



JAGIELLONIAN UNIVERSITY
IN KRAKOW



SOLARIS
NATIONAL SYNCHROTRON
RADIATION CENTRE



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Synoptic GUIs in NSRC SOLARIS for Beamlines and Accelerators Visualization and Control

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National Synchrotron Radiation Centre SOLARIS

**SCADA systems play very
important role in control systems**

What should synoptic do?

- Show control system clearly.
- Be reliable and stable.
- Show exactly what we need to see.
- And it should be intuitive.
- Or even allow to interact with devices and control them in easy way.

First there was a simple panel to control a beamline...

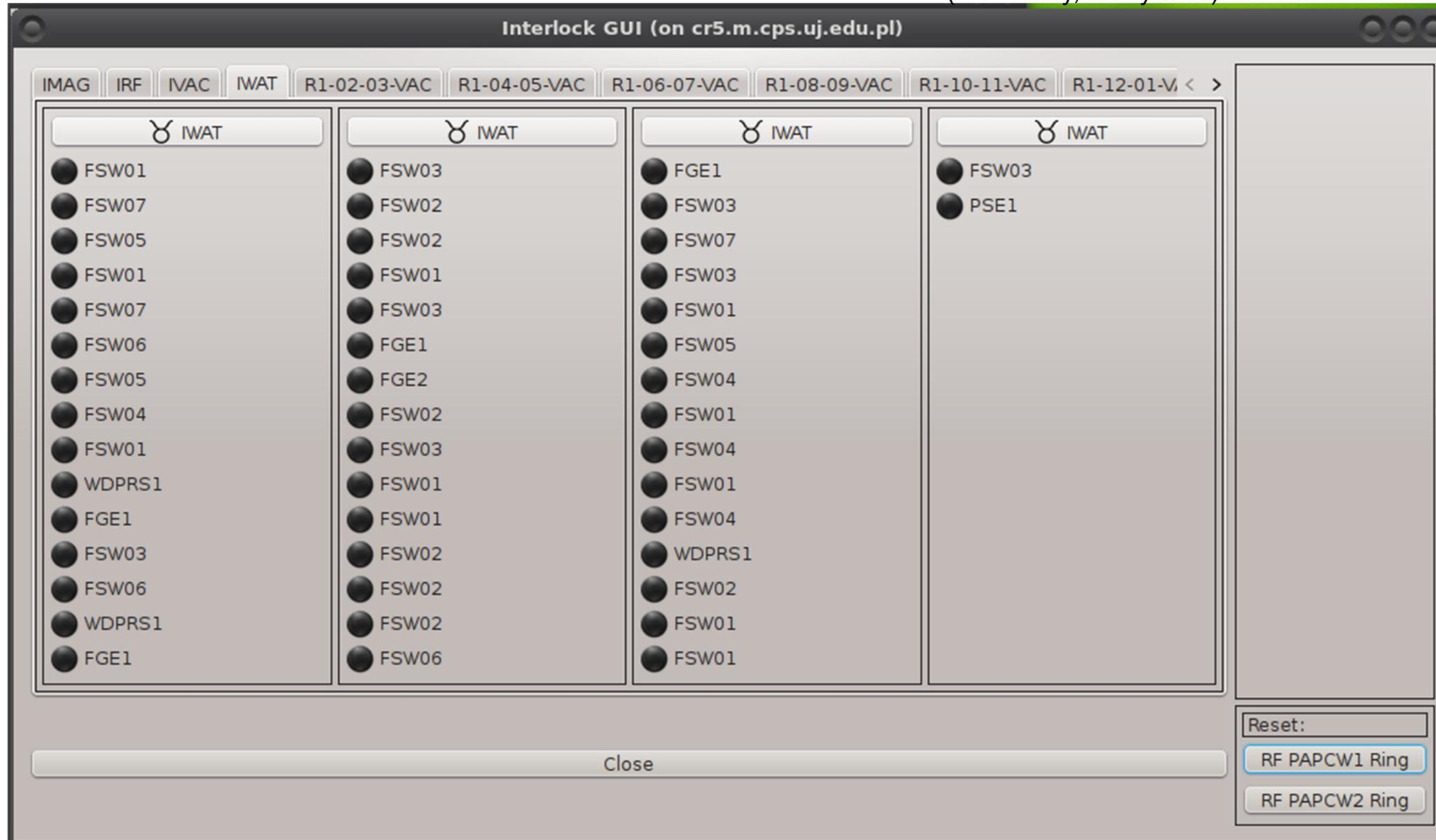
The screenshot displays the PEEM_BL2 control interface, organized into several vertical panels. Each panel contains controls for different beamline components, including valves, pumps, gauges, and interlocks. The status of each component is indicated by color-coded text and icons.

