Integrated Test Results

=ESS.NSS.H01.LOKI

PRESENTED BY ANDREW JACKSON

2025-09-11

Integrated Tests

- From SAT tests, we knew the components worked in isolation. Minor issues were known
- The aim was to test the interfaces and the “end user” facing operation of the instrument
- Tests were developed and executed in close collaboration with ECDC, ICS, MCA, Detector Group, Chopper Group and DMSC staff. Excellent support was provided by all.

ESS-5601100	Integrated Test Plan for the LOKI Chopper System	**Released**: 4 June 2025	**Test complete**: 23 June 2025	ESS-5759105	Integrated Test Report for the LoKI Chopper System	**Released:** 29 August 2025
ESS-5601101	Integrated Test Plan for the LoKI Collimation System	**Released**: 19 May 2025	**Test complete**: 26 June 2025	ESS-5769855	Integrated Test Report for the LoKI Collimation System	**Released:** 5 Sept 2025
ESS-5601102	Cold commissioning plan for the LOKI detector motion system	**Released**: 19 June 2025	**Test complete**: 3 July 2025	ESS-5767051	Integrated Test Report for the LoKI Detector Motion System	**Released:** 5 Sept 2025
ESS-5758315	Integrated Test Plan for the LOKI detector & beam monitor system	**Released**: 2 Sept 2025	**Test complete** : 3 Sept 2025	ESS-5818477	Integrated Test Report for the LoKI Detector and Beam Monitor Systems	**Released:** 5 Sept 2025
ESS-5758591	Integrated Test Plan for the LOKI Sample Area	**Released**: 16 July 2025	**Test complete**: 17-18 July & 4 Aug 2025	ESS-5769853	Integrated Test Report for the LoKI Sample Area	**Released:** 5 Sept 2025
ESS-5758586	Integrated Test Plan for the LoKI Instrument	**Released**: 8 Sept 2025	**Test complete** : 3 Sept 2025	ESS-5773511	Integrated Test Report for the LoKI Instrument	**Released:** 11 Sept 2025

Test Statistics

Test Report		Test Cases	Executed	Passed	Sub-cases	Executed	Passed
ESS-5759105	Integrated Test Report for the LoKI Chopper System	3	3	3	29	29	29
ESS-5769855	Integrated Test Report for the LoKI Collimation System	6	6	3	40	40	28
ESS-5767051	Integrated Test Report for the LoKI Detector Motion System	3	3	1	127	127	107
ESS-5818477	Integrated Test Report for the LoKI Detector and Beam Monitor Systems	6	6	4	24	16	12
ESS-5769853	Integrated Test Report for the LoKI Sample Area	7	7	2	52	54	34
ESS-5773511	Integrated Test Report for the LoKI Instrument	9	3	1	36	8	6

Choppers

ESS-5759105

- Phasing to reference pulse
- Control from NICOS
- Recording of chopper data to NeXUS files

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS				
	Pass	Fail	NA	Signature	Date
1. Band width chopper	☑	☐	☐	Hannah Burrall	21-July-2025
Comments:					
2. Frame overlap chopper	☑	☐	☐	Hannah Burrall	21-July-2025
Comments:					
3. Data acquisition	☑	☐	☐	Hannah Burrall	21-July-2025
Comments:					

All tests passed

Example Test Case

TEST CASE 1. Bandwidth chopper

Part A: Parking of the discs

1.1 Both discs can be parked from NICOS with position known to an accuracy of better than 0.1°, confirmed by the read-out from the SKF controller

☐N/A ☒Pass ☐Fail ☒Remark: Set 150° as default open/close. Note user needs to switch to a new window to change the park angle (window 1-10)

Part B: Phasing only to reference pulse at 7 Hz

Note: **These tests will use (i) the TDC pulse that is generated every complete rotation of the chopper disc, and (ii) the reference pulse at 7 Hz or 14 Hz. These two pulses should line up together but will not be perfect due accumulated errors from the tuning of the control loop. We will calculate that error during these tests using NICOS, and compare to the readout from the SKF controller and values measurement during the chopper FAT performed by the chopper group.**

1.2 Disc 1 (BWC-101, closest to the target) is spun at 7 Hz, disc is phased at 0 degrees and the phase error is smaller than ±10 µs FWHM.

☐N/A ☒Pass ☐Fail ☐Remark:

1.3 Disc 2 (BWC-102, furthest from the target) is spun at 7 Hz, disc is phased at 0 degrees and the phase error is smaller than ±10 µs FWHM.

