ATLAS Roman Pot interlock validation

Sune Jakobsen (EP-UAT) on behalf of ATLAS Roman Pots

Changes since last validation

No change in interlock diagrams nor logic.

Changes in ALFA:

Fix memory leak on FESA.

Automatic recovery of PXI: Automatic configuration after power cycle (PXI functionality stays untouched).

Changes in AFP:

Some de-cable/re-cabling at the stations due to other work.

Automatic recovery of PXI: Automatic configuration after power cycle (PXI functionality stays untouched).
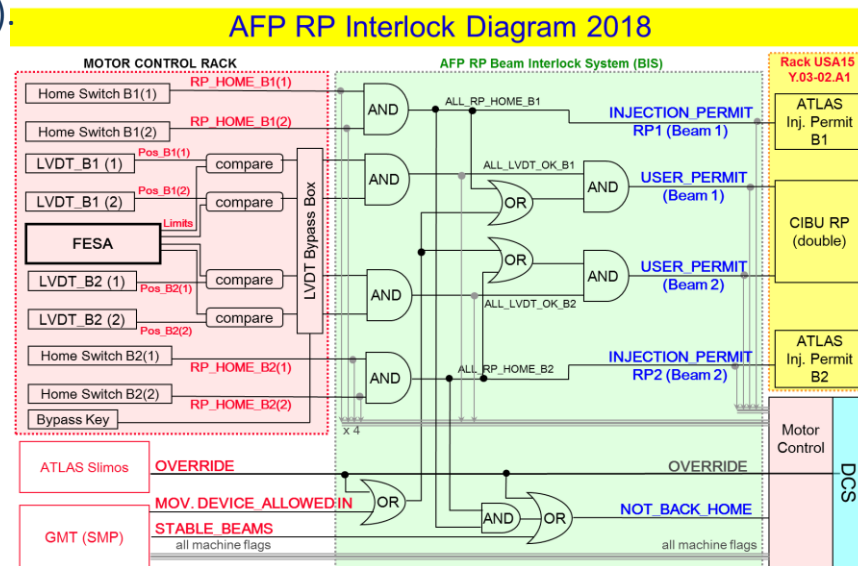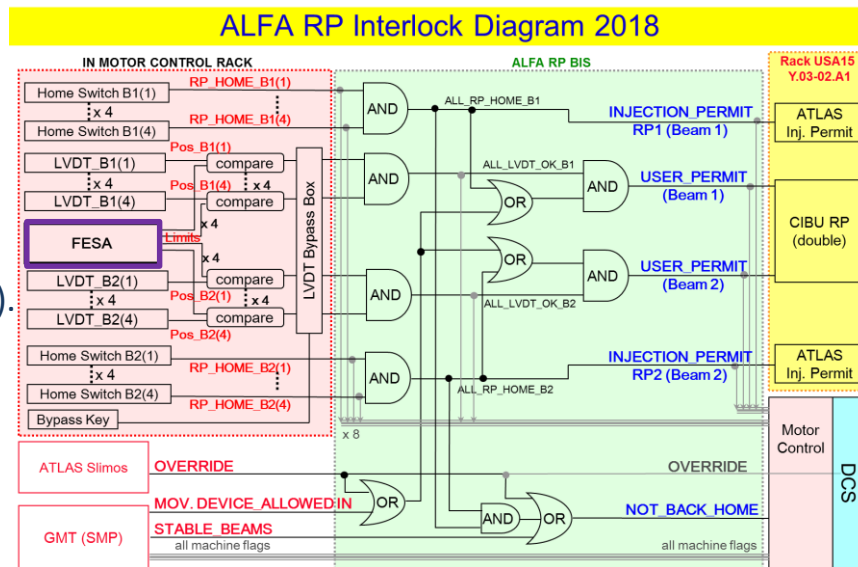
List of test from previous years:

