



**EUROPEAN
SPALLATION
SOURCE**



Motion Control & Automation (MCA)

System Acceptance Review BIFROST

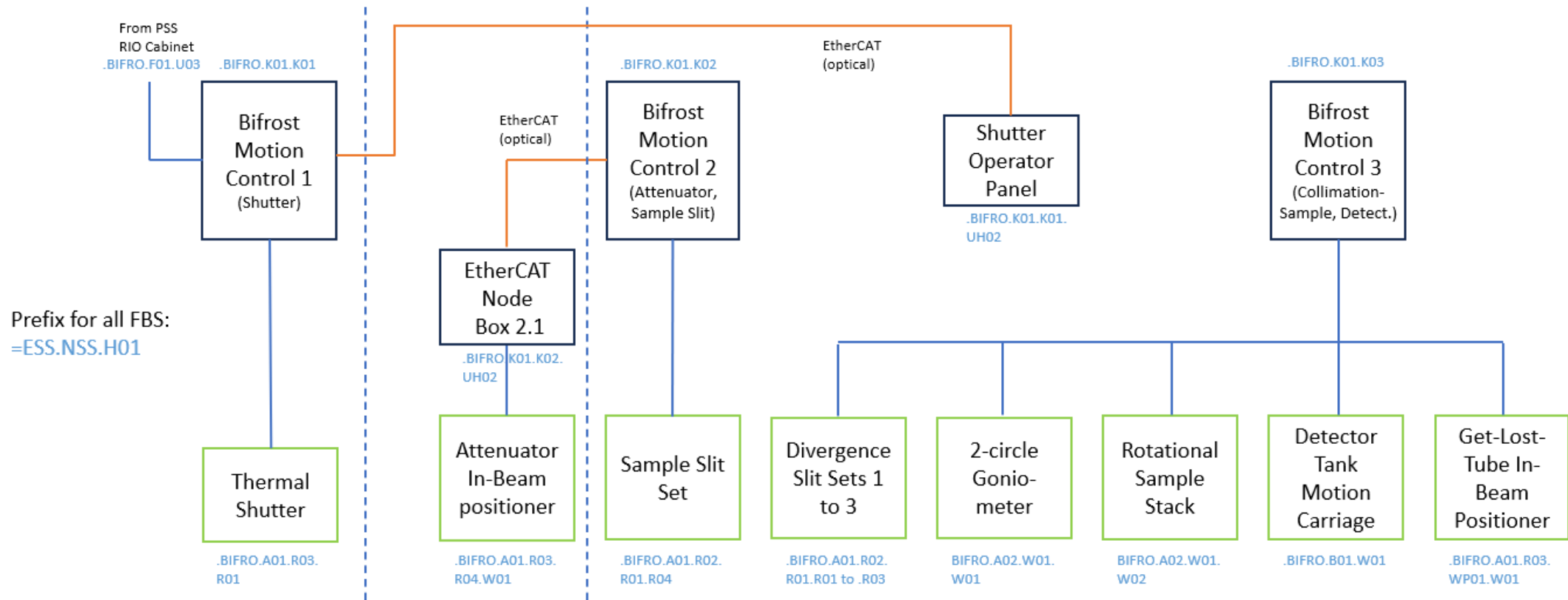
PRESENTED BY FEDERICO ROJAS

2025-09-01

Motion Control & Automation



Bifrost Local Test (SAT 1)



| MCA Control System | Connected Instrument Subsystems | Test Reports | Status |
|---------------------------------|---|--------------|------------------------|
| MC1 Shutter | Thermal Shutter | ESS-5694447 | Passed w/ Minor Issues |
| MC2 Attenuators+Sample Slits | Attenuator and Sample Slits | ESS-5770642 | Passed w/ Minor Issues |
| MC3 Collimation-Sample-Detector | Divergence Slits, 2x Circle Goniometer, Rotation Sample Stage, Detector Tank Carriage, GLT and Platform Status Switch | ESS-5702798 | Passed w/ Minor Issues |