☐N/A ☒Pass ☐Fail ☐Remark:

1.4 Discs 1 and 2 (BWC-101 and BWC-102) are spun simultaneously at 7 Hz, discs are phased at 0 degrees and the phase error is smaller than ±10 µs FWHM.

☐N/A ☒Pass ☐Fail ☐Remark:

Collimation System

- Motion control from NICOS
- Recording of motion axis data to NeXUS files

ESS-5769855

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS				
	Pass	Fail	NA	Signature	Date
1. Collimation Selector Table 1 (nearest to target)	☑	☐	☐	Hannah Burrall	28 July 2025
Comments:					
2. Collimation Selector Table 2 (nearest to sample position)	☑	☐	☐	Hannah Burrall	28 July 2025
Comments:					
3. Slit Set 1 (nearest to target)	☐	☑	☐	Hannah Burrall	28 July 2025
Comments:					
4. Slit Set 2 (middle)	☐	☑	☐	Hannah Burrall	28 July 2025
Comments:					
5. Slit Set 3 (closest to sample position)	☐	☑	☐	Hannah Burrall	28 July 2025
Comments:					
6. Data Acquisition	☑	☐	☐	Hannah Burrall	28 July 2025
Comments:					

Example Test Case

TEST CASE 1. Collimation Selector Table 1 (nearest to target)

1.1 Selector table moves across the full travel range — between absolute MCA/TwinCAT soft limits — within the collimation tank, controlled via NICOS. Motion direction is correctly mapped to the corresponding axis on the motion control rack.

☐N/A ☒Pass ☐Fail ☒Remark: Set the default motor speed in NICOS to the maximum value allowed by TwinCAT.

1.2 Selector table can be reliably cycled between position A (center position for collimation) to position B (center position for guide), with position feedback consistently returning the readout position.

☐N/A ☒Pass ☐Fail ☒Remark: Set placeholder positions at -9.23 mm (Collimation) and 251.92 mm (Guide), to be updated during HC.

1.3 Confirm that NICOS user limits for the selector table can be configured and enforced in NICOS.

☐N/A ☒Pass ☐Fail ☐Remark:

1.4 Verify that the absolute MCA/TwinCAT soft limits are accessible and correctly interpreted by NICOS

☐N/A ☒Pass ☐Fail ☐Remark:

1.5 Verify that NICOS correctly reports TwinCAT errors (e.g. over-temperature, encoder faults, or limit switch activation)

☐N/A ☒Pass ☐Fail ☒Remark: Error Message: 'DrvHw notrdy 4650'

Test cases 3 – 5 failed on scanning sub-cases but core functionality works

NIT-210 & NIT-344

Detector Motion System

ESS-5767051

- Control of rear detector carriage from NICOS
- Control of beamstop system from NICOS
- Storage of relevant device data to NeXUS

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS				
	Pass	Fail	NA	Signature	Date
1. Rear Detector Carriage Motion	☐	☑	☐	Hannah Burrall	9 July 2025
Comments: N/A					
2. Beamstop Mechanism	☐	☑	☐	Hannah Burrall	9 July 2025
Comments: Develop NICOS routine for selecting and positioning the beamstop arm. Positioning can currently be verified manually, but an automated routine is required for hot commissioning.					
3. Data Acquisition	☑	☐	☐	Hannah Burrall	9 July 2025
Comments: Minor bugs identified with NICOS status display and server reliability. However, metadata is correctly written to the NeXus file.					

Test plan executed twice – once at atmosphere and once under vacuum

Key integration items failed :

- Control of detector HV/LV
- Logic for beamstop control

- Underlying device control worked and device data was recorded to NeXUS

- NIT-189,NIT-191, NIT-193 to NIT-209

Example Test Case

TEST CASE 1. Rear Detector Carriage Motion

Note: The test must be executed twice: (1) with the system at atmospheric pressure to visually verify motion, and (2) under vacuum conditions to validate performance in the operational environment. High voltage power supplies MUST BE TURNED OFF before any carriage motion tests are executed

1.1 Verify the high-voltage (HV) status readout in NICOS accurately reflects the actual status shown on the detector control rack.

Atmosphere: ☐N/A ☐Pass ☒Fail ☒Remark: Status readout not available in NICOS

Vacuum: ☐N/A ☐Pass ☒Fail ☒Remark: Status readout not available in NICOS

1.2 Verify that all HV supplies are switched off before the detector carriage is moved.

Atmosphere: ☐N/A ☐Pass ☒Fail ☒Remark: Manually confirmed via the Phoebus instrument status screen and Detector rack readout. An advanced A4528 interface card is required to connect the interlock cable from the MCA cabinet to the Detector Slave 1 cabinet.

