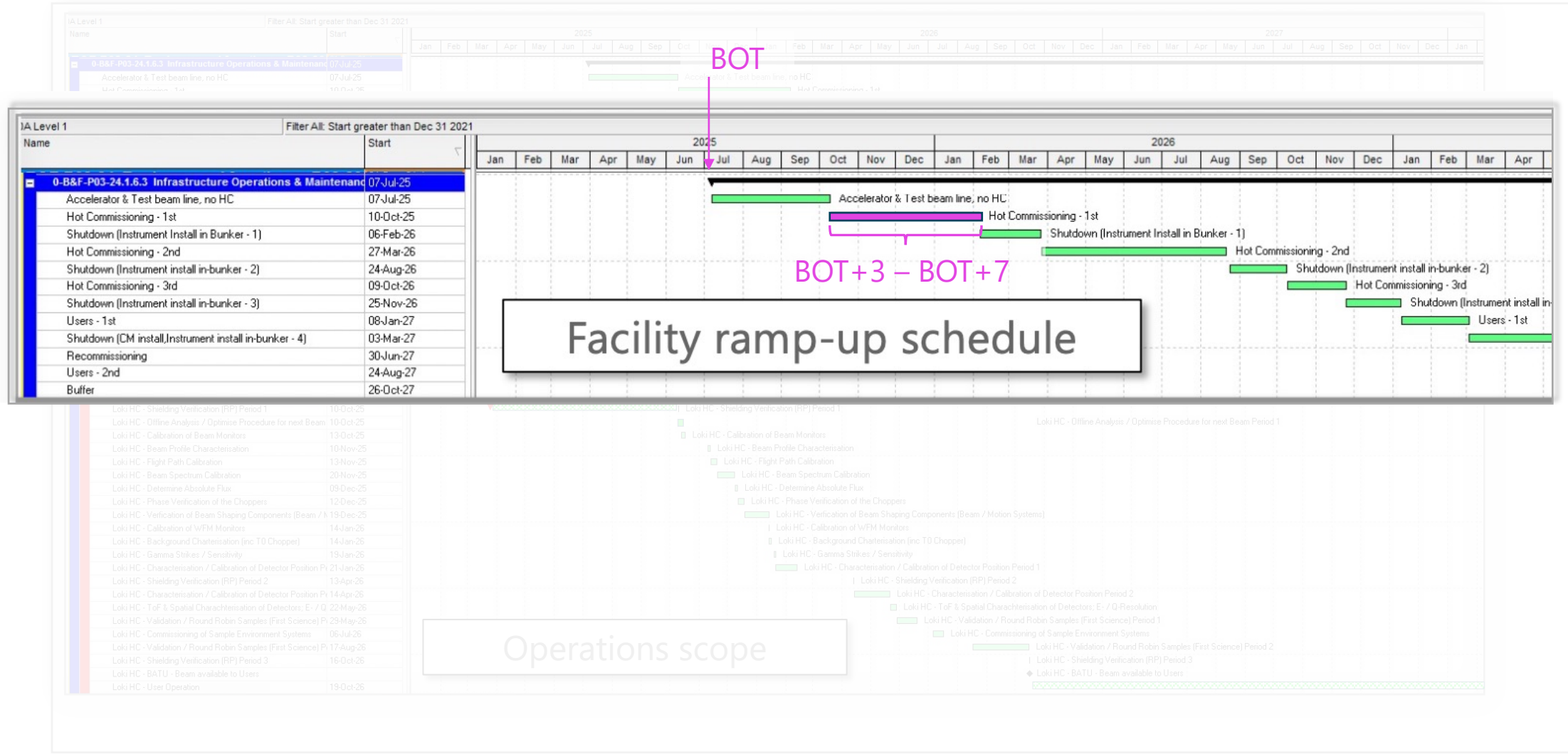
Delay of TG5 milestone for all instruments





Post-BOT planning

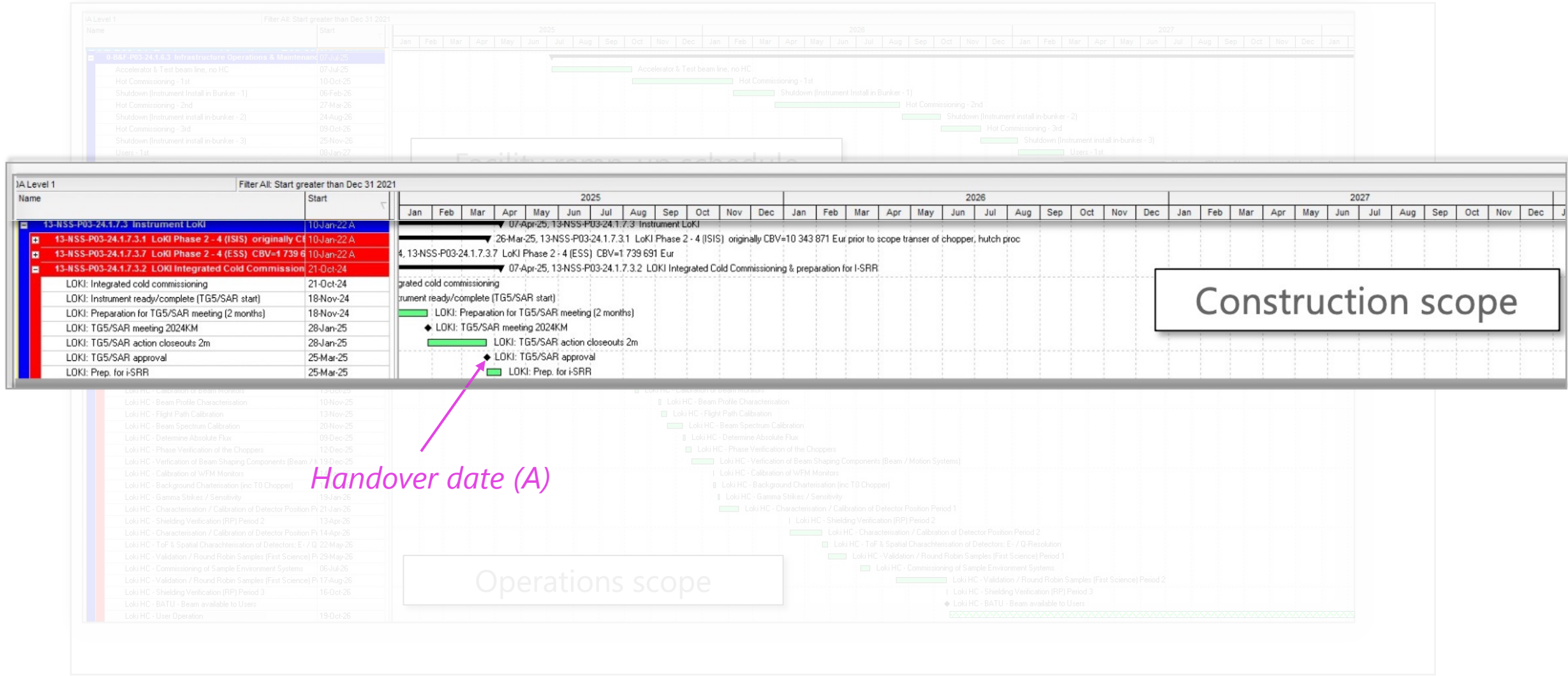
P6 implementation – example: Loki (T1)





Post-BOT planning

P6 implementation – example: Loki (T1)



Construction scope

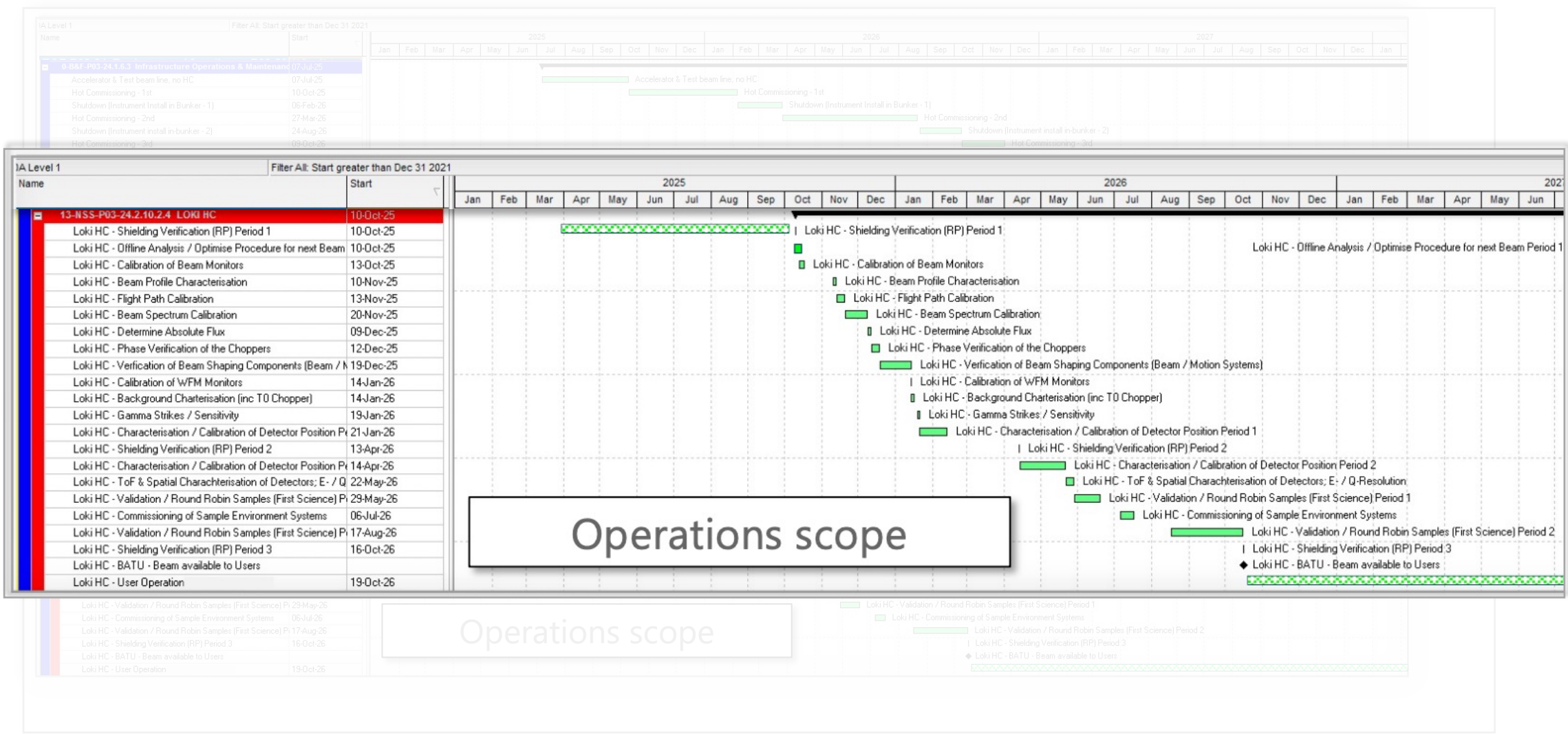
Operations scope

Handover date (A)