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Bifrost Local Test (SAT 1) – MC 1 (Shutter) Report ESS-5694447

| System name | FBS | FAT/DAT Status | SAT1 Status | Issue Tracker | Issues | To be fixed before |
|-------------------------|-----------------------|----------------|--------------|-------------------------|--|--|
| Bifrost Thermal Shutter | BIFRO.A01. R03.R01 | No issues | Minor Issues | NIT-143 | Switches do not follow standard connection to controller. Update connections and labels. | Before ORR, as soon as the shielding is removed. |
| | | | | NIT-234 | Descriptive error propagation to NICOS not fully implemented. | Before SRR. |
| MCC1 | BIFRO.K01. K01 | No issues | Minor issues | NIT-144 | As-built ePlan drawings | Before ORR |

- Test cases for motion control functionality passed.
- SAT 2 with PSS and CUP passed.
- Shutter Operation via Shutter Operator Panel works.
- Switches standard connection to be fixed when shielding is removed.
- Descriptive error handling for pneumatics development on going.

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Bifrost Local Test (SAT 1) – MC 2 (Attenuators+Sample Slits) Report ESS-5770642



| System name | FBS | FAT/DAT Status | SAT1 Status | Issue Tracker | Issues | To be fixed before |
|---|---------------------------|----------------|--------------|-------------------------|---|--------------------|
| Attenuators | BIFRO.A01.R03. R04.W01 | No issues | Minor Issues | NIT-142 | Adjust flow control valve for Attenuator 1 and change the operating pressure accordingly. | Before ORR |
| | | | | | Update tags with new FBS. | |
| | | | | | Block unused channels from pneumatics box. | |
| Sample Slits (including manual positioning) | BIFRO.A01.R02. R01.R04 | N/A | Minor issues | NIT-249 | Subsystem cables labels and junction boxes. | Before SRR |
| | | | | NIT-266 | Replace sensor box with one with screw holes. | Before SRR |
| MCC2 | BIFRO.K01.K02 | No issues | Minor issues | NIT-144 | Retest potentiometers readings after cable management. | Before SRR |
| | | | | | As-built ePlan drawings | Before ORR |

- Test cases for motion control functionality passed.
- Attenuators' flow control valves and pressure needs to be recalibrated.
- Recalibrate potentiometer readings after shortening cables.

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Bifrost Local Test (SAT 1) – MC 3 (Collimation-Sample-Detector)

| System name | FBS | FAT/DAT Status | SAT1 Status | Issue Tracker | Issues | To be fixed before |
|-----------------------------|--------------------------------------|--------------------------------------|--------------|-------------------------|---|--------------------|
| Divergence Slits 1, 2 and 3 | BIFRO.A01.R02.R01.R01; .R02 and .R03 | No issues after motor exchanged | Minor Issues | NIT-249 | Cable management and labels for motion components. | Before SRR |
| Sample Rotation Stage | BIFRO.A02.W01.W02 | No issues | Minor Issues | NIT-249 | Labels for motion components and cable management. | Before SRR |
| 2 Circle Goniometers | BIFRO.A02.W01.W01 | No issues after installing gearboxes | Minor Issues | NIT-249 | Labels for motion components and cable management. | Before SRR |
| | | | | NIT-265 | Retest goniometers after cable fix. | |
| Get Lost Tube | BIFRO.A01.R03.WP01.W01 | N/A | Minor Issues | NIT-234 | Descriptive error propagation to NICOS not fully implemented. | Before SRR |
| | | | | NIT-249 | Block unused channels from pneumatics box. | Before SRR |

- Test cases for motion control functionality passed.
- Retesting of goniometers after cables fix needed.