Vacuum: ☐N/A ☐Pass ☒Fail ☐Remark:

1.3 Scan the rear detector carriage across the full travel range from 5 m to 10 m — between absolute MCA/TwinCAT soft limits — via the NICOS control software. Verify the position and direction are correct and match the readout on the motion control rack.

Atmosphere: ☐N/A ☒Pass ☐Fail ☒Remark: Important to verify the positions of all detectors relative to the sample position and calibrate them against the positions reported by the motion cabinet.

Max motor speed: 12 mm/s. NICOS default: 3 mm/s – can be updated in parameters.

Note: When the input speed exceeds the maximum, NICOS automatically limits the speed to the maximum value. However, the speed parameter is not updated correctly. For example, if the speed is set to 13 mm/s, NICOS will automatically set it to 12 mm/s, but the parameter still shows 13 mm/s. This bug should be fixed to ensure the correct speed parameter is displayed.

Vacuum: ☐N/A ☒Pass ☐Fail ☐Remark:

1.4 Verify that the rear detector carriage can be reliably cycled between 5 m and 10 m with position feedback consistently returning the readout position.

Atmosphere: ☐N/A ☒Pass ☐Fail ☐Remark:

Vacuum: ☐N/A ☒Pass ☐Fail ☐Remark:

Detector and Beam Monitor System

ESS-5818477

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS			
	Pass	Fail	NA	Signature
1. Start/Stop Counting	☑	☐	☐	Andrew Jackson
Comments:				
2. Live Display of Neutron Data	☑	☐	☐	Andrew Jackson
Comments:				
3. Storage of Neutron Events				Andrew Jackson
Comments:	☑	☐	☐	
4. Storage of Instrument Metadata	☐	☑	☐	Andrew Jackson
Comments:				
5. Storage of Timing System / Source Metadata	☐	☑	☐	Andrew Jackson
Comments:				
6. Data Processing	☑	☐	☐	Andrew Jackson
Comments:				

Core functionality of display, storage, and processing of neutron data from the scattering detector works.

Test cases 4 and 5 failed

Test case 4 : data file has placeholders for required detector position data, but the entries are not completed with the correct values that could be used for data processing

Test case 5 : connection from TN to NiN for transfer of accelerator and target PVs through to Kafka was working the week prior to the test. On the day of the test it had stopped working. The team attempted to solve the problem, but it appeared to be a credentials or network configuration change/problem that was not solvable during the test period.

- Live display of neutron data
- Storage of neutron data to NeXUS file
- Storage of source & timing information to NeXUS file
- Data processing

- Beam Monitor tests deferred with scope

Example Test Case

TEST CASE 2. Live Display of Neutron Data

2.1 Total counts since start of counting per detector panel can be displayed in NICOS

☐N/A ☒Pass ☐Fail ☐Remark: Currently have to set just-bin-it separately from start of file writing. It was noted that just-bin-it will stop with no errors unexpectedly.

2.2 Total counts since start of counting per beam monitor can be displayed in NICOS

☒N/A ☐Pass ☐Fail ☐Remark: Beam monitors are deferred scope

2.3 Count rate (averaged over last XX seconds) per detector panel can be displayed in NICOS

☐N/A ☒Pass ☐Fail ☐Remark: Currently found by double clicking just-bin-it display item and looking at properties. Needs adding to just-bin-it display.

2.4 Count rate (averaged over last XX seconds) per beam monitor can be displayed in NICOS

☒N/A ☐Pass ☐Fail ☐Remark: Beam monitors are deferred scope

2.5 Accumulated counts per detector element (“pixel”) since start of counting can be displayed live

☐N/A ☒Pass ☐Fail ☐Remark: NICOS Detector Image provides the information. However, it is noted that there is an offset between where the mouse pointer is and which pixel is being read out.