Test of Injection Permits

Test of response to the LVDT-to-limit comparison

Test of USER_PERMIT and automatic extraction as a function of all input flags

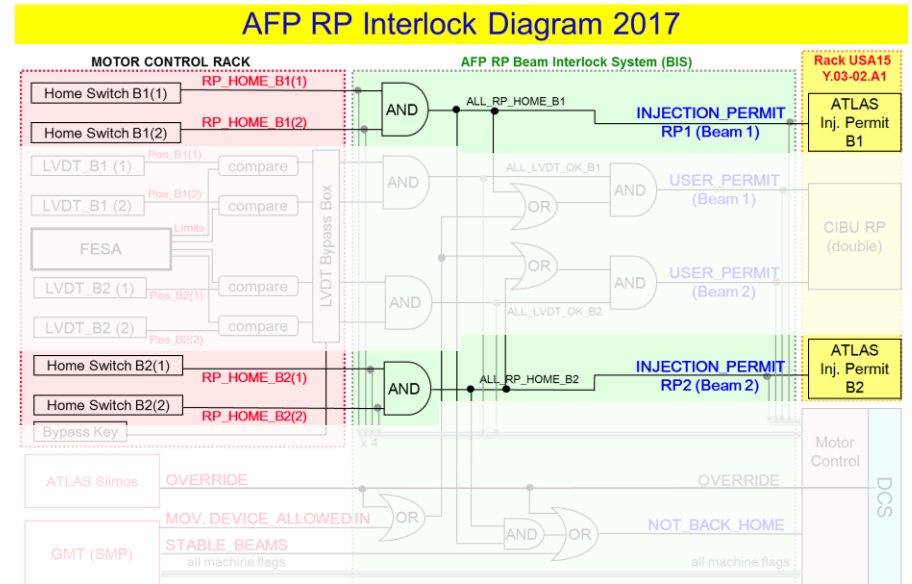Test of the LVDT-bypass box

Test of hardware and software buttons

Interlock validation – Injection Permits (Done)

Purpose: Check that the Injection Permit is removed if a Roman Pot is out of garage position.

Test sequence:

1. All Roman Pots at HOME position.

2. Observe that the AFP/ALFA inputs to the ATLAS injection permit are TRUE.

3. Move in the Roman Pot to be tested.

4. Observe that the AFP/ALFA to the ATLAS injection input for the correct beam is FALSE.

5. Move the Roman Pot to be tested to HOME.

6. Observe that the AFP/ALFA inputs to the ATLAS injection permit are TRUE.

Interlock validation – Injection Permits result

Test performed separately on each Roman Pot on 07-03-2018 (details in collimation logbook).

All worked correctly.

Summary table for AFP:

Station name	INJECTION_PERMIT lost [elog]	INJECTION_PERMIT recovered [elog]	INJECTION_PERMIT affected
XRPH.B6L1.B2	23:44	23:45	Beam2
XRPH.A6L1.B2	23:47	23:50	Beam2
XRPH.A6R1.B1	23:51	23:53	Beam1
XRPH.B6R1.B1	23:54	23:55	Beam1

Summary tables for ALFA:

Station name	INJECTION_PERMIT lost [elog]	INJECTION_PERMIT recovered [elog]	INJECTION_PERMIT affected
XRPV.B7L1.B2	23:03	23:05	Beam2
XRPV.B7L1.B2	23:10	23:11	Beam2
XRPV.A7L1.B2	23:20	23:21	Beam2
XRPV.A7L1.B2	23:23	23:25	Beam2