- General Control:** Includes a 'Reset beamline interlocks' button and controls for O-Ring valve 1 (BL-04BM-VAC-VGOB01, CLOSE), O-Ring valve 2, Pumping stage 1 (BL-04BM-VAC-IP07, 0.00 mbar, 0.00 A, 7000.00 V, Activated), O-Ring valve 3 (BL-04BM-VAC-VGOB03, OPEN), and O-Ring valve 4 (BL-04BM-VAC-VGOB04, OPEN).
- Pumping stage 3:** Controls BL-04BM-VAC-IP08 (0.00 mbar, 0.00 A, 6900.00 V, Activated), BL-04BM-VAC-VGP09 (None, Deactivated), BL-04BM-VAC-VGC09 (0.00 mbar, Activated), and BL-04BM-VAC-VGOB06 (CLOSE).
- Gas cell:** Controls BL-04BM-VAC-VGP10 (0.00 mbar, Activated), BL-04BM-VAC-VGP11 (0.00 mbar, Activated), BL-04BM-VAC-VGC11 (0.00 mbar, Activated), and BL-04BM-VAC-VGOB10 (OPEN).
- XAS Tube:** Controls BL-04BM-VAC-IP09 (0.00 mbar, 0.00 A, 0.00 V, Deactivated) and BL-04BM-VAC-IP12 (None, None, None, None).
- Mirror 3:** Controls BL-04BM-VAC-IP10 (0.00 mbar, 0.00 A, 6950.00 V, Activated), BL-04BM-VAC-VGP12 (0.00 mbar, Activated), and BL-04BM-VAC-VGC12 (0.00 mbar, Activated).
- Diagnostic 4:** Controls BL-04BM-VAC-IP11 (0.00 mbar, 0.00 A, 7000.00 V, Activated), BL-04BM-VAC-VGP13 (None, Deactivated), and BL-04BM-VAC-VGC13 (0.00 mbar, Activated).
- Other components:** O-Ring valve 6 (BL-04BM-VAC-VGOB06, CLOSE), O-Ring valve 7 (BL-04BM-VAC-VGOB07, CLOSE), O-Ring valve 8 (BL-04BM-VAC-VGOB08, CLOSE), and O-Ring valve 9 (BL-04BM-VAC-VGOB09, CLOSE).

At the bottom right of the interface, the text '(actually there were few of them for one BL)' is displayed.