Post-BOT planning

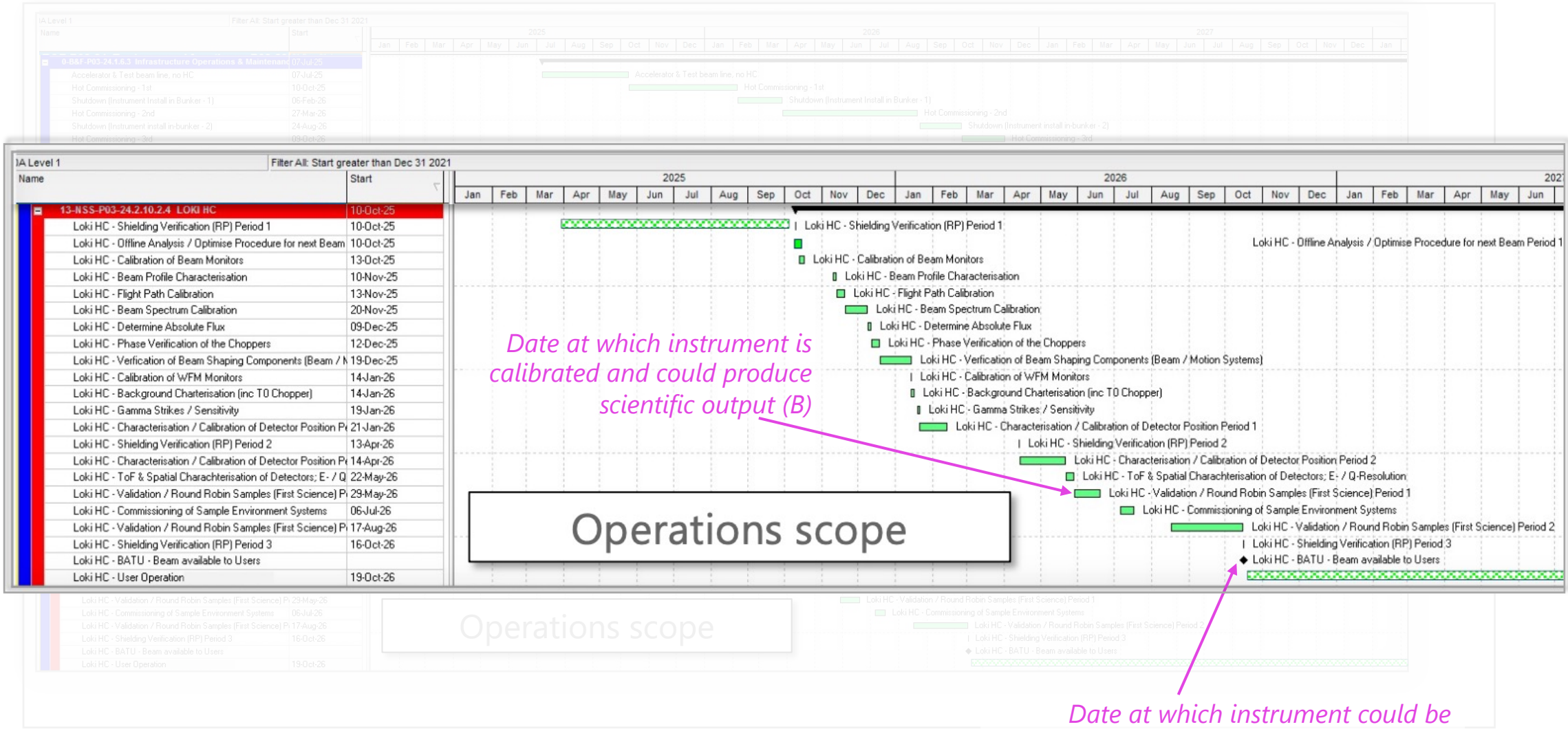
P6 implementation – example: Loki (T1)





Post-BOT planning

P6 implementation – example: Loki (T1)



Date at which instrument is calibrated and could produce scientific output (B)

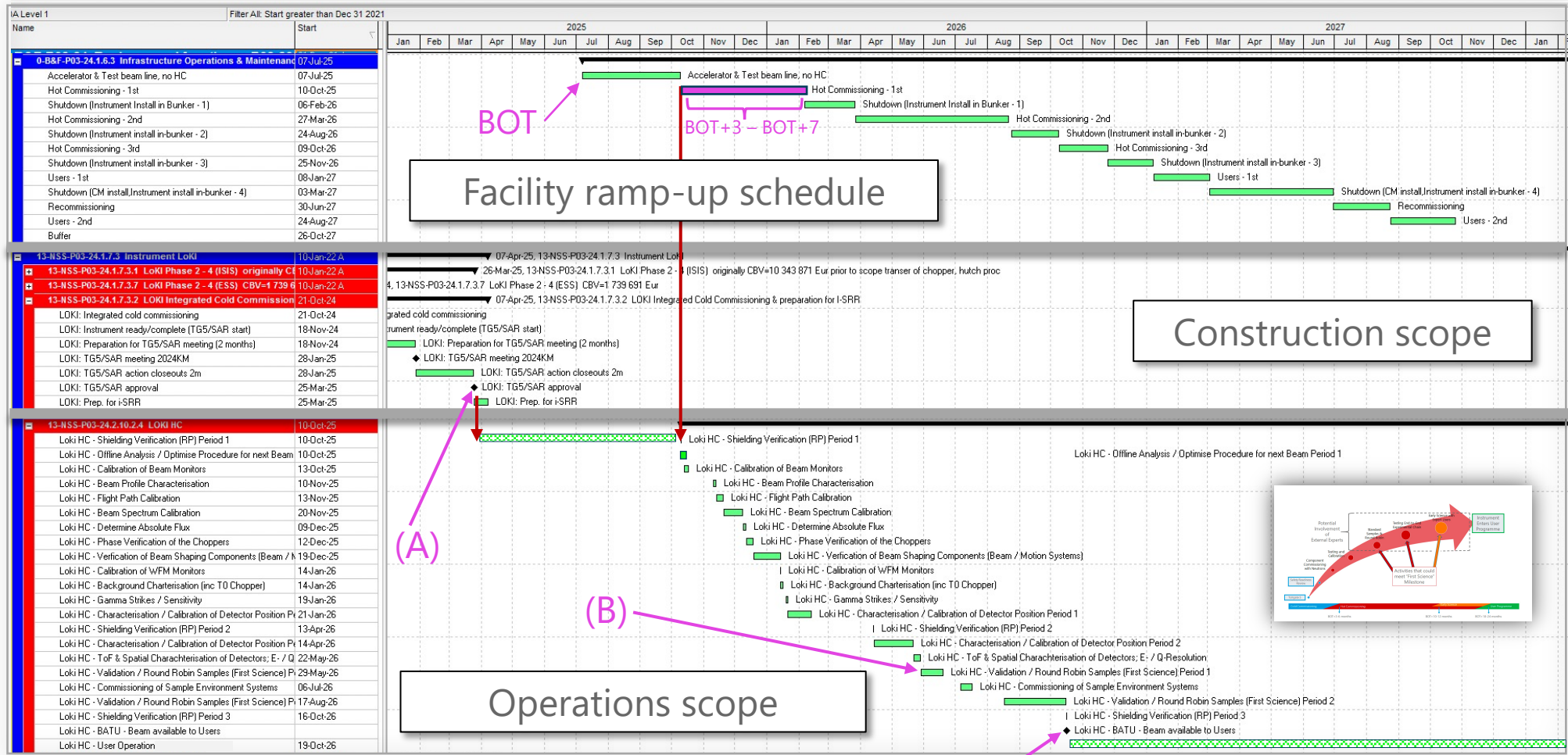
Operations scope

Date at which instrument could be transferred into User Programme (C)



Post-BOT planning

P6 implementation – example: Loki (T1)



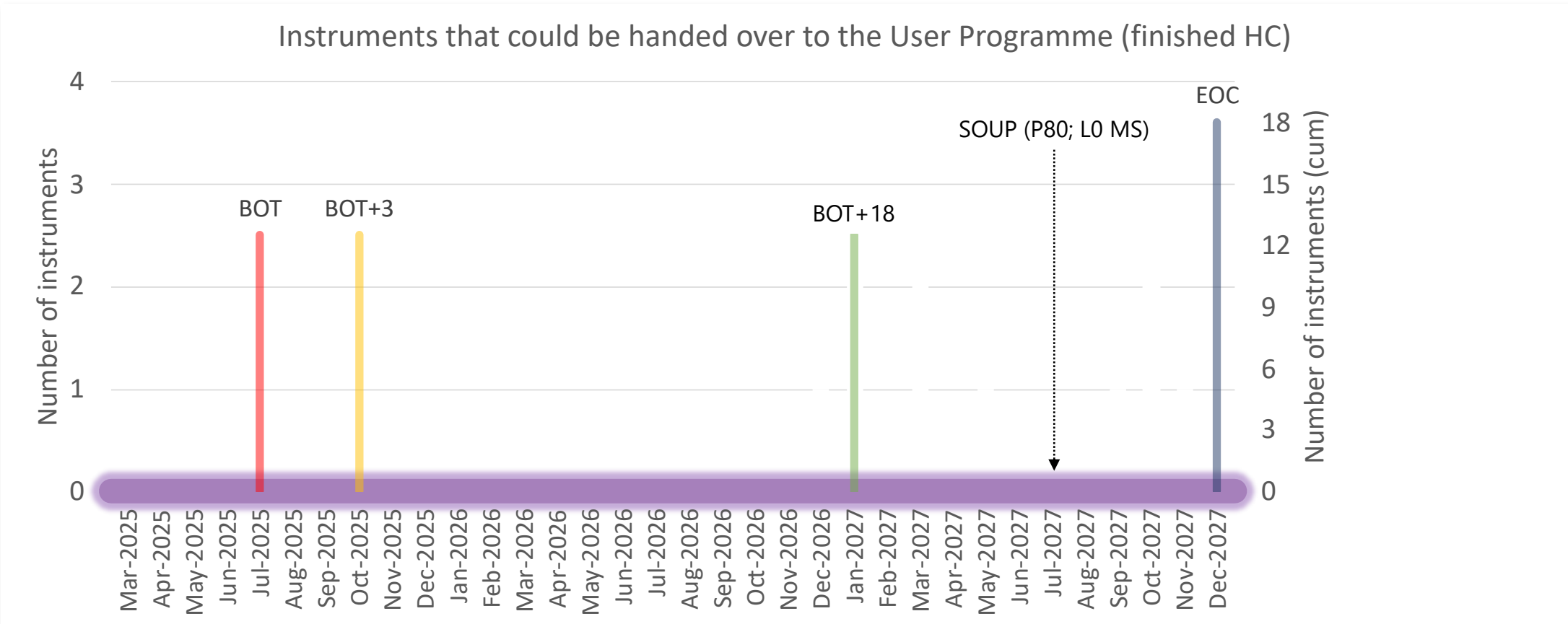


A closer look at Instruments & the User Programme



Instruments in User Programme

Hot Commissioning (HC) / Verification & Validation document signed off

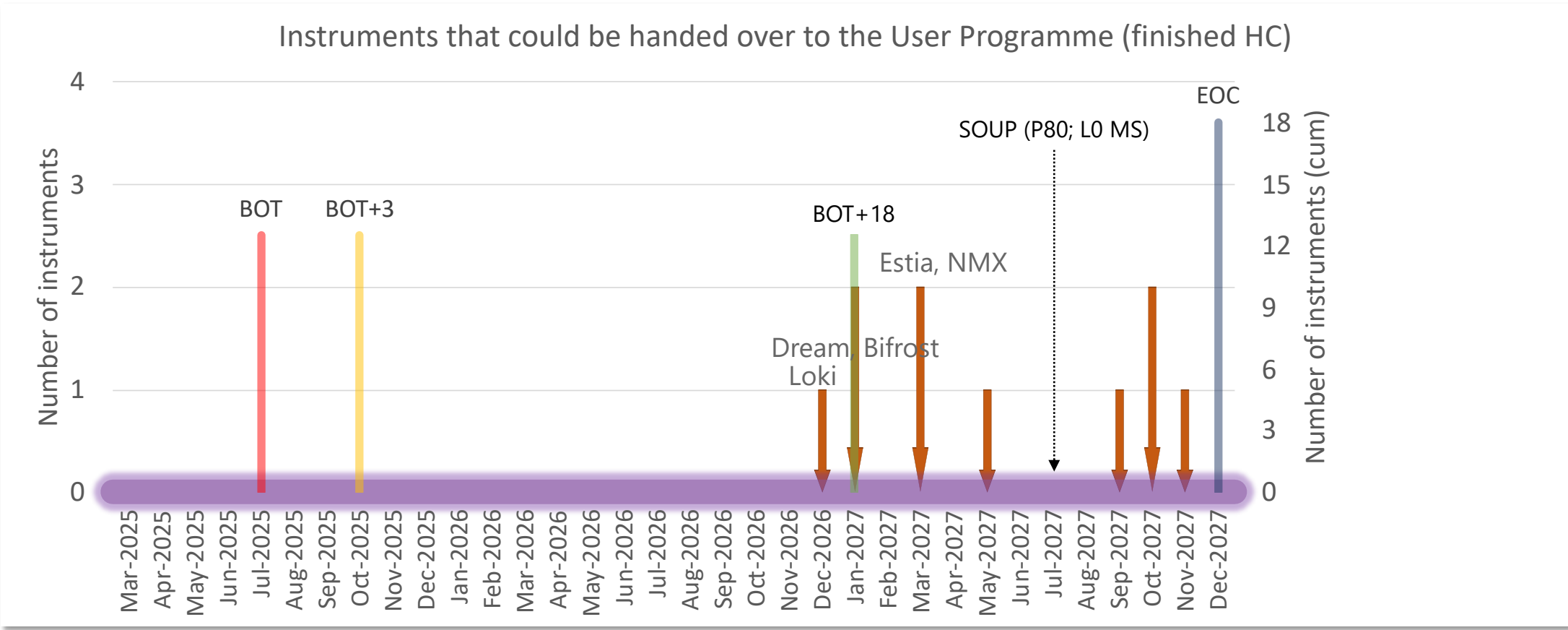


BOT: Beam-On-Target
EOC: End-Of-Construction
SOUP: Start-Of-User-Programme
L0 MS: Level 0 Milestone - under Council control