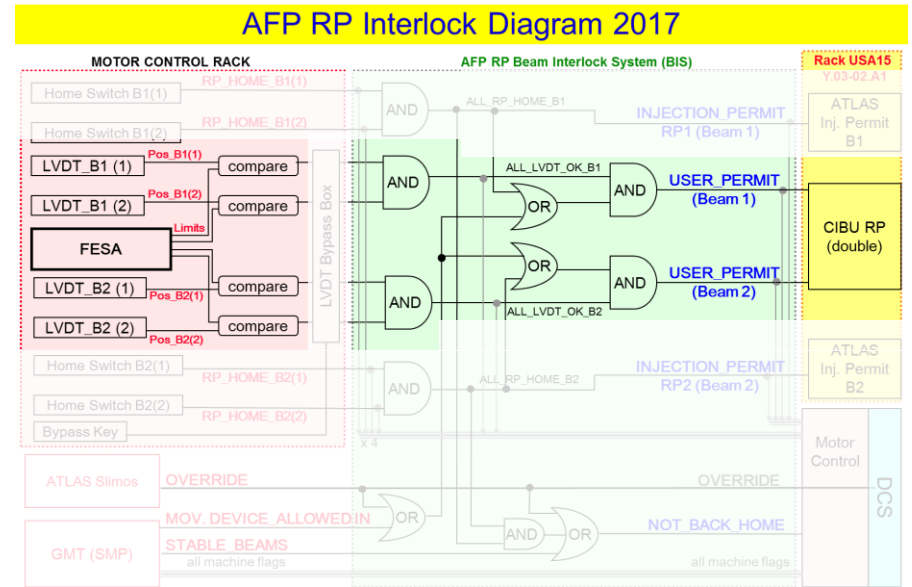| Station name	INJECTION_PERMIT lost [elog]	INJECTION_PERMIT recovered [elog]	INJECTION_PERMIT affected
XRPV.A7R1.B1	23:26	23:29	Beam1
XRPV.A7R1.B1	23:30	23:31	Beam1
XRPV.B7R1.B1	23:36	23:37	Beam1
XRPV.B7R1.B1	23:38	23:39	Beam1

Interlock validation – LVDT-to-limit comparison (Done)

Purpose: Check of the automatic extraction and loss of USER_PERMITs when a limit is violated.

Test sequence:

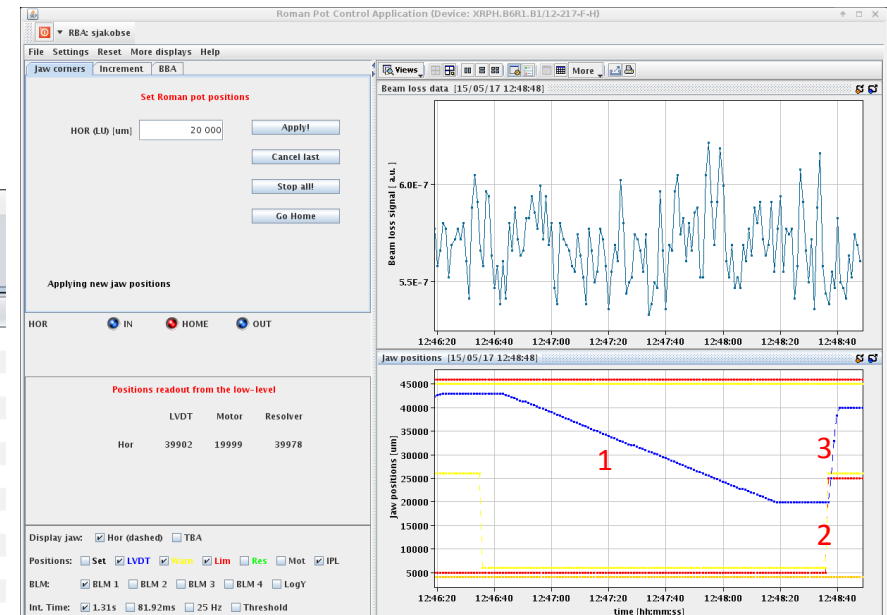Not possible to move to illegal position, therefore:

1. Move in the Roman Pot to be tested.

2. Make position illegal by changing limit.

3. Observed automatic extraction and (not for WARNING) loss of USER PERMIT for the beam affected.

4. When extracted beyond the limit, observe the return of the USER PERMIT.

5. "Ringing" observed for several AFP Roman Pots (not a problem for safety, but not nice for the log).

AFP Interlock validation – LVDT-to-limit comparison result

Test performed separately on each Roman Pot on 07-03-2018 (details in collimation logbook).

All worked correctly.

Summary table for AFP:

	Old Inner warning				Old Inner Dump				New Inner Dump			
	USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)			
Station name	React	Extraction?	Final	Time	React	Extraction?	Final	Time	React	Extraction?	Final	Time
XRPH.B6L1.B2	1,1	Yes	1,1	20.49	1,0	Yes	1,1	20.55	1,0	Yes	1,1	20.58
XRPH.A6L1.B2	1,1	Yes	1,1	20.31	1,0	Yes	1,1	20.36	1,0	Yes	1,1	20.40
XRPH.A6R1.B1	1,1	Yes	1,1	21.17	0,1	Yes	1,1	20.21	0,1	Yes	1,1	21.24
XRPH.B6R1.B1	1,1	Yes	1,1	21.05	0,1	Yes	1,1	21.09	0,1	Yes	1,1	21.12

"Ringing" for the USER PERMIT observed for several AFP Roman Pots.