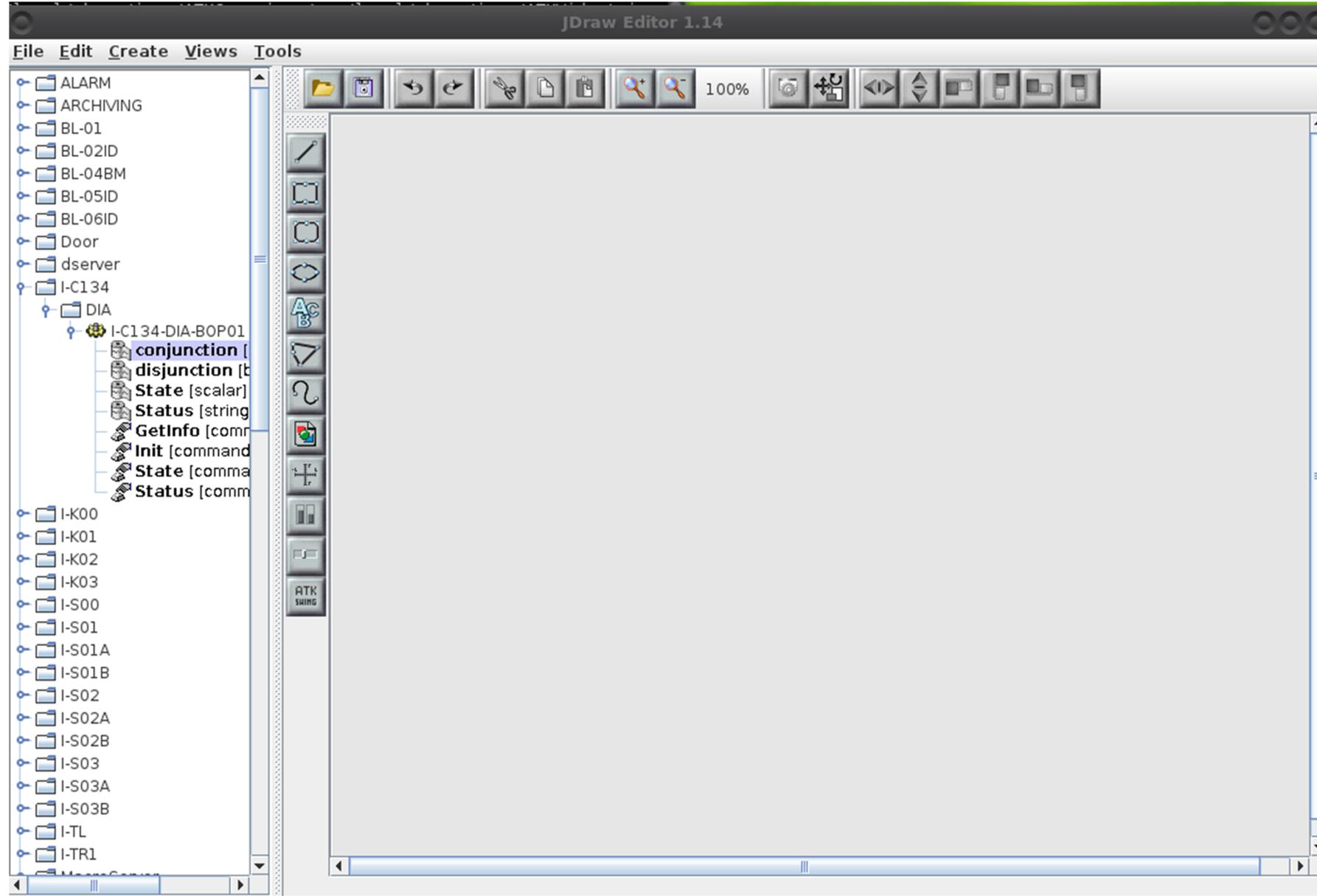
...and a simple panel to watch interlocks

(with many, many tabs)