2.6 Accumulated counts per detection element (“pixel”) on multi-dimensional beam monitors since start of counting can be displayed live

☒N/A ☐Pass ☐Fail ☐Remark: Beam monitors are deferred scope

Sample Area Systems

- Mechanical integration of sample environment (sample changer)
- Control integration of sample environment (sample changer)
- Operation of other equipment in the sample area

ESS-5769853

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS				
	Pass	Fail	NA	Signature	Date
1. Gate Valve	☐	☑	☐	Hannah Burrall	8-August-2025
Comments: Some minor development is required to clarify PV status. (See test case and punch list for details).					
2. Experiment Shutter	☐	☑	☐	Hannah Burrall	8-August-2025
Comments: Follow-up is required for error messages (see test case and punch list for details).					
3. M2 In-Beam Positioner	☑	☐	☐	Hannah Burrall	8-August-2025
Comments: N/A					
4. Alignment Laser	☑	☐	☐	Hannah Burrall	8-August-2025
Comments: N/A					
5. Sample Stack	☐	☑	☐	Hannah Burrall	8-August-2025
Comments: Z-Axis not available for integrated testing. Encoder reading scale replacement in progress. (See test case and punch list for details).					
6. Sample Environment Equipment				Hannah Burrall	8-August-2025
Comments: Z-axis was not available for integrated testing; therefore, the sample holder macro could not be tested. Additionally, Julabo devices were not available for integrated testing (see NIT-181 & ECDC-4621).	☐	☑	☐		
7. Data Acquisition	☐	☑	☐	Hannah Burrall	8-August-2025
Comments: Verification of sample mapping metadata is incomplete due to missing software functionalities that prevent proper file-writing tests. Testing will need to be repeated.					

Example Test Case

TEST CASE 6. Sample Environment Equipment (Includes sample conditioning & positioning)

6.1 Verify mechanical integration of the sample trolley system with the pneumatically activated KIPP base.

☐N/A ☒Pass ☐Fail ☐Remark:

6.2 Verify mechanical integration of the sample holder system with the top of the sample trolley system.

☐N/A ☐Pass ☒Fail ☒Remark: There is a height misalignment, with the center of the rotational sample holder sitting approximately 5 cm too high, even when the Z-stage is at its lowest position.

6.3 Scan the linear stage across its full travel range via NICOS. Verify the position and direction are correct and match the readout on the motion control rack.

☐N/A ☒Pass ☐Fail ☐Remark:

6.4 Confirm that NICOS user limits can be configured and enforced in NICOS.

☐N/A ☒Pass ☐Fail ☐Remark:

6.5 Verify that the absolute MCA/TwinCAT soft limits are read correctly and properly interpreted by NICOS.

☐N/A ☒Pass ☐Fail ☒Remark:

6.6 Verify that NICOS correctly reports TwinCAT warnings and/or errors. (e.g. encoder faults, limit switch activation, anti-collision switch activation, over temperature).

☐N/A ☒Pass ☐Fail ☐Remark: Error Message: 'E:Follw Enc 4650' (red background)

Test cases 1, 2, 5, 6 and 7 failed
Test case 1 & 2 : minor EPICS->NICOS issues
Test case 5 : Z axis encoder issue
Test case 6 : various issues including incomplete controls integration of SE equipment
Test case 7 : issues with file writing

NIT-181 to NIT-190, NIT-215, NIT-216, NIT-218 to NIT-221, NIT-233

LoKI Level Tests

ESS-5773511

TEST CASE(S) TO BE PERFORMED	SUMMARY FINDINGS				
	Pass	Fail	NA	Signature	Date
1. Confirmation of Detector Bank Positions Relative to Sample Position	☑	☐	☐	Andrew Jackson Hannah Burrall	2025-08-15
Comments:					
2. Heavy Shutter	☐	☐	☑	Andrew Jackson	2025-09-02
Comments:					
3. Window Safety Guard	☐	☐	☑	Andrew Jackson	2025-09-02
Comments:					
4. Cave Opening and Access Procedure	☐	☐	☑	Andrew Jackson	2025-09-02
Comments:					
5. Cave Closing Procedure	☐	☐	☑	Andrew Jackson	2025-09-02
Comments:					
6. Crane Operation	☐	☐	☑	Andrew Jackson	2025-09-02
Comments:					
7. Goods Lift Operation	☑	☐	☐	Andrew Jackson Clara Lopez	2025-08-29
Comments:					
8. AC in Sample Area	☐	☑	☐	Andrew Jackson Hannah Burrall	2025-08-15
Comments:					
9. Containment Ventilation Hood				Andrew Jackson	2025-09-02
Comments:	☐	☐	☑		

- Equipment at LoKI level that did not fit other test plans

Tests 2 to 5 are deferred until after PSS SIT – it was decided that nothing extra would be gained beyond the SAT without PSS integration

Test 9 was deferred because the connection to the confinement ventilation was not yet complete.

Test 1 failed (error in table above) as the middle detector banks were not measured as being in the correct position within tolerance

Test 8 failed due to non-compliance of cooling manifold (skid) : NCR-10567

Test 7 passed