Summary table for ALFA:

	Old Inner warning				Old Inner Dump				New Inner Dump			
	USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)			
Station name	React	Extraction?	Final	Time	React	Extraction?	Final	Time	React	Extraction?	Final	Time
XRPV.B7L1.B2	1,1	Yes	1,1	21:36	1,0	Yes	1,1	21:38	1,0	Yes	1,1	21:42
XRPV.B7L1.B2	1,1	Yes	1,1	21:46	1,0	Yes	1,1	21:49	1,0	Yes	1,1	21:51
XRPV.A7L1.B2	1,1	Yes	1,1	21:56	1,0	Yes	1,1	21:59	1,0	Yes	1,1	22:02
XRPV.A7L1.B2	1,1	Yes	1,1	22:10	1,0	Yes	1,1	22:06	1,0	Yes	1,1	22:13

	Old Inner warning				Old inner Dump				New inner Dump			
	USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)				USER_PERMIT (B1, B2)			
Station name	React	Extraction?	Final	Time	React	Extraction?	Final	Time	React	Extraction?	Final	Time
XRPV.A7R1.B2	1,1	Yes	1,1	22:17	0,1	Yes	1,1	22:22	0,1	Yes	1,1	22:25
XRPV.A7R1.B2	1,1	Yes	1,1	22:29	0,1	Yes	1,1	22:33	0,1	Yes	1,1	22:35
XRPV.B7R1.B2	1,1	Yes	1,1	22:39	0,1	Yes	1,1	22:42	0,1	Yes	1,1	22:45
XRPV.A7L1.B2	1,1	Yes	1,1	22:48	0,1	Yes	1,1	22:51	0,1	Yes	1,1	22:53

Interlock validation – Reaction to flags (not done)

Purpose: Check of the reaction to SMP flags and the override key.

Test sequence (simplified):

1. Cycle though STABLE_BEAM, UNSTABLE_BEAM and ADJUST and observed extraction and loss of USER PERMITs.

2. Observe correct behavior to LVDT-to-limit comparison in all relevant combinations.

3. Repeat with OVERRIDE in place.

NOTHING related to the SMP flags has been touched neither in AFLA or AFP.

The test is rather demanding for LHC OP and experiments (mainly CMS).

We therefore propose to NOT repeat this step.