Instruments in User Programme

Hot Commissioning (HC) / Verification & Validation document signed off

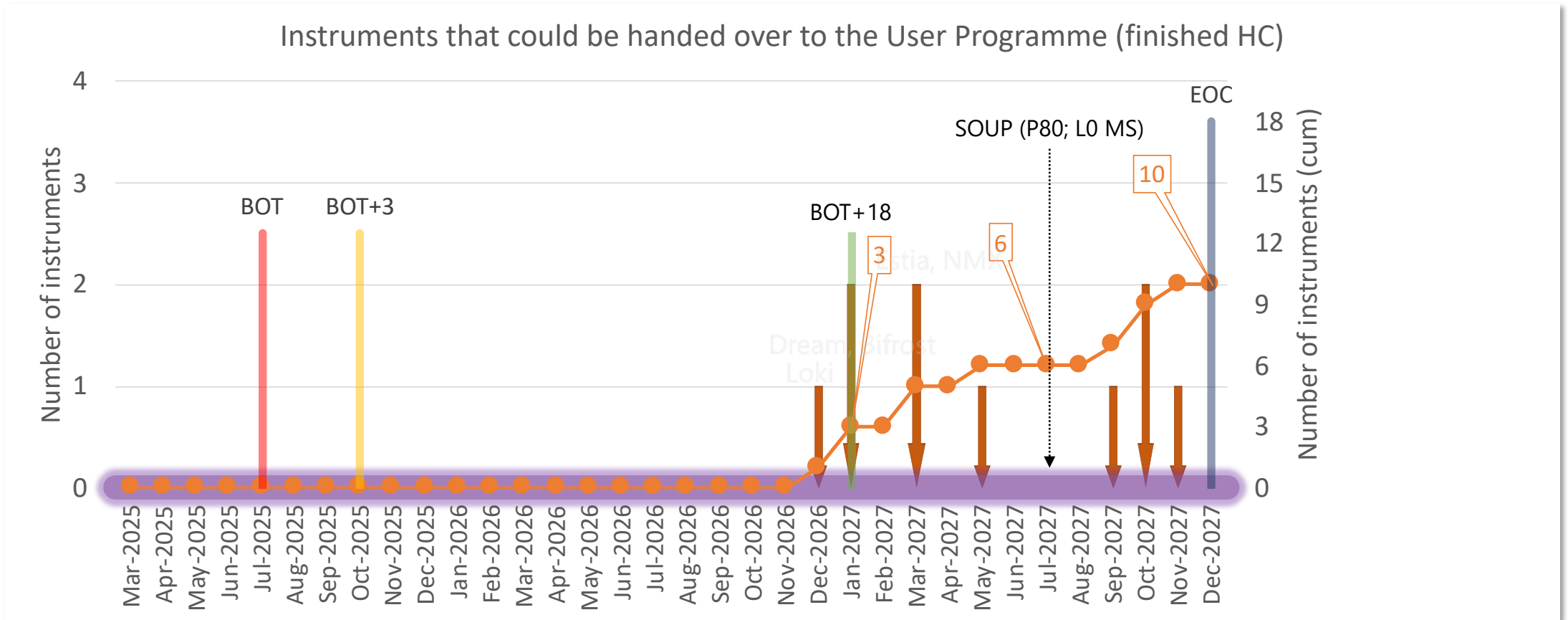


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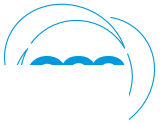
Instruments in User Programme



Hot Commissioning (HC) / Verification & Validation document signed off



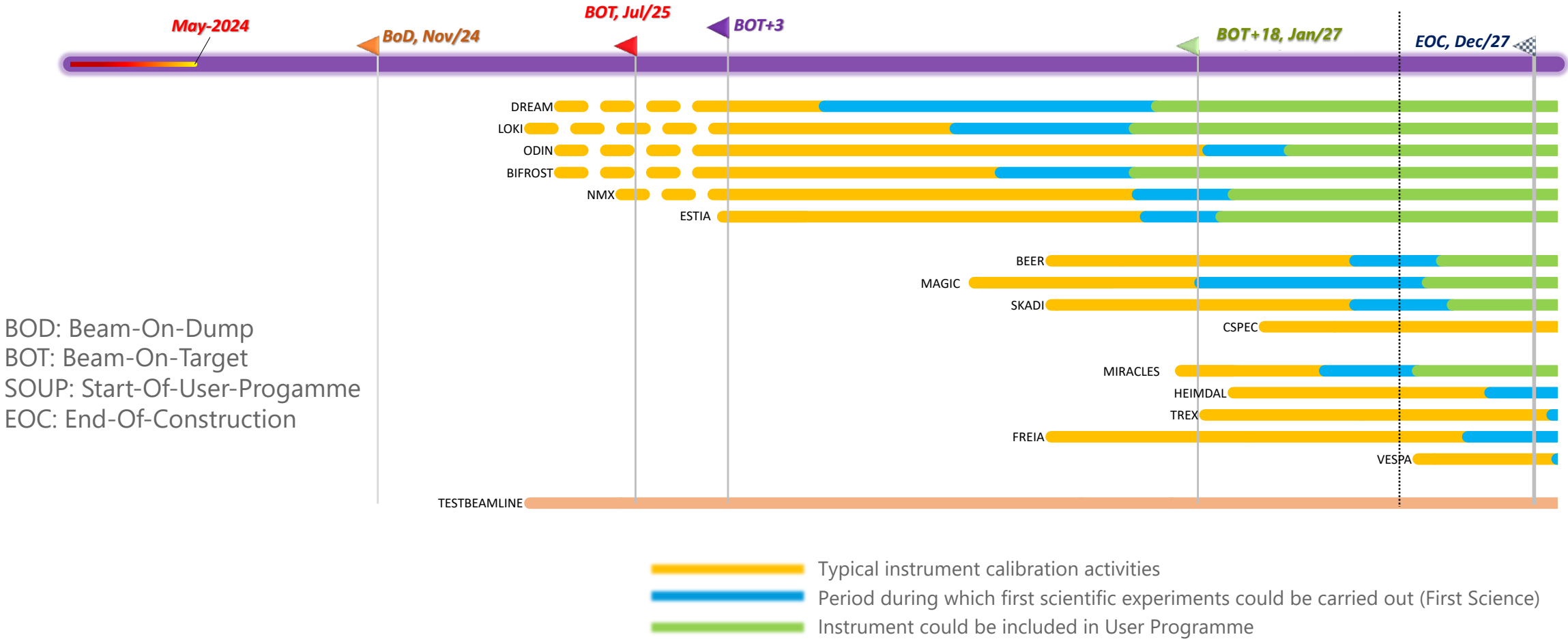
BOT: Beam-On-Target
EOC: End-Of-Construction
SOUP: Start-Of-User-Programme
L0 MS: Level 0 Milestone - under Council control



Simplified schedule

Basis - current TG5 dates / handover dates (replanning on-going)

SOUP (P80; L0 MS)



BOD: Beam-On-Dump
 BOT: Beam-On-Target
 SOUP: Start-Of-User-Programme
 EOC: End-Of-Construction

With the updated TG5/SRR schedule all instruments should be in hot commissioning by EOC



Estimated resource & duration requirements

Resource requirements

Direct operational FTE requirements

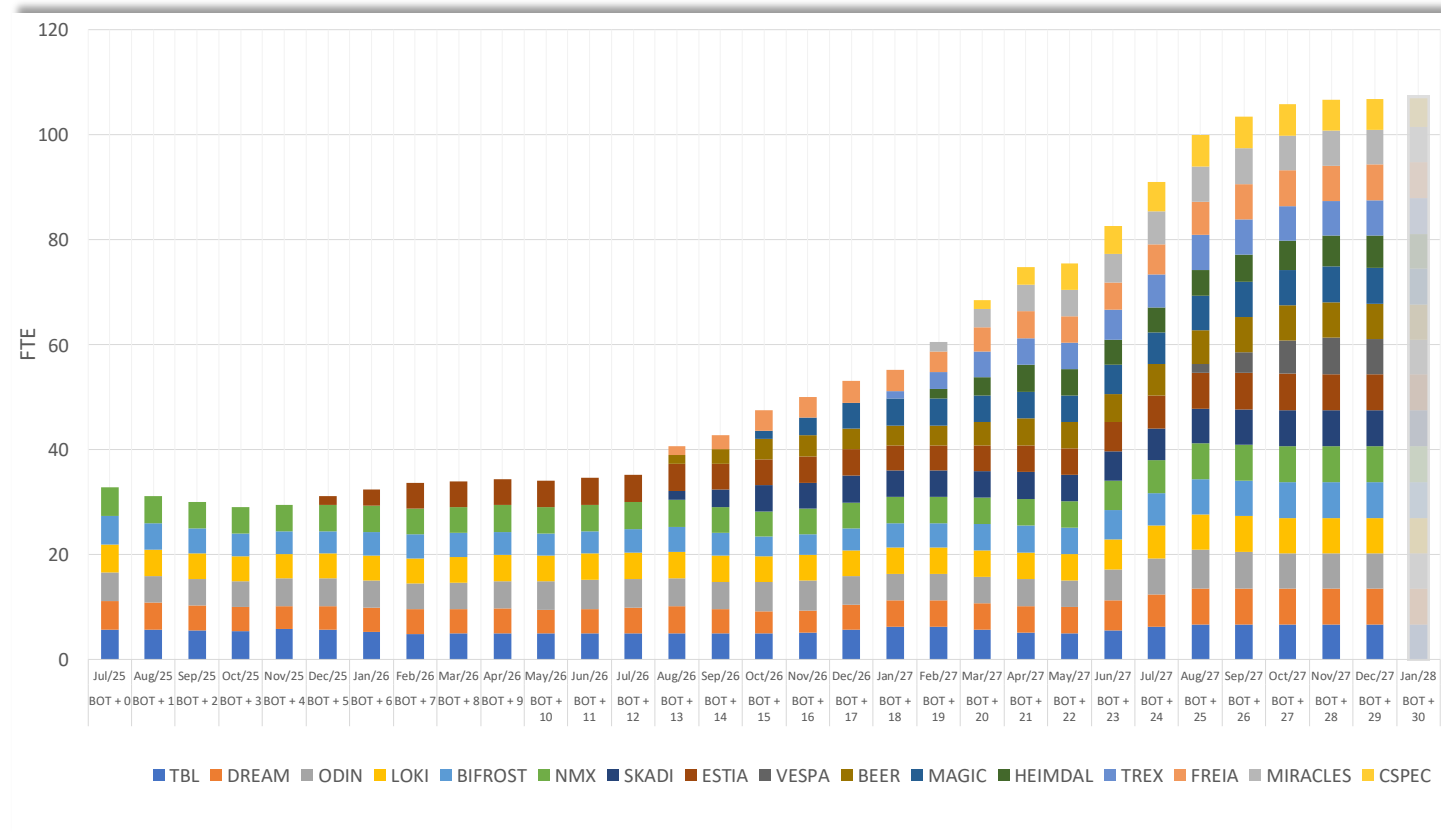


Included

- Instrument Scientists
- Instrument Data Scientists
- Hall coordination
- Scientist/Engineer & Technician support
 - Detector
 - Chopper
 - Motion Control
 - Chemistry & Life Science (CLS)
 - Materials Science & Physics Support (MSPS)
 - Polarisation
 - General lab support/operation

Excluded back office such as

- Administration (ie Director+PA, Project Management, Division Heads/Group leaders)
- Research Coordination Office
- Remaining DMSC activities