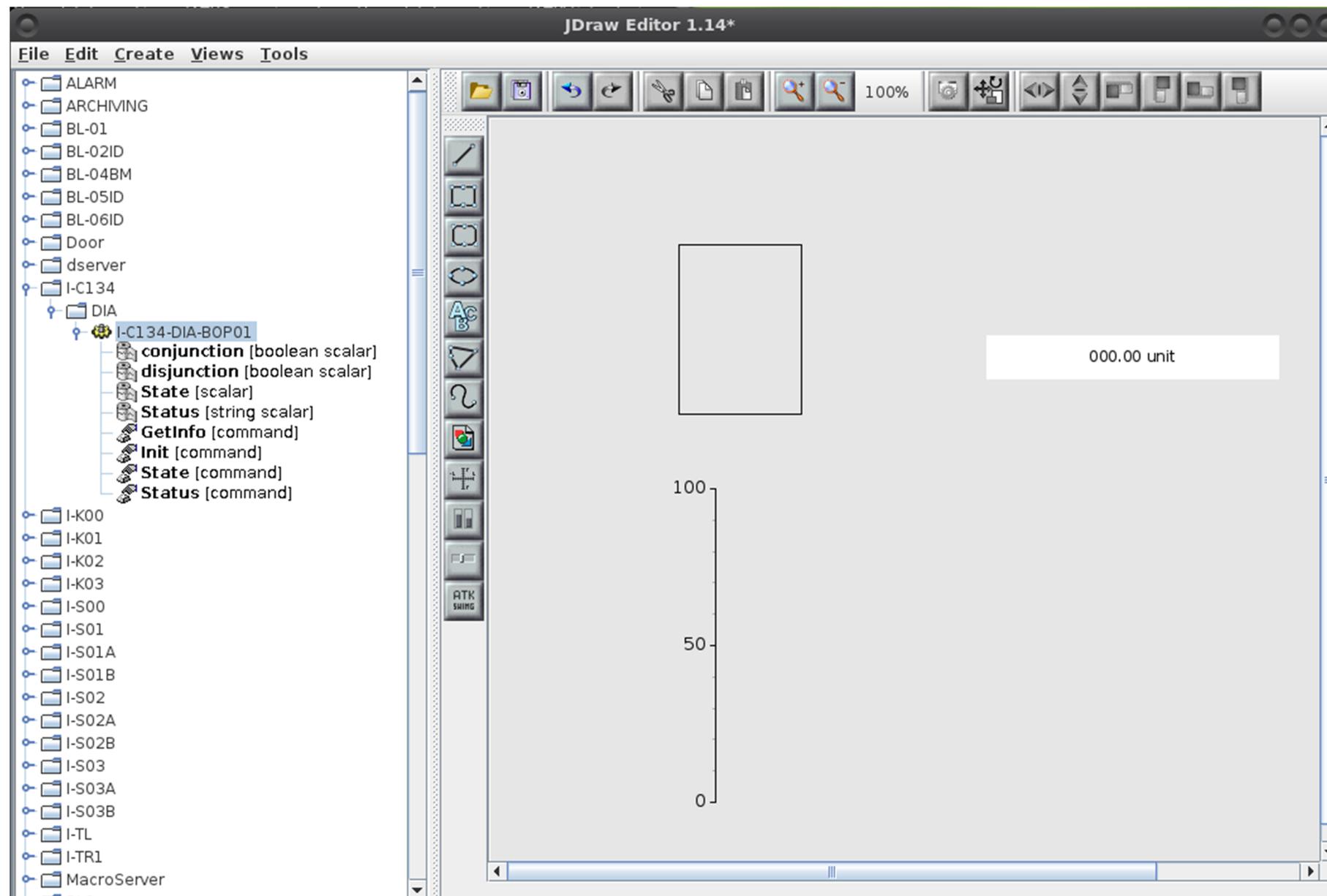


**Conclusion was simple:
we need synoptics**

So we tried JDraw



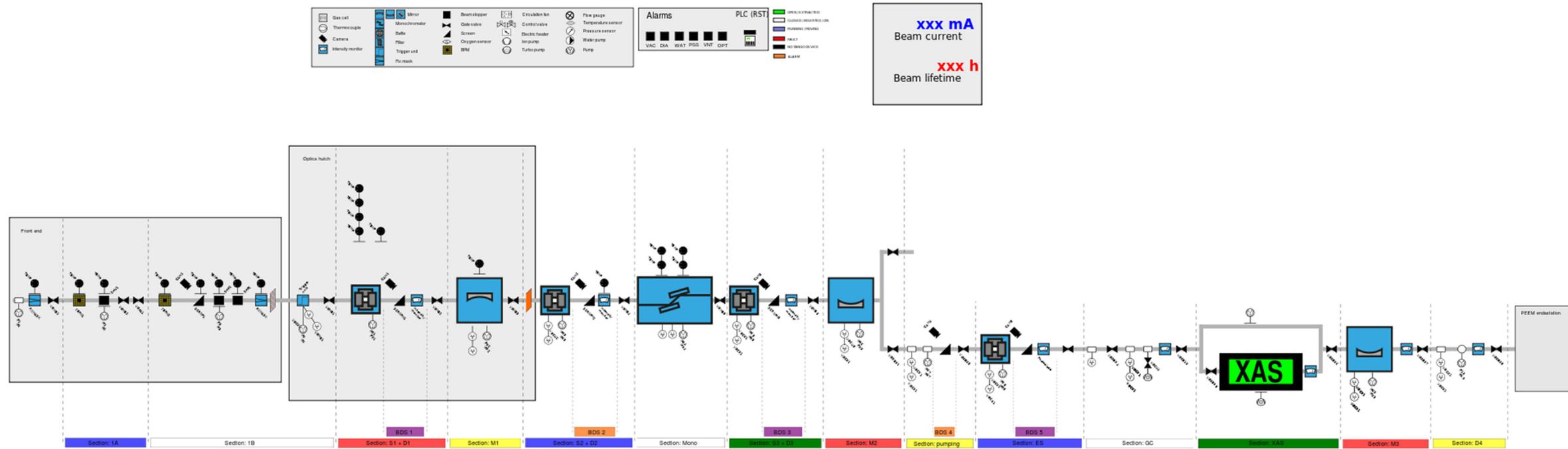
And after some time we got



But then MAX IV came with help