If MPP decides it is required, it has shortly been discussed with LHC OP that it could be scheduled for week 13.
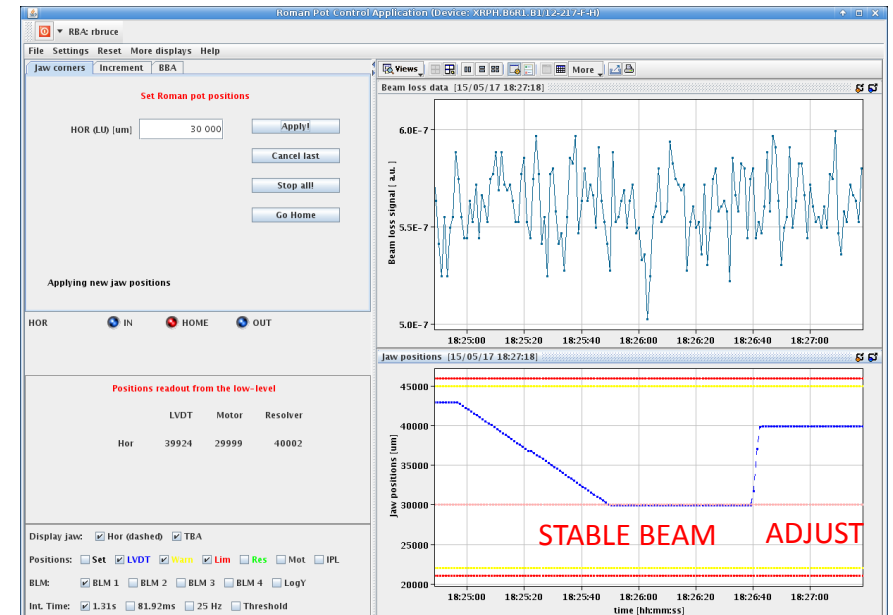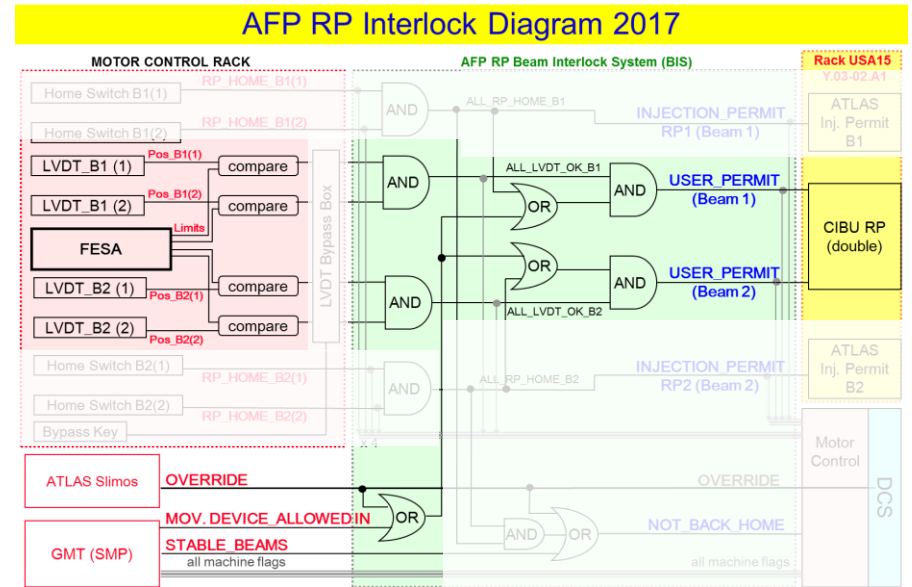
Interlock validation – LVDT-bypass box (not done yet)

Purpose: Check that the LVDT-bypass box force the LVDT comparison TRUE while simultaneously disabling the motors.

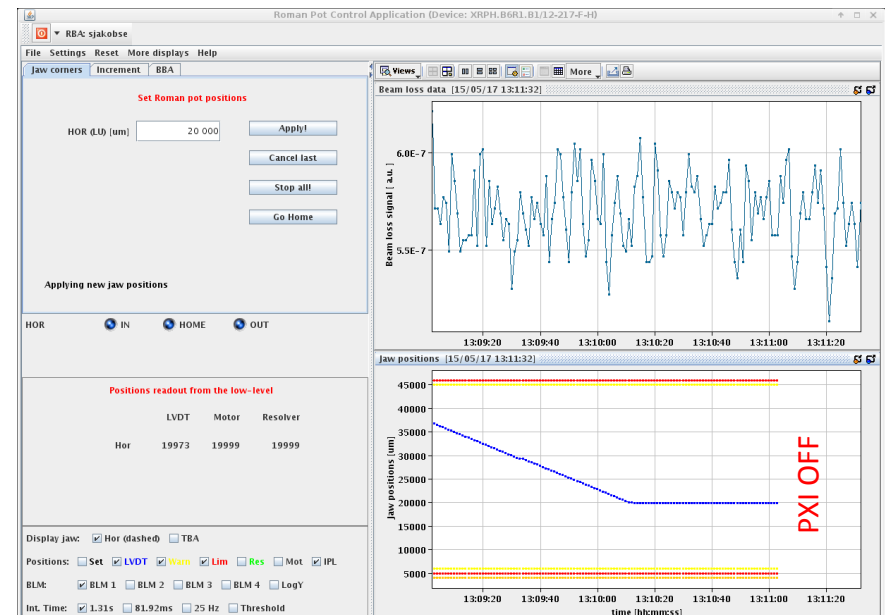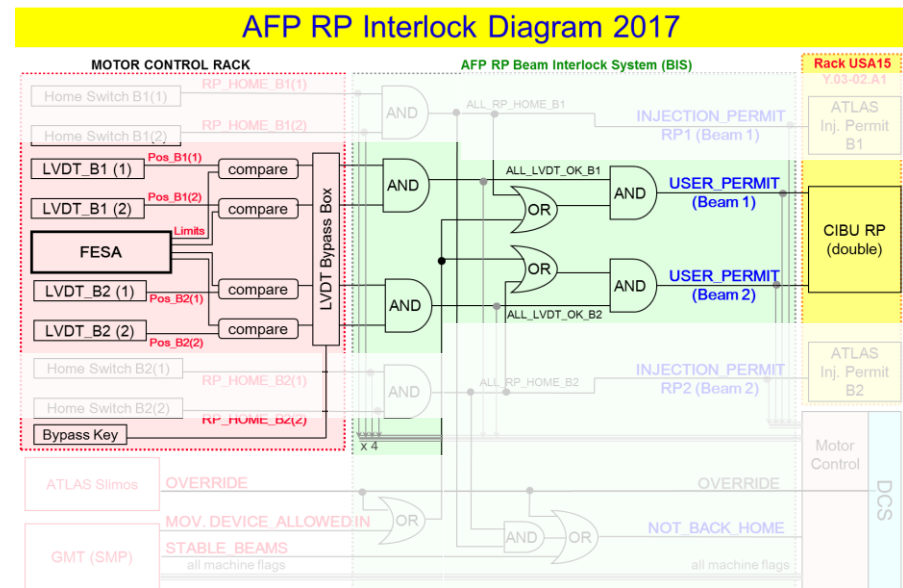Fake situations from when the LVDT-bypass key was introduced:

TEST1: Failure with AFP Roman Pots inserted. Beam dump and then insure LHC operation without AFP/ALFA Roman Pots.

TEST2 (The forbidden use case): Problem with Roman Pot inserted. Recovery without beam dump.

TEST3 (Holiday mode): Insure LHC operation without AFP/ALFA Roman Pots when manpower is not available to react fast.

TEST4: Failure with AFP/ALFA Roman Pots in garage. Beam dump and then insure LHC operation without AFP Roman Pots

Proposal: Simplify test to validate the purpose (basically reduced to TEST2 for both beam simultaneously).

Interlock validation – Test of buttons (Done)

Purpose: Check functionality of hardware and software buttons.

Tests:

Hardware emergency extract: Hardware disable of power to all motors => Extraction (no change in USER PERMITs).
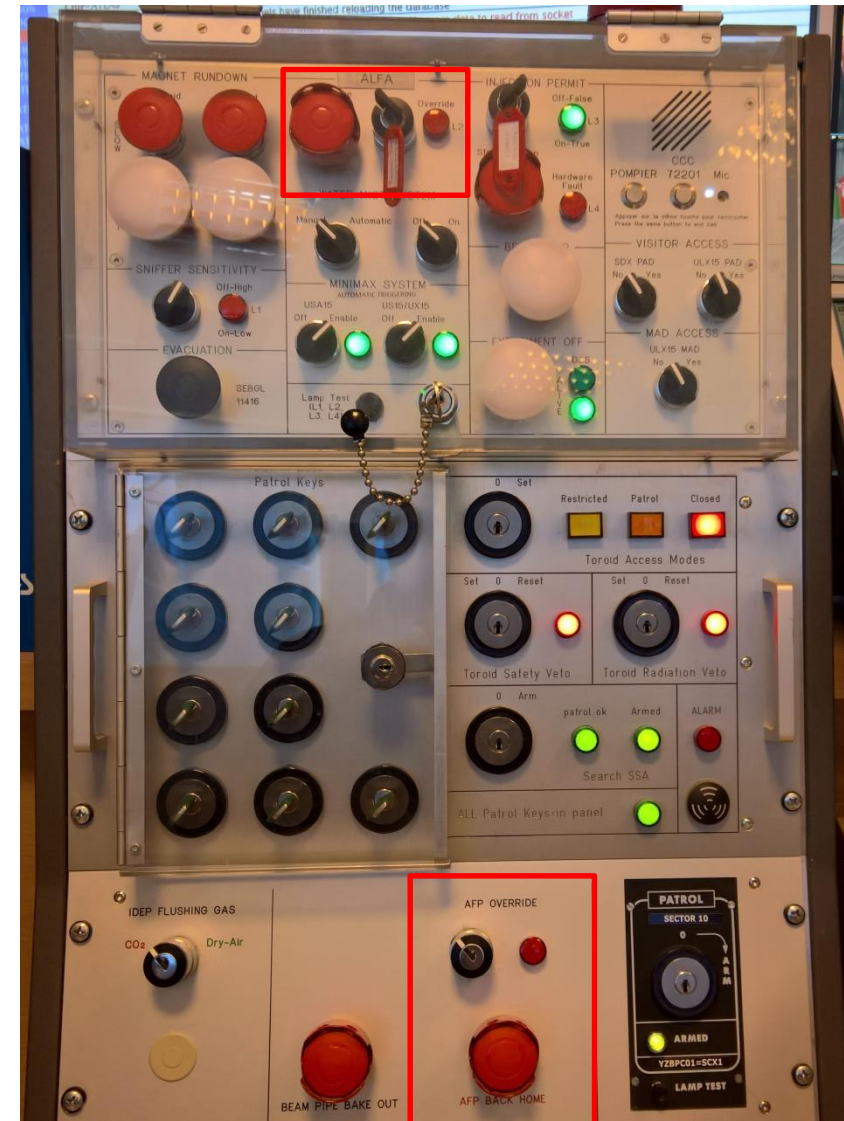
Software extract per Roman Pot: Extraction via DCS command to PXI (no change in USER PERMITs).