Resource requirements

Direct operational FTE requirements

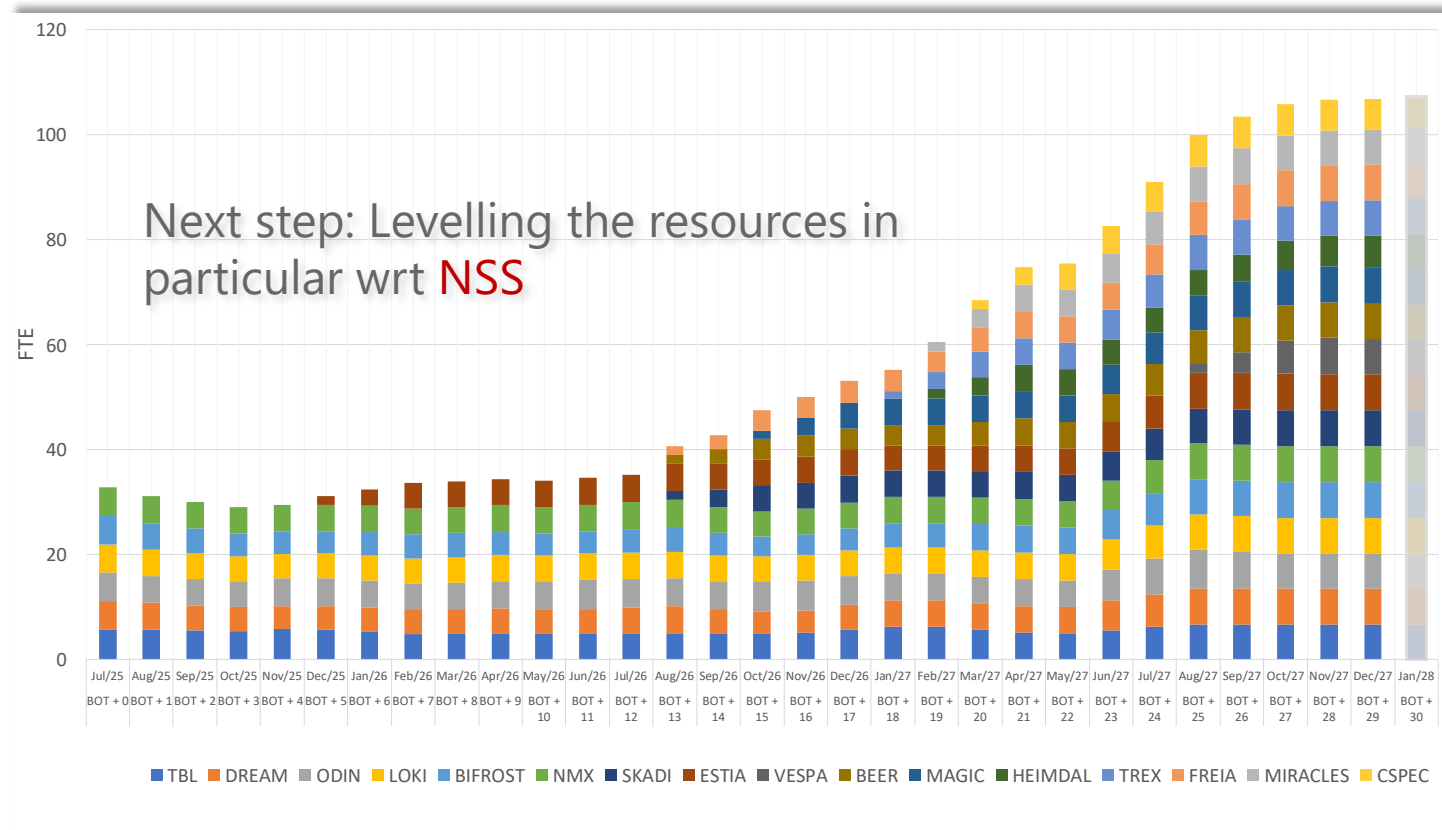


Included

- Instrument Scientists
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- Scientist/Engineer & Technician support
 - Detector (NSS)
 - Chopper (NSS)
 - Motion Control (NSS)
- Chemistry & Life Science (CLS)
- Materials Science & Physics Support (MSPS)
- Polarisation (NSS)
- General lab support/operation

Excluded back office such as

- Administration (ie Director+PA, Project Management, Division Heads/Group leaders)
- Research Coordination Office
- Remaining DMSC activities





Summary

Summary

Period from BOT+0 to SOUP to EOC

Post SRR / BOT activities are implemented in Primavera V6

- Coordinated across ESS involving all stakeholders
- Includes up-to-date information regarding TG5/hand-over dates
- Indicative: First Science could be “produced” from February 2026 (*initial estimation previous PAC: Nov '25 – Feb '26*)

By EOC 10 instruments should have finalised Hot Commissioning

- Could be included in the User Programme (*exact number depends on when the call for proposal submission is made*)
- All instruments should have started Hot Commissioning

At the time of SOUP it is likely that DREAM, LoKi, Bifrost have finished respective Verification & Validation activities (aka *Hot Commissioning*) and entered the User Programme

Ramp-up schedule provides provision to negotiate the number of Hot Commissioning days to mitigate issues (currently conservative)



| | | | |
|-----------------|-------------------|-----------------------|--------------|
| Document Type | Verification Plan | Date | Mar 28, 2024 |
| Document Number | ESS-5215012 | State | Released |
| Revision | 3 | Confidentiality Level | Internal |

4. HIGH LEVEL TECHNICAL COMMISSIONING GOALS

The following high level technical commissioning goals are extracted from information shared with the ESS Council, and will be used for the facility technical commissioning milestones:

Beam on Target (BOT)

- Demonstration (by measurement) of first protons striking the target ✓

Start of User Programme (SOUP)

- At least 3 instruments have completed hot commissioning, and entered in the user programme. ✓
- Source power at or above 570kW, with a neutron beam availability (for users) of at least 80%

End of Construction (EOC)

2MW capable neutron source delivered by separate demonstration of

- 4% duty factor (2.86ms proton beam pulses at 14Hz)
- Beam energy of 800MeV
- Nominal peak current (62.5mA) proton beam accelerated
- Source power in excess of 1MW with 80% reliability for users

All 15 Neutron Instruments installed, of which ✓

- 6 instruments in the user programme (stretch goal 10) ✓
- Remaining instruments in hot commissioning ✓

Test beam line neutron flux at 570MeV measured over a 3x6 cm² area in excess of

- 3.58 10⁻³ n/sr/p for cold neutrons (stretch goal 8.96 10⁻³ n/sr/p)
- 2.56 10⁻³ n/sr/p for thermal neutrons (stretch goal 6.40 10⁻³ n/sr/p)

5. RESOURCES AND THEIR ALLOCATION

Each subproject allocates resources to test their own deliverables, as well as to participate in integrated facility commissioning. Each subproject is also responsible to support operations (by supervision, maintenance and repairs) of their deliverables and unless a handover of that responsibility is agreed upon.

6. RESPONSIBILITIES AND AUTHORITY

Each subproject is responsible for timely delivery of their scope. In case of competing requests for commissioning time between subprojects, the global testing and commissioning coordinator prioritizes.

5 (7)

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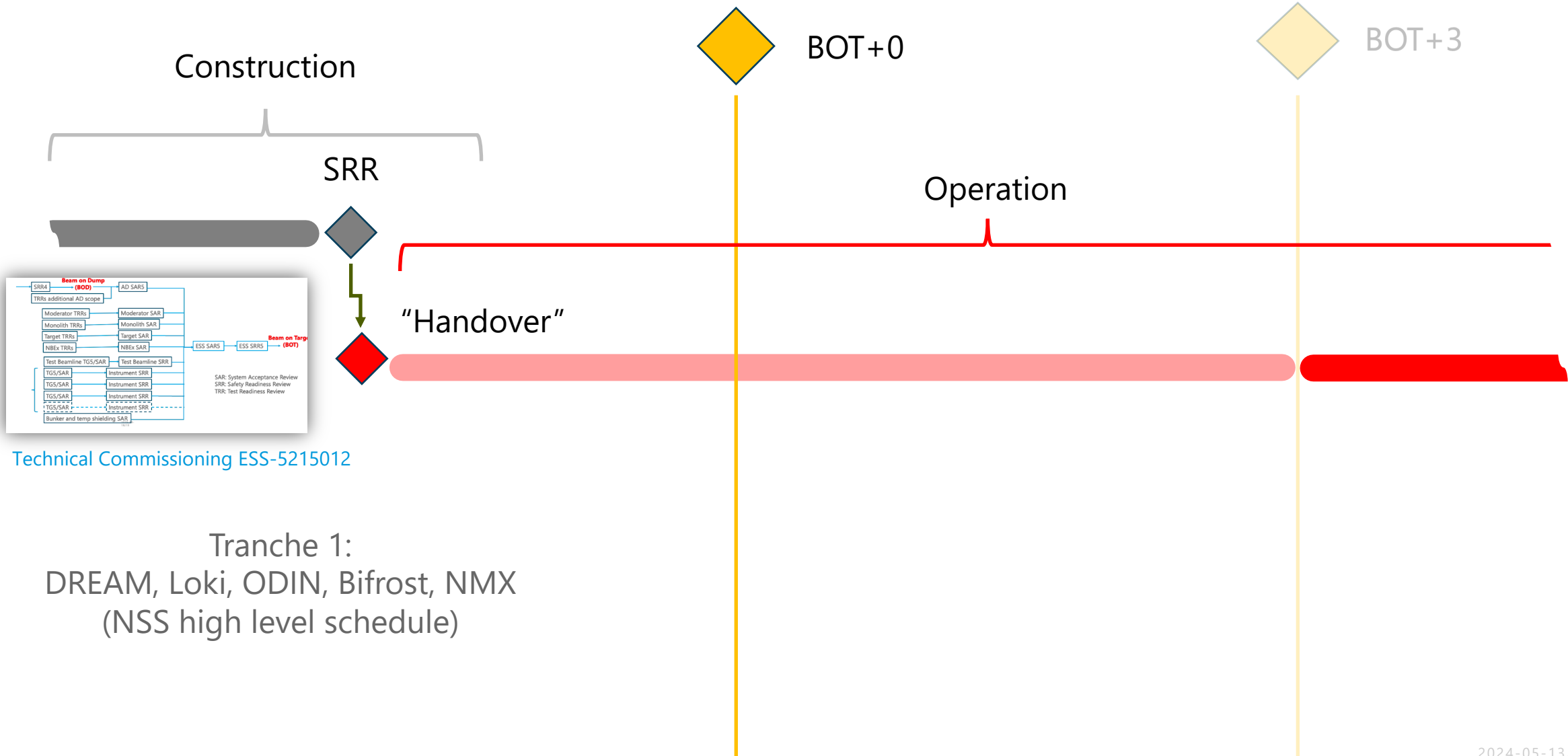