svgsynoptic2

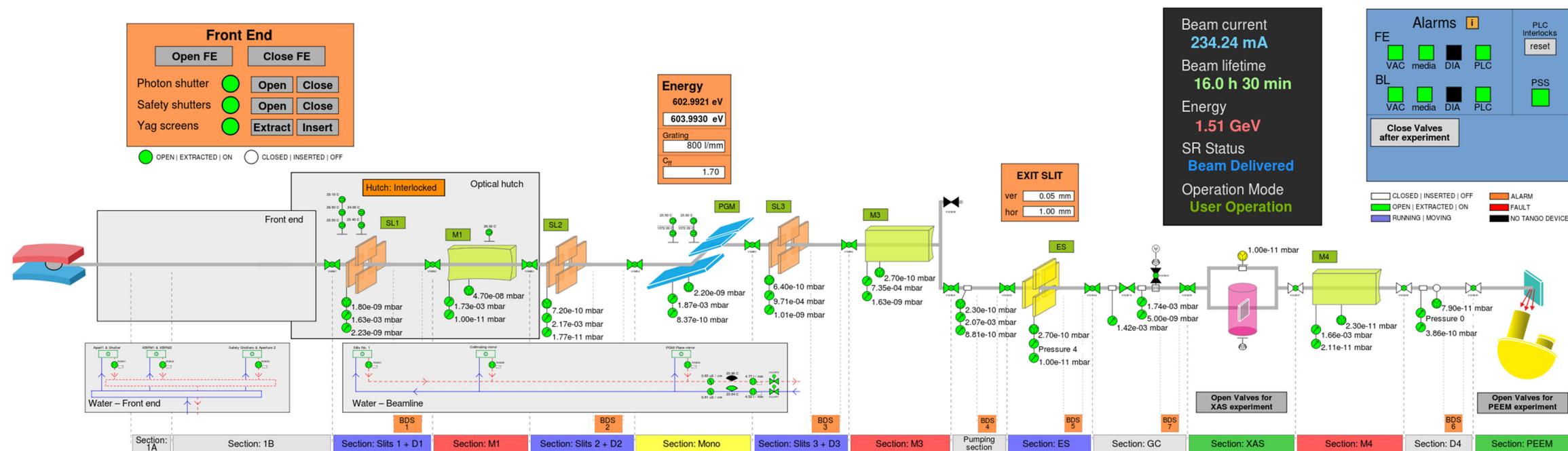
With svgsynoptic we created this:



But that wasn't enough

- It's too small.
- Elements are too archaic.
- We need more stuff there (like buttons, indicators etc).