Test performed for all Roman Pot on 09-03-2018 (details in collimation logbook).

Result: All worked correctly.
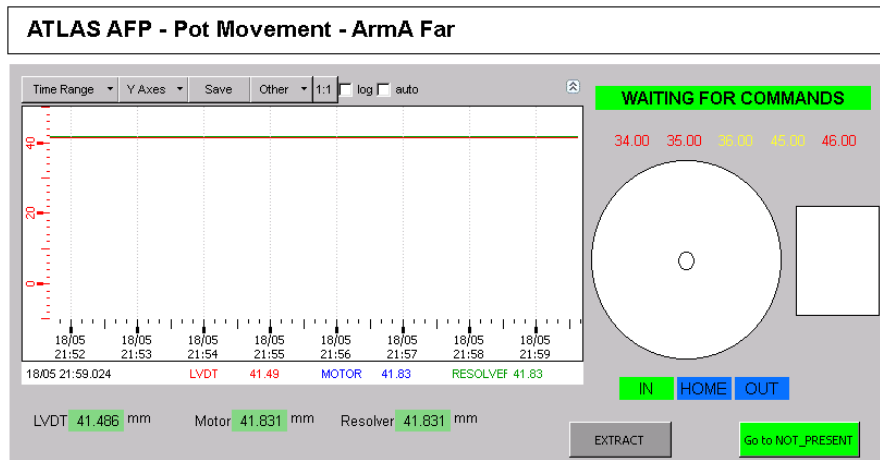
ATLAS SLIMOS hardware panel

ATLAS AFP - Pot Movement - ArmA Far

Test of automatic PXI recovery

Sometimes referred to as "executables for PXI".

Very useful as the expert is no longer needed for the recovery.