Additional material



BOT vs BOT + 3

Focus on BOT – Consequences for start of Hot Commissioning



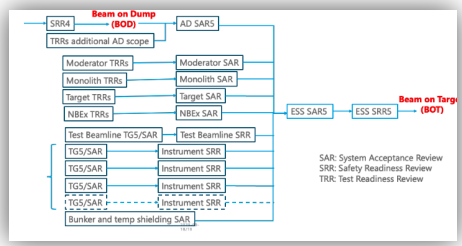
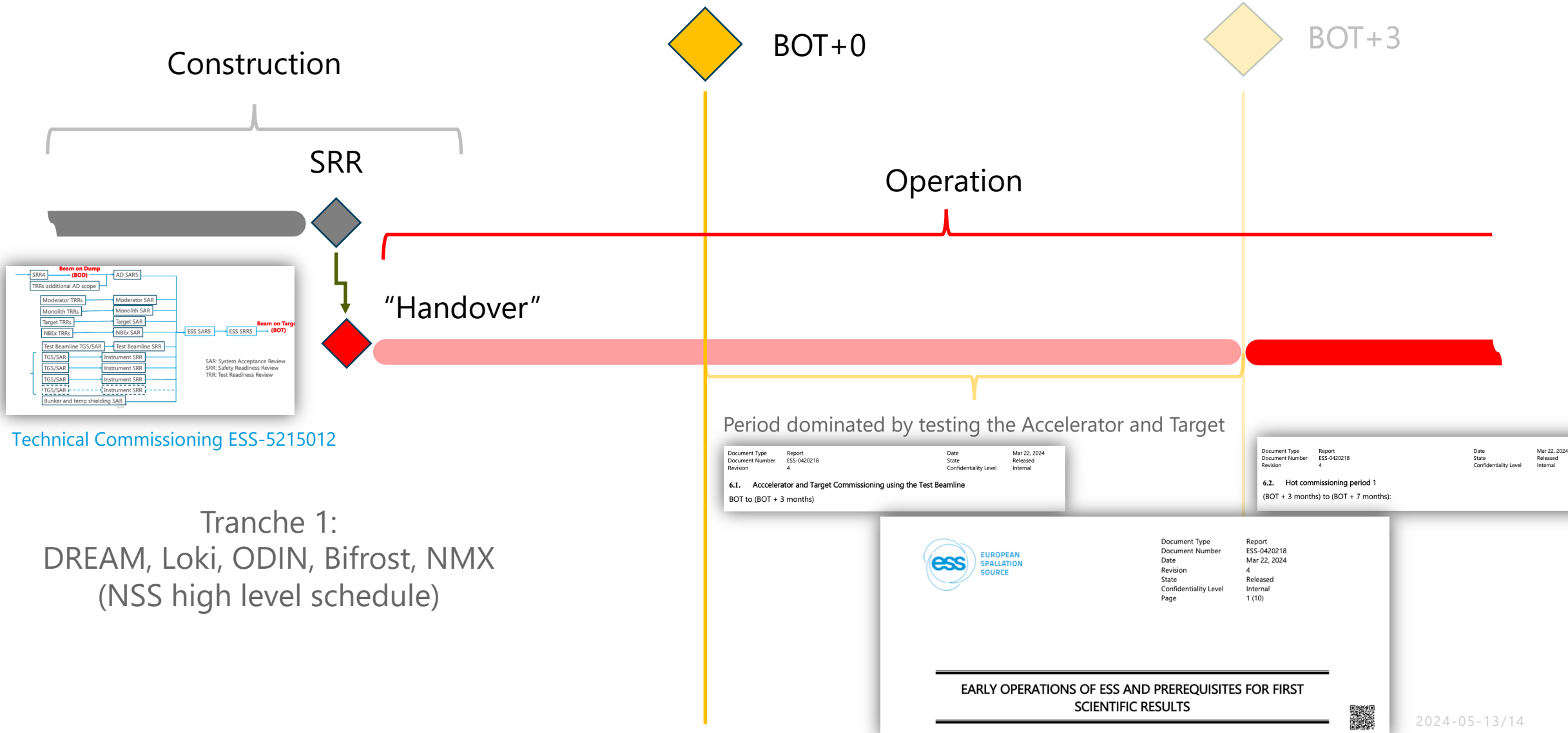
Technical Commissioning ESS-5215012

Tranche 1:
DREAM, Loki, ODIN, Bifrost, NMX
(NSS high level schedule)



BOT vs BOT + 3

Focus on BOT – Consequences for start of Hot Commissioning



Technical Commissioning ESS-5215012

| | | | |
|-----------------|-------------|-----------------------|--------------|
| Document Type | Report | Date | Mar 22, 2024 |
| Document Number | ESS-0420218 | State | Released |
| Revision | 4 | Confidentiality Level | Internal |

6.1. Accelerator and Target Commissioning using the Test Beamline
BOT to (BOT + 3 months)

| | | | |
|-----------------|-------------|-----------------------|--------------|
| Document Type | Report | Date | Mar 22, 2024 |
| Document Number | ESS-0420218 | State | Released |
| Revision | 4 | Confidentiality Level | Internal |

6.2. Hot commissioning period 1
(BOT + 3 months) to (BOT + 7 months)

EUROPEAN SPALLATION SOURCE

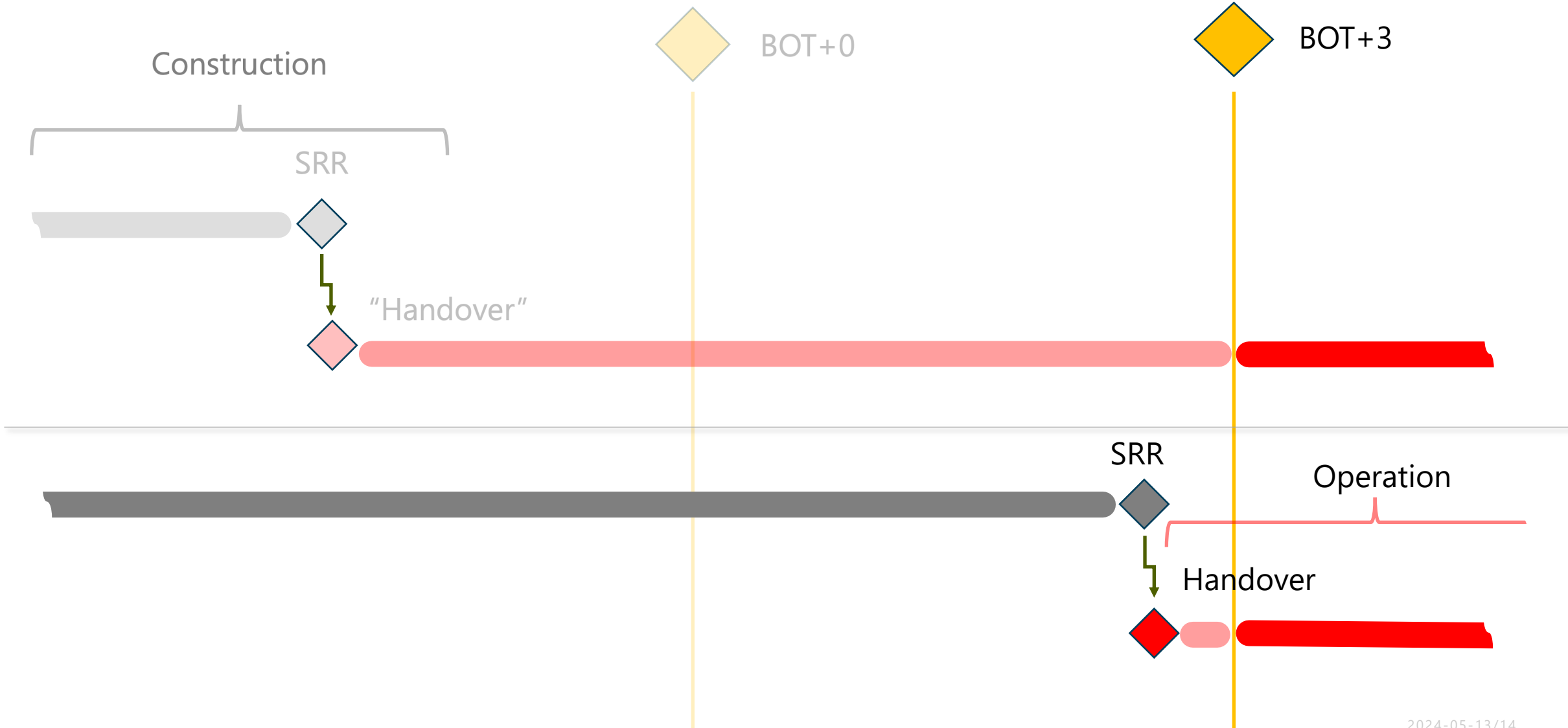
Document Type: Report
Document Number: ESS-0420218
Date: Mar 22, 2024
Revision: 4
State: Released
Confidentiality Level: Internal
Page: 1 (10)

EARLY OPERATIONS OF ESS AND PREREQUISITES FOR FIRST SCIENTIFIC RESULTS



BOT vs BOT + 3


Re-focus on BOT+3; effectively no impact if handover after BOT+0






BOT and beyond planning

Technical Commissioning ESS-5215012




Document Type: Verification Plan
 Document Number: ESS-5215012
 Date: Mar 28, 2024
 Revision: 3
 State: Released
 Confidentiality Level: Internal
 Page: 1 (7)

TECHNICAL COMMISSIONING OF THE ESS FACILITY



| | Name | Role/Title |
|----------|-------------------|--------------------------------------|
| Owner | Andreas Jansson | ESS Global Commissioning Coordinator |
| Reviewer | Ciprian Plostinar | Accelerator Project Manager |
| Reviewer | Rikard Linander | Target Project Leader |
| Reviewer | Robert Connatser | NSS Project Leader |
| Reviewer | Henrik Carling | ICS Project Leader |
| Reviewer | Oliver Kirstein | Science Project Leader |
| Reviewer | Peter Rådahl | Chief Engineer |
| Approver | Kevin Jones | Technical Director |
| Approver | Giovanna Fragneto | Science Director |

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<https://dms.ess.eu/external/ESS-5215012-921306.5116641123-0087>



Template: Plan (ESS-1554921 Rev: 2, Active date: Feb 20, 2020)

3. COMMISSIONING ACTIVITIES

All subsystems undergo required testing prior to start of full facility commissioning with proton beam to target. The readiness of all individual subsystems is verified through a series of reviews leading up to the Facility RBOT (Ready for Beam on Target) milestone, which is preceded by the Facility Safety Readiness Review (SRR5) [1]. See Figure 1 for an overview of how these reviews are connected.

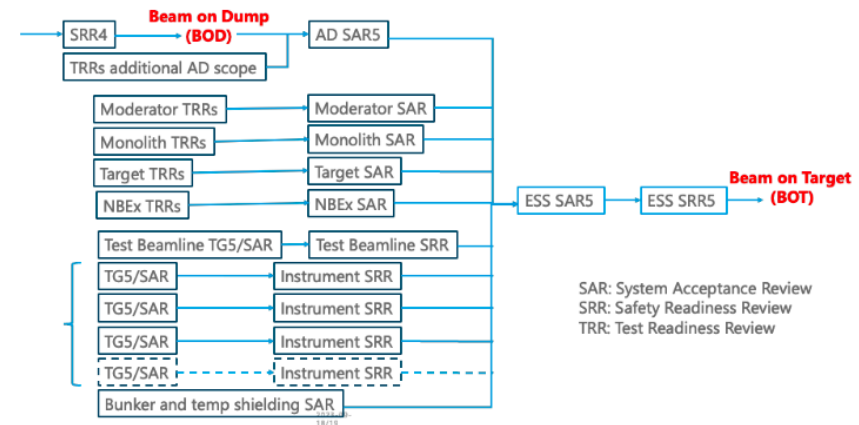


Figure 1 Reviews leading up to Beam on Target. The Facility Ready for Beam on Target (RBOT) milestone precedes the beam on target milestone (BOT).

- Contains a high level description of facility commissioning
- Outlines review steps to Beam on Target
- Provides references to detailed test plans
- Intended as a high level entry reference


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BOT and beyond planning



Early Operations ESS-0420218 (r4*)


*R3 from 2019 was called "Early operations of the ESS Neutron Instruments and first scientific results"



EUROPEAN
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SOURCE


Document Type: Report
 Document Number: ESS-0420218
 Date: Mar 22, 2024
 Revision: 4
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EARLY OPERATIONS OF ESS AND PREREQUISITES FOR FIRST SCIENTIFIC RESULTS

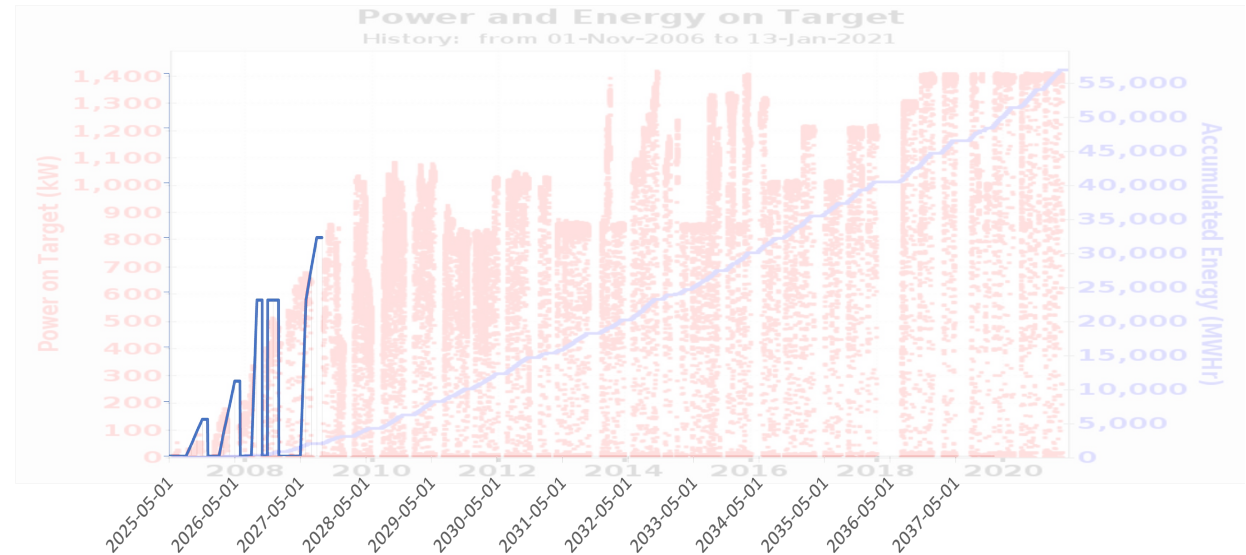


| | Name | Role/Title |
|----------|-------------------|---|
| Owner | Helmut Schober | Director General |
| Author | Andreas Jansson | Global Test and Commissioning Coordinator |
| Author | Oliver Kirstein | Science Project Leader |
| Reviewer | Carlo Bocchetta | Operations and Infrastructure Director |
| Reviewer | Kevin Jones | Technical Director |
| Reviewer | Giovanna Fragneto | Science Director |
| Approver | Helmut Schober | Director General |

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<https://crss.ess.eu/sei/enov/IN/ESS-0420218-421308.51166.47628.28601>



Template: Report (ESS-0060987 Rev. 4, Active date: Feb 20, 2020)



- Describes the main phases of the period from BOT to EOC
- Outlines assumptions on beam parameters (incl. power)
- Overall shift distribution and a tentative shift schedule
- Meant to be a common reference, and will be a living document
- Document is date agnostics. Dates to be tracked in P6, where shutdown and user periods will be locked down closer to BOT.



Feedback from 8+1 instruments

Information used to estimate effort for remaining 6

At the PAC.12 the average number of Hot Commissioning days estimated to be 152 days/instrument

Current estimation 128 days/instrument

(consistent with 3 – 4 months commissioning assuming continuous availability of “quality neutron beam”)

| Period | Sequence | Activity | Days | RP Technician | Instrument Scientist | Instrument Data Scientist | Detector scientist | CLS scientist | Chopper support (\$0/50 Scient/Tech) | DMSC support (\$0/50 Scient/Tech) | MCA support (\$0/50 Scient/Tech) | MPS support (\$0/50 Scient/Tech) | Polarisation (MPS) support (\$0/50 Scient/Tech) | Hall coordination (Eng) | General lab support (CLS, MPS, SCUO) (Techn) |
|-------------------|----------|--|------|---------------|----------------------|---------------------------|--------------------|---------------|--------------------------------------|-----------------------------------|----------------------------------|----------------------------------|---|-------------------------|--|
| Hot commissioning | 1 | Shielding verification (RP) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | Hot commissioning / calibration of beam monitors | 5.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 3 | Beam profile characterisation | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 4 | Flight path calibration | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 5 | Beam spectrum calibration | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 6 | Gold foil measurements to determine absolute flux (sample, along beamline) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 7 | Phase verification of the choppers | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 8 | Verification of beam shaping components along the beam/motion systems | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 9 | Calibration of WFM system / RRM | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 10 | Background characterisation (ind TO chopper) | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 11 | Gamma strikes/sensitivity | 2.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 12 | Characterisation/calibration of detector(s) position(s) | 20.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 13 | Trif and spatial characterisation of detector(s); E/ Q-resolution | 5.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 14 | Validation/round robin samples (First Science) | 15.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 15 | Commissioning of Sample Environment Systems | 10.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 16 | Commissioning of Polarisation equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| Buffer | 17 | Offline mode / offline activities | | 0.0 | 2.0 | 1.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.1 |
| Ops | 18 | BAU => User Operation | | 0.0 | 2.0 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |

BOT and beyond planning

Early Operations ESS-0420218 (rev4)



EUROPEAN
SPALLATION
SOURCE

Document Type Report
Document Number ESS-0420218
Date Mar 22, 2024
Revision 4
State Released
Confidentiality Level Internal
Page 1 (10)

EARLY OPERATIONS OF ESS AND PREREQUISITES FOR FIRST SCIENTIFIC RESULTS



| | Name | Role/Title |
|----------|-------------------|---|
| Owner | Helmut Schober | Director General |
| Author | Andreas Jansson | Global Test and Commissioning Coordinator |
| Author | Oliver Kirstein | Science Project Leader |
| Reviewer | Carlo Bocchetta | Operations and Infrastructure Director |
| Reviewer | Kevin Jones | Technical Director |
| Reviewer | Giovanna Fragneto | Science Director |
| Approver | Helmut Schober | Director General |

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https://cress.ess.eu.se/enowiki/ESS-0420218_421308151166_47628_28601



Template: Report (ESS-0060987 Rev. 4, Active date: Feb 20, 2020)

6.2. Hot commissioning period 1

(BOT + 3 months) to (BOT + 7 months):

- **Main activities:** The key performance challenges of the neutron source (accelerator, target and moderators) should have been identified, in part with data provided by the test beamline, and will begin to be addressed. Meanwhile several more instruments will commence hot commissioning. Emphasis shall be on availability¹ and reliability of beam over beam power, when operating in neutron production mode. Unscheduled access into the bunker and other irradiated areas may be needed for corrective work on beamline components. The repetition rate can be adjusted to ramp up the accelerator power
- **Overall objectives:** An increase in the availability and reliability of neutron beams. Consolidation of hot commissioning process of the first 5 instruments [2], while installing more instruments in the experimental halls.
- **Neutron pulse parameters:** Pulse length: 2.86 ms stable current throughout the pulse.
- **Proton Beam parameters for hot commissioning** (indicative): Current ~6 mA (ramping up to 12 mA) and beam energy between 570 and 870MeV.
- **Proton Beam parameters for beam studies** (indicative): Current ~6 mA (ramping up to 12 mA) and beam energy in range 570-870 MeV.

¹ Here availability refers to the percentage of neutron production delivered relative to planned neutron production, whereas reliability refers to percentage of neutron production delivered on schedule.

5 (10)

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Document Type Report
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- **Operating cycle for the neutron scattering instruments:** 2 consecutive days (6 shifts) per week at minimum power (0.14MW) with possible ramp-up at no expense to availability). More shifts will be needed for the neutron source itself: their planning will have to be properly coordinated between all stakeholders.
- **Shutdowns:** Weekly planned maintenance stops of 1 shift.
- **Radiation Protection (RP) & Occupation Health Safety (OHS):** Control and support (troubleshooting) for the NSS instruments in terms of RP and OHS.

BOT and beyond planning

Early Operations ESS-0420218 (rev4)







Document Type Report
 Document Number ESS-0420218
 Date Mar 22, 2024
 Revision 4
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 Page 1 (10)

EARLY OPERATIONS OF ESS AND PREREQUISITES FOR FIRST SCIENTIFIC RESULTS

| | Name | Role/Title |
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| Owner | Helmut Schober | Director General |
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| Approver | Helmut Schober | Director General |



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<https://cress.ess.eu/sei/enow/IN/ESS-0420218-421308151166-47628-28601>



Template: Report (ESS-0060987 Rev: 4, Active date: Feb 20, 2020)

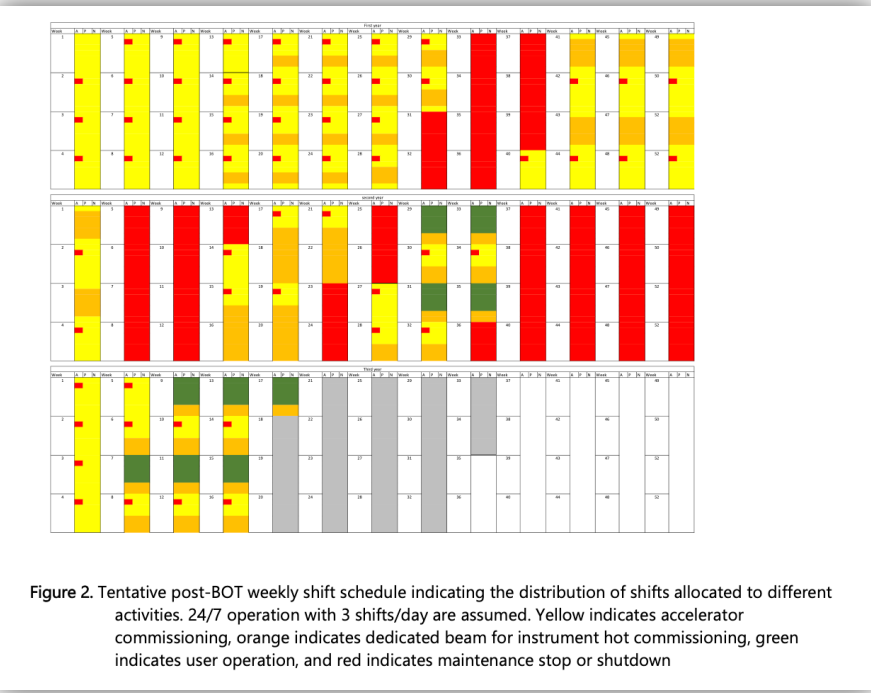
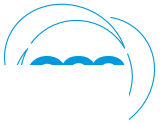


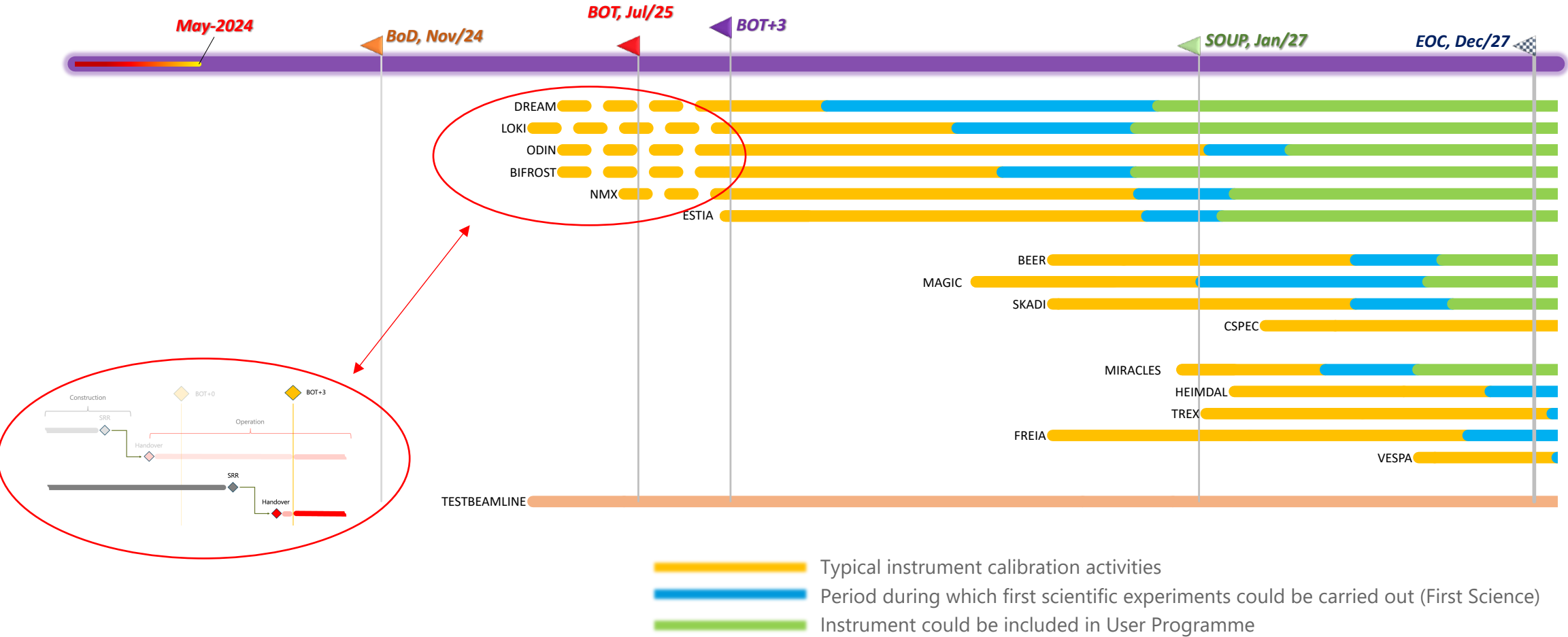
Figure 2. Tentative post-BOT weekly shift schedule indicating the distribution of shifts allocated to different activities. 24/7 operation with 3 shifts/day are assumed. Yellow indicates accelerator commissioning, orange indicates dedicated beam for instrument hot commissioning, green indicates user operation, and red indicates maintenance stop or shutdown

| # | Activity ID | Activity Name | Activity % Complete | Start | Finish |
|-----|--------------|--|---------------------|-----------|-----------|
| 531 | | Infrastructure Operations & Maintenance | | 23-Aug-25 | 31-Dec-27 |
| 532 | OID-A3214280 | Accelerator & Test beam line, no HC | 0% | 23-Aug-25 | 05-Nov-25 |
| 533 | OID-A3214290 | Hot Commissioning - 1st | 0% | 06-Nov-25 | 04-Mar-26 |
| 534 | OID-A3214300 | Shutdown (Instrument Install in Bunker - 1) | 0% | 05-Mar-26 | 24-Apr-26 |
| 535 | OID-A3214310 | Hot Commissioning - 2nd | 0% | 27-Apr-26 | 17-Sep-26 |
| 536 | OID-A3214320 | Shutdown (Instrument install in-bunker - 2) | 0% | 18-Sep-26 | 04-Nov-26 |
| 537 | OID-A3214330 | Hot Commissioning - 3rd | 0% | 05-Nov-26 | 21-Dec-26 |
| 538 | OID-A3214340 | Shutdown (Instrument install in-bunker - 3) | 0% | 22-Dec-26 | 03-Feb-27 |
| 539 | OID-A3214350 | Users - 1st | 0% | 04-Feb-27 | 31-Mar-27 |
| 540 | OID-A3214360 | Shutdown (CM install Instrument install in-bunker - 4) | 0% | 01-Apr-27 | 23-Aug-27 |
| 541 | OID-A3214370 | Recommissioning | 0% | 24-Aug-27 | 17-Sep-27 |
| 542 | OID-A3214380 | Users - 2nd | 0% | 20-Sep-27 | 19-Nov-27 |



Simplified schedule

Basis - current TG5 dates / handover dates (replanning on-going)



With the updated TG5/SRR schedule all instruments should be in hot commissioning by EOC

Post BOT planning

LOKI – System Validation and Verification Description (ESS-1108651)



Document Type: Validation Plan
 Document Number: ESS-1108651
 Date: Mar 8, 2023
 Revision: 0.3 (30)
 State: Draft
 Confidentiality Level: Internal
 Page: 1 (33)

ESS LOKI

15 m

Sample at 23.5 m

Side view

| Period | Sequence | Activity | Days | RP Technician | Instrument Scientist | Instrument Data Scientist | Detector scientist | CLS scientist | Chopper support (50/50) Scient/Tech | DMSC support (50/50) Scient/Tech | MCA support (50/50) Scient/Tech | MPS support (50/50) Scient/Tech | Polarisation (MPS) support (50/50) Scient/Tech | Hall coordination (Eng) | General lab support (CLS, MPS, SCUO) (Techn) |
|-------------------|----------|--|------|---------------|----------------------|---------------------------|--------------------|---------------|-------------------------------------|----------------------------------|---------------------------------|---------------------------------|--|-------------------------|--|
| Hot commissioning | 1 | Shielding verification (RP) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | Hot commissioning / calibration of beam monitors | 5.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 3 | Beam profile characterisation | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 4 | Flight path calibration | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 5 | Beam spectrum calibration | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 6 | Gold foil measurements to determine absolute flux (sample, along beamline) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 7 | Phase verification of the choppers | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 8 | Verification of beam shaping components along the beam/motion systems | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 9 | Calibration of WFM system / RRM | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 10 | Background characterisation (incl TO chopper) | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 11 | Gamma strikes/sensitivity | 2.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 12 | Characterisation/calibration of detector(s) position(s) | 20.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 13 | ToF and spatial characterisation of detector(s); E-/ Q-resolution | 5.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 14 | Validation/round robin samples (First Science) | 15.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 15 | Commissioning of Sample Environment Systems | 10.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 16 | Commissioning of Polarisation equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| Buffer | 17 | Offline mode / offline activities | | 0.0 | 2.0 | 1.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.1 |
| Ops | 18 | BAU => User Operation | | 0.0 | 2.0 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |

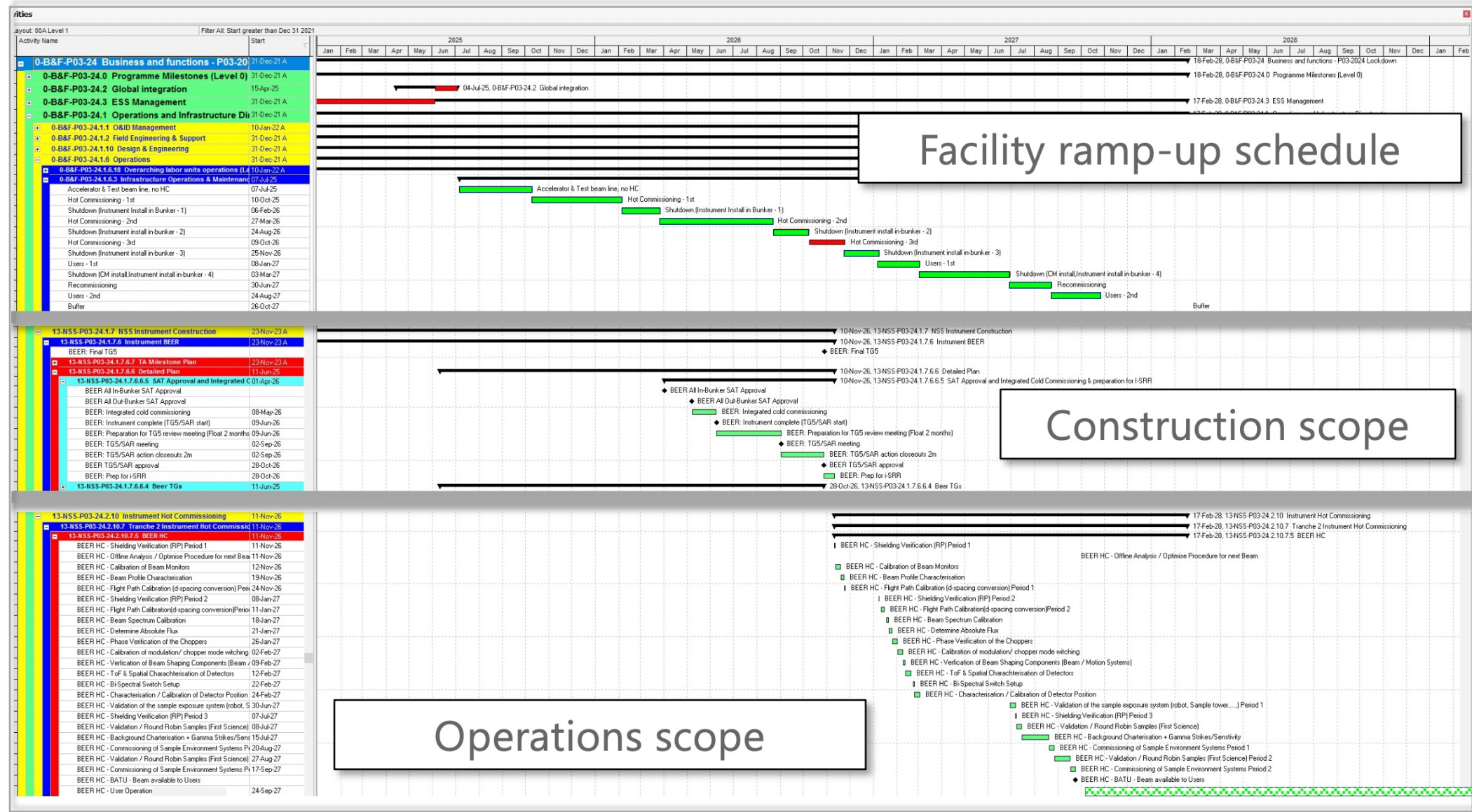
| | | |
|---|-----------|---|
| Chopper phasing verification | 5 days | May need the chopper group to help |
| Optimise collimation tube, guide and jaw set positions | 10 days | Reliant on availability of portable neutron cameras |
| Check neutron beam through all components in sample area | 5 days | Reliant on availability of portable neutron cameras |
| Collection of detector calibration mask data and silver behenate powder | 15 days | Perhaps collect data at night time during some other tasks. |
| Processing of calibration mask data, integration with survey results, check against reduced behenate powder data. | (*5 days) | Can be during "beam off". |
| Collection of data from standard samples for detector efficiency iterations. | 12 days | |

| Period | Sequence | Activity | Days | RP Technician | Instrument Scientist | Instrument Data Scientist | Detector scientist | CLS scientist | Chopper support (50/50) Scient/Tech | DMSC support (50/50) Scient/Tech | MCA support (50/50) Scient/Tech | MPS support (50/50) Scient/Tech | Polarisation (MPS) support (50/50) Scient/Tech | Hall coordination (Eng) | General lab support (CLS, MPS, SCUO) (Techn) |
|-------------------|----------|--|------|---------------|----------------------|---------------------------|--------------------|---------------|-------------------------------------|----------------------------------|---------------------------------|---------------------------------|--|-------------------------|--|
| Hot commissioning | 1 | Shielding verification (RP) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | Hot commissioning / calibration of beam monitors | 5.0 | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 3 | Beam profile characterisation | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 4 | Flight path calibration | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 5 | Beam spectrum calibration | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 6 | Gold foil measurements to determine absolute flux (sample, along beamline) | 3.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 7 | Phase verification of the choppers | 5.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 8 | Verification of beam shaping components along the beam/motion systems | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 9 | Calibration of WFM system / RRM | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 10 | Background characterisation (incl TO chopper) | 3.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 11 | Gamma strikes/sensitivity | 2.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 12 | Characterisation/calibration of detector(s) position(s) | 20.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 13 | ToF and spatial characterisation of detector(s); E-/ Q-resolution | 5.0 | 0.0 | 2.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| | 14 | Validation/round robin samples (First Science) | 15.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 15 | Commissioning of Sample Environment Systems | 10.0 | 0.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.2 | 0.1 |
| | 16 | Commissioning of Polarisation equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 |
| Buffer | 17 | Offline mode / offline activities | | 0.0 | 2.0 | 1.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.1 |
| Ops | 18 | BAU => User Operation | | 0.0 | 2.0 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |



Post BOT planning

P6 implementation – example: BEER (T2)