We have improved

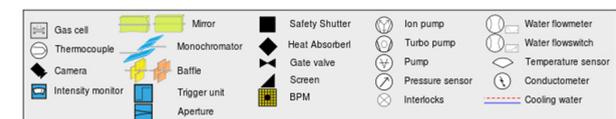


Operator Message:

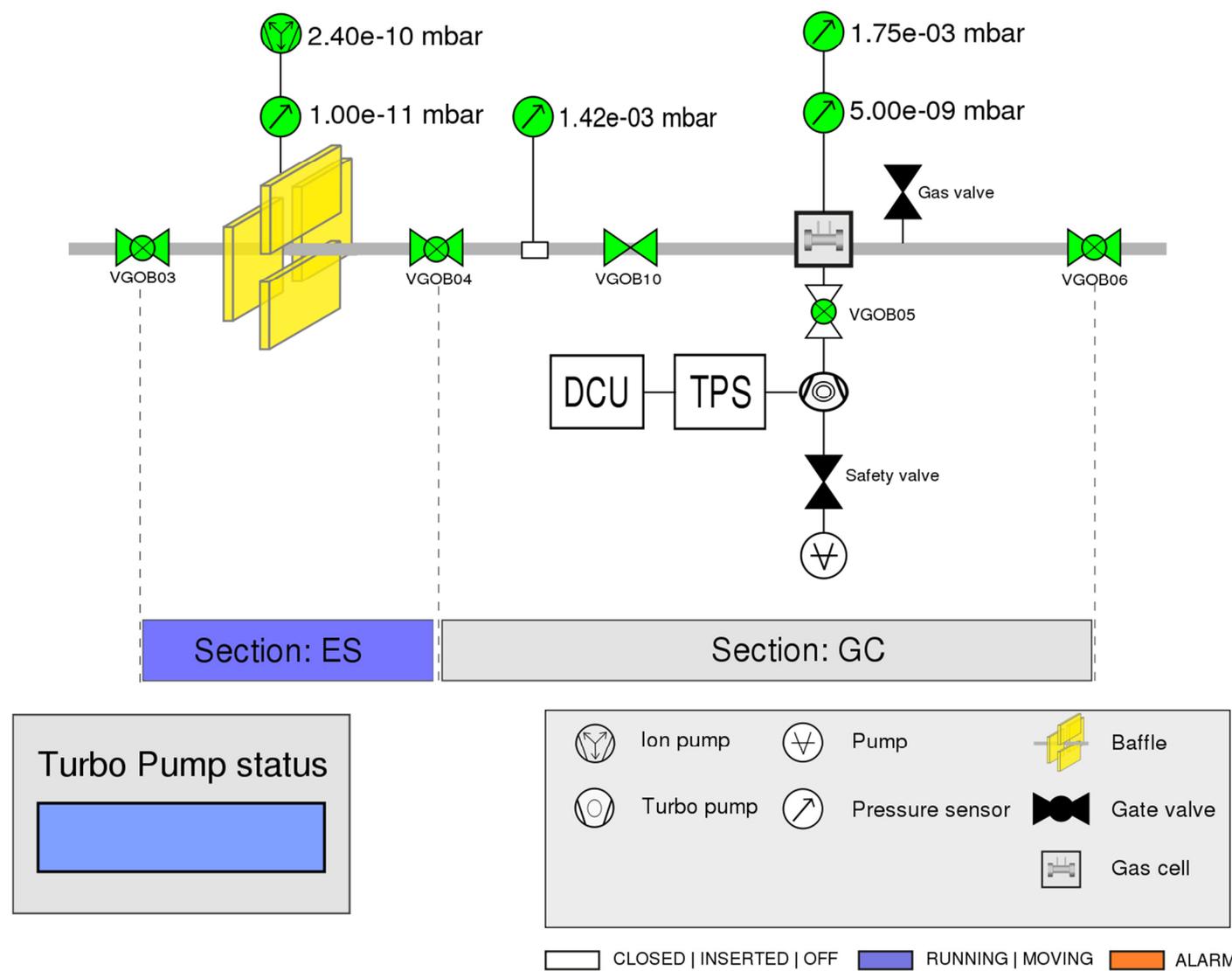
2019-05-31 17:06:25 Saturday - injection on beamlines demand between 8:00-9:00 am

2019-05-31 16:00:23 Injection delay on UARPES beamline request