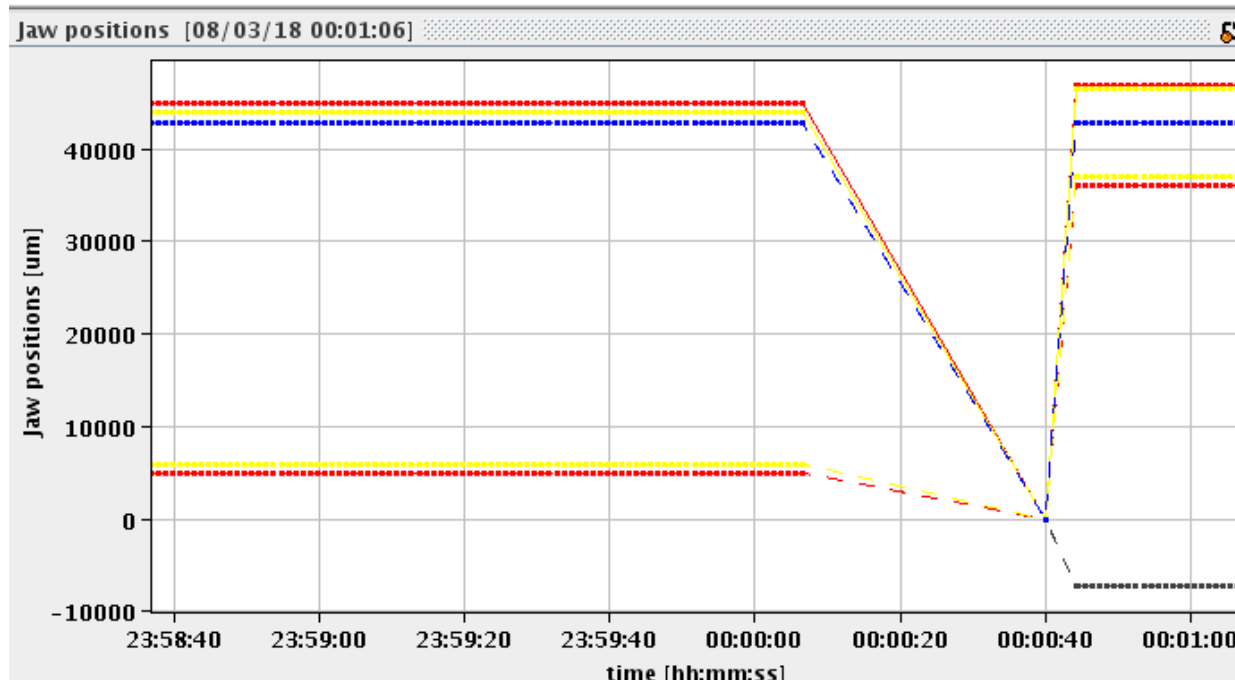No change in logic or FPGAs.

Test (26-02-2018 for ALFA and 08-03-2018 for AFP):

> Remote power cycle.

> All communication is lost for about 30 s.

> PXI recovers automatically.

> The limits after the power cycle are set around garage position.

Proposal: Common automatic beam based alignment

Automatic beam based alignment common for AFP + ALFA + TOTEM (like for collimators).

Basic principal (almost the same as currently done manually):

> Shape the beam with TCP.
>
> Tail many/all jaws (Roman Pots) after each other.
>
> Stop all movement when a BLM signal is over the set threshold.
>
> Verify which jaw (Roman Pot) touched the beam by taking one more step.
>
> Store position.
>
> Step back with the jaw touching the beam.
>
> Reshape the beam with the TCP.
>
> Start movement of the remaining jaws (Roman Pots).
>
> Repeat until all jaws (Roman Pots) are aligned.

This can be implemented purely in high level software (no change to FESA , PXI etc.).

The speed of the Roman Pots will be kept (so much slower than collimators).

Potential gain:

> Less beam time to align Roman Pots.
>
> Fewer human errors.
>
> Potentially also positions and limits by scrips (not by hand) and import of settings like for collimators.

Collimation/LHC OP (Belen, Gaby and mainly Gianluca) is looking into this on a "best effort" basis (many thanks!)

Conclusion

Changes in ALFA:

    Fix memory leak on FESA.

    Automatic recovery of PXI: Automatic configuration after power cycle (PXI functionality stays untouched).

Changes in AFP:

    Some de-cable/re-cabling due to other work.

    Automatic recovery of PXI: Automatic configuration after power cycle (PXI functionality stays untouched).

Validations already performed:

    Test of Injection Permits.

    Test of response to the LVDT-to-limit comparison.

    Test of hardware and software buttons.

    Test of PXI recovery.

Validations proposed to be skipped:

    Test of USER_PERMIT and automatic extraction as a function of all input flags.

Validations propose to simplify:

    Test of the LVDT-bypass box.

New feature proposed: Common automatic Roman Pot alignment (implementation on "best effort").