Operations scope

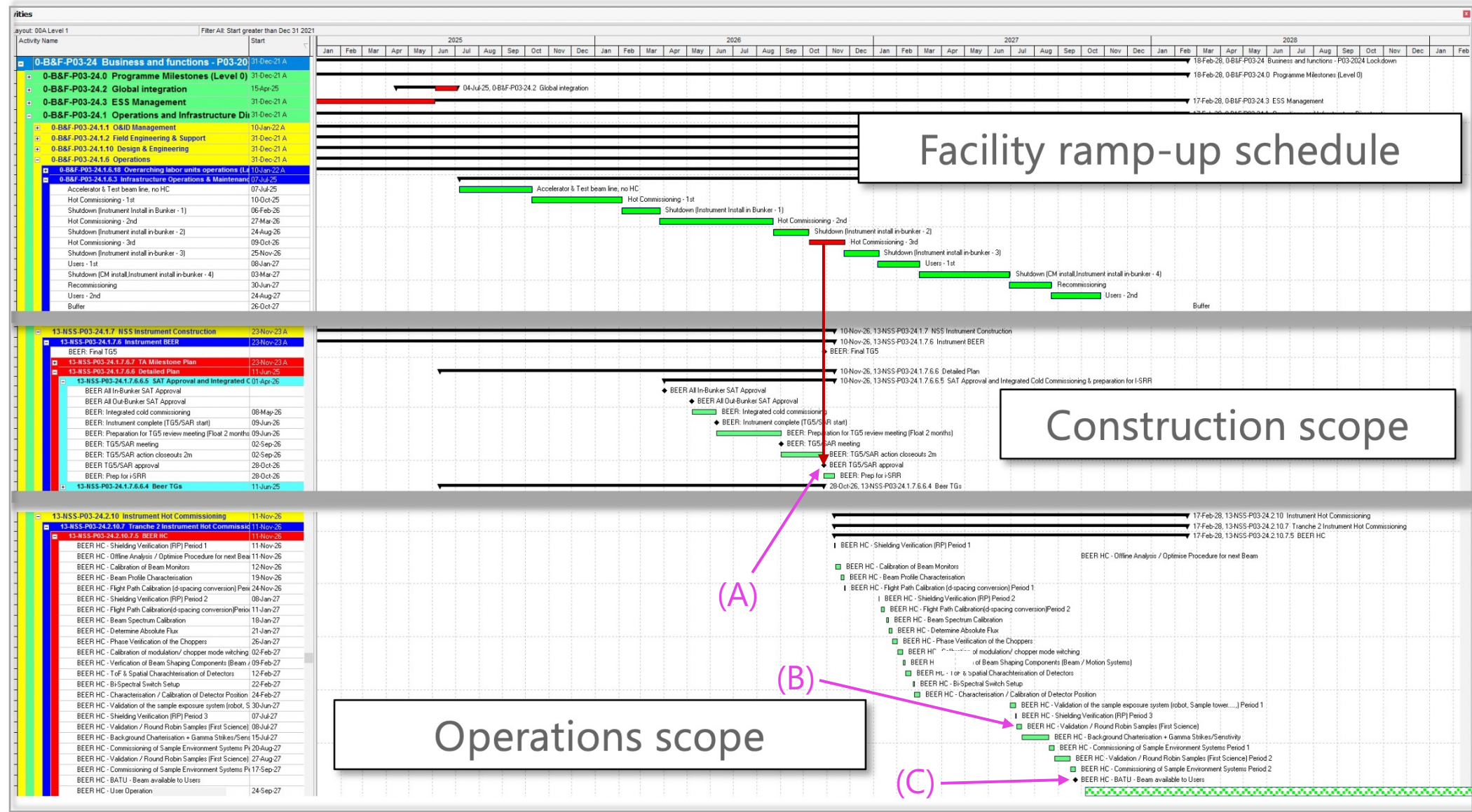
Construction scope

Facility ramp-up schedule



Post BOT planning

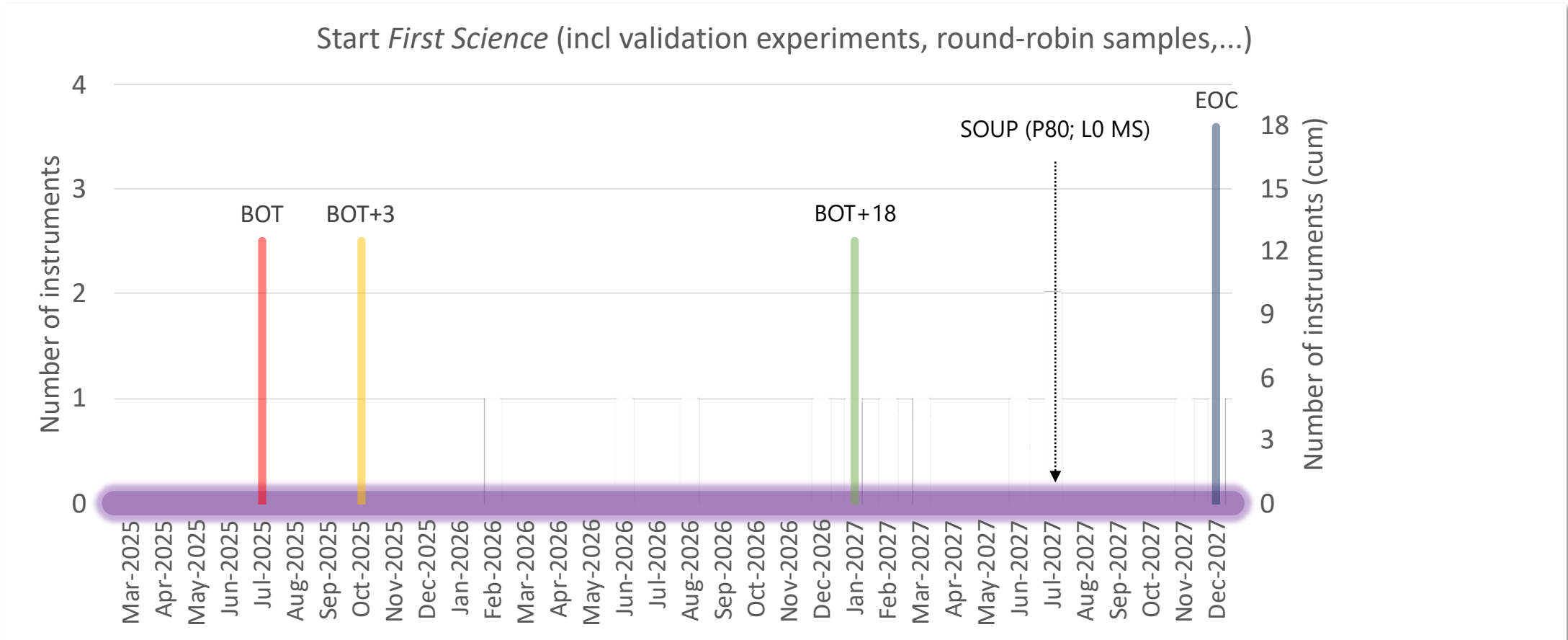
P6 implementation – example: BEER (T2)



First Science



Earliest possibility; basic instrument calibrations done



BOT: Beam-On-Target

EOC: End-Of-Construction

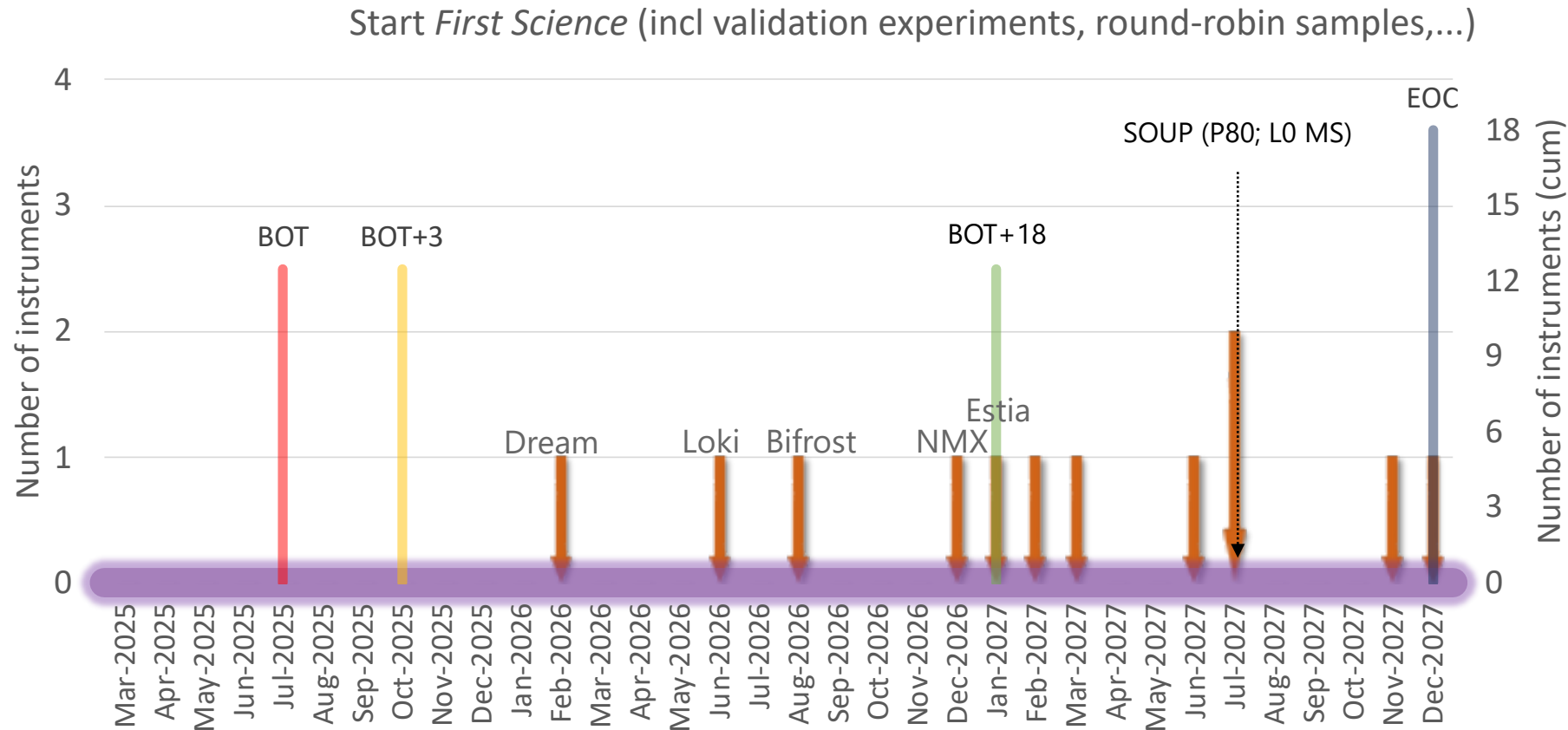
SOUP: Start-Of-User-Programme

L0 MS: Level 0 Milestone - under Council control

First Science



Earliest possibility; basic instrument calibrations done



BOT: Beam-On-Target

EOC: End-Of-Construction

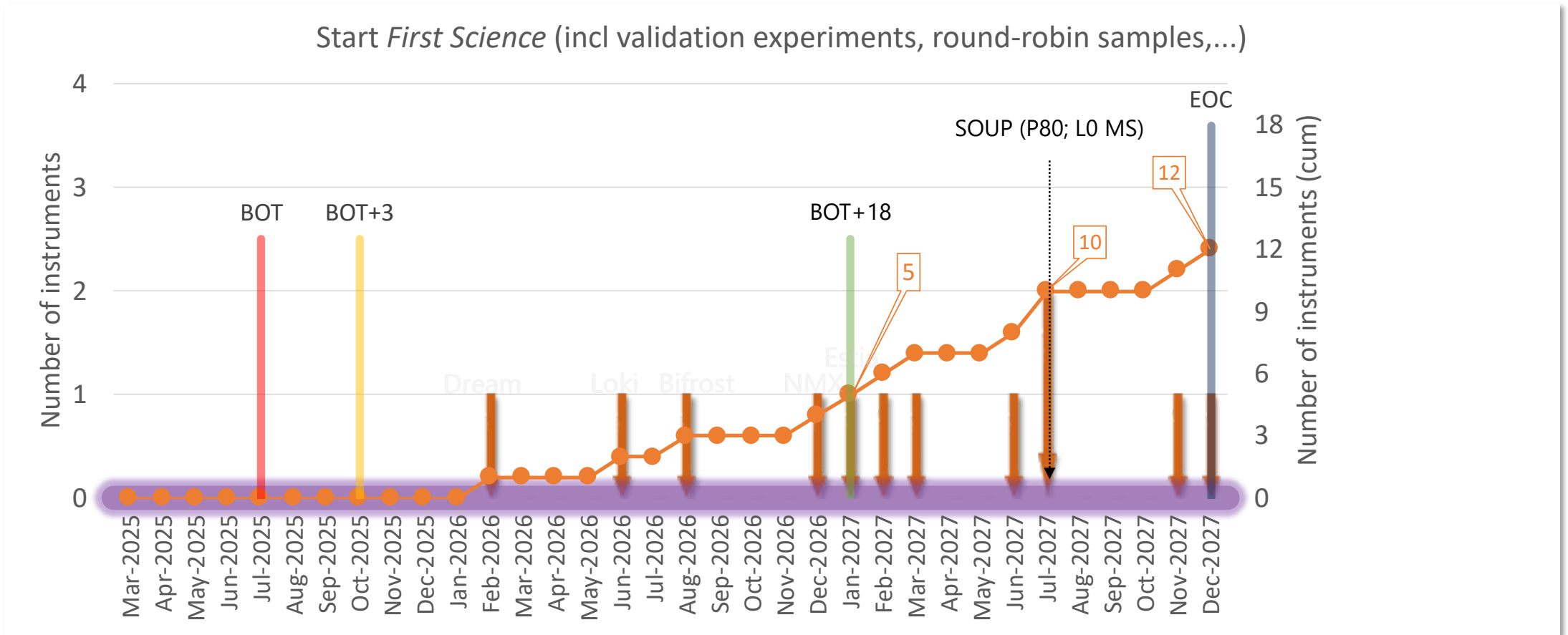
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First Science



Earliest possibility; basic instrument calibrations done



BOT: Beam-On-Target
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Thank you for
your attention





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