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Bifrost Local Test (SAT 1) – MC 3 (Collimation-Sample-Detector)

| System name | FBS | FAT/DAT Status | SAT1 Status | Issue Tracker | Issues | To be fixed before |
|------------------------|----------------|---------------------------|--------------|-------------------------|--|--------------------|
| Detector Tank Carriage | BIFRO.B01.W01 | Not tested in Closed Loop | Minor Issues | NIT-249 | Labels for motion components and cable management. | Before SRR |
| | | | | NIT-144 | Limit switches inverted, add info in ePlan. | Before ORR |
| Sample Platform Switch | BIFRO.U01.WS01 | N/A | Minor Issues | NIT-249 | Labels for motion components and cable management. | Before SRR |
| MCC3 | BIFRO.K01.K03 | No issues | Minor issue | NIT-144 | As-built ePlan drawings | Before ORR |
| | | | Issue | NIT-246 | No PTP support, neither other precision timing implemented | Before SOUP |

- Test cases for motion control functionality passed.
- Detector tank tested and controlled in closed loop.
- Collision avoidance software for Detector Tank and GLT tested.
- Need for a precision timing for timestamping motion positions. The current solution is good enough for first science, but something with better resolution is needed for SOUP.

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BIFROST Local Test (SAT 1) – Status of Motion Safety (compliance to Machine Directive)

- The cabinet design includes safety circuits according to EN ISO 13849-1 for a safe stop of the moving parts of the instrument subsystems. E-stops are either installed permanently or temporarily. These stop categories according to EN 61800-5-2 can be implemented:
 - Safet Torque Off (**STO**)
 - Safe Stop 1 (**SS1**)
- IHA is reviewed; hazards related to motion safety systems controlled by MCA control systems have been transferred to the MCA documentation (sheet 3 of Table-of-Motion, ESS-1798247); work will be executed by the Common MCA (CMCA) project.
- Hazard analysis has been started according to ESS-5467337 - Motion Risk Analysis of Neutron Instruments:
 - Operation = Hazards in Areas accessible to the user; Implementation of hazard mitigation in the control system (SRP/CS)
 - Maintenance: Hazards in shielded areas accessible to trained personnel only; Implementation of hazard mitigation with procedures (RAMS, fencing, signage etc.)
- The full motion safety system verification and validation will be done together with PSS before the Safety Readiness Review (i-SRR).



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BIFROST Local Test (SAT 1) – ePlan documentation (NIT-144)

- For each motion system 1 to 3 an electrical documentation package has been issued (ePlan drawing, BOM, fuse chart, cable list etc.)
- Drawings include the controll cabinet, external boxes (if applicable), motion safety circuits and all instrument sub-systems connected.
- As built drawings need to be produced after the changes and adaptations during the local and integrated tests, and the implementation of the safety circuit.

EUROPEAN SPALLATION SOURCE

Designation:

TBL Motion Control 1 (In-Bunker)

Functional Location (FBS):

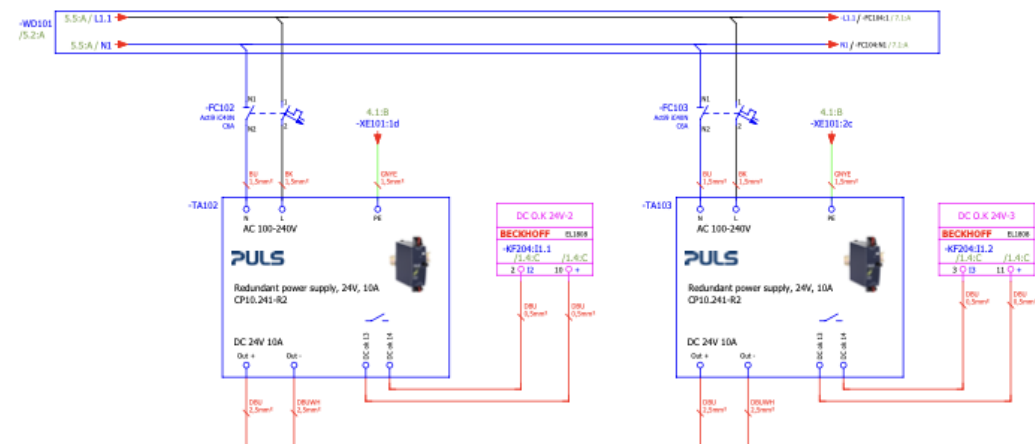
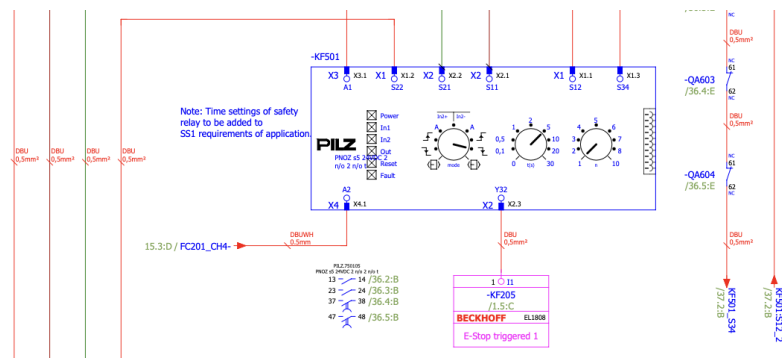
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Physical Location (LBS):

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- Bifrost MC 1 ESS-4934944
- Bifrost MC 2 ESS-4934945
- Bifrost MC 3 ESS-4934946



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BIFROST Local Test (SAT 1) – Summary

- All test cases for motion control functionality and performance passed.
- Minor issues, mainly on the labeling and cable management.
- Most issues do not affect the functionality of the instrument.
- Retesting issues are based on fixes needed after the testing was concluded.
- Tickets filed in the NSS Issue Tracker (NIT):
 - NIT-142: Amendment of Attenuator 1 Valve and Attenuator Tags; to be resolved before ORR
 - NIT-143: Shutter Switch Junction Box; to be resolved before ORR
 - NIT-144: As-Built Drawings for MCAG Scope; to be resolved before ORR
 - NIT-234: Bifrost pneumatics error handling; to be resolved before SRR (affects all instruments)
 - NIT-246: Precision time stamping for motor positions; to be resolved before ORR
 - NIT-249: Addition and amendment of motion tags in the cave; to be resolved before SRR
 - NIT-265: Retesting of Goniometers; to be resolved before SRR
 - NIT-266: Retest of Potentiometers; to be resolved before SRR

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BIFROST Local Test (SAT 1) – Summary

- NIT-249 Addition and amendment of motion tags in the cave progress:
 - Replace label wg031 in slit 1, slit 2: wg053, wg061. **Done**
 - Divergence slit cable raceway grounding and missing parts. **Done**
 - Labels for pot cables of subsystem. **Done**
 - Replace piezo box clamps for box with screw holes. **Waiting for delivery**
 - Labels the piezo boxes. **Done**
 - Labels on the JB close to the piezo slits. **Done**
 - Labels on slit frame. **Done**
 - Label for connection points of sample rot stage. **Done**
 - Cable management, cut raceway of sample rotation. **Done**
 - Label for the platform JB. **Instrument team**
 - Labels on bracket of detector tank. **Done**
 - Label in motor tank. **Done**
 - Label in encoder tank. **Done**
 - Close unused pneumatics channels in pneumatic box. **Done**
 - FBS + FBS subscription labels in all subsystems. **Instrument team**

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BIFROST Local Test (SAT 1) – Next steps

- After fixing the NIT issues, the motion control systems for BIFROST are ready for operation in Hot Commissioning.
- MCA group is planning to support hot commissioning with these activities:
 - Support instrument team with motion related issues.
 - Technician support if requested.
 - Engineering support if requested.
- User and maintenance manuals for the cabinets are available:
 - ESS-5483415 - Service & Maintenance Plan for MCA Cabinets and Boxes
 - ESS-5669197 - Operation Manual - MCU6001: Shutter Motion Control Cabinet
 - ESS-5669198 - Operation Manual - MCU5001: 16Ax. Motion Control Cabinet
 - ESS-5669199 - Operation Manual - MCU5002: Servo Motion Control Cabinet
 - ESS-5669200 - Operation Manual - MCU5003: Piezo Motion Control Cabinet
- No displaced working hours or on-call support planned.



Thank You!

2025-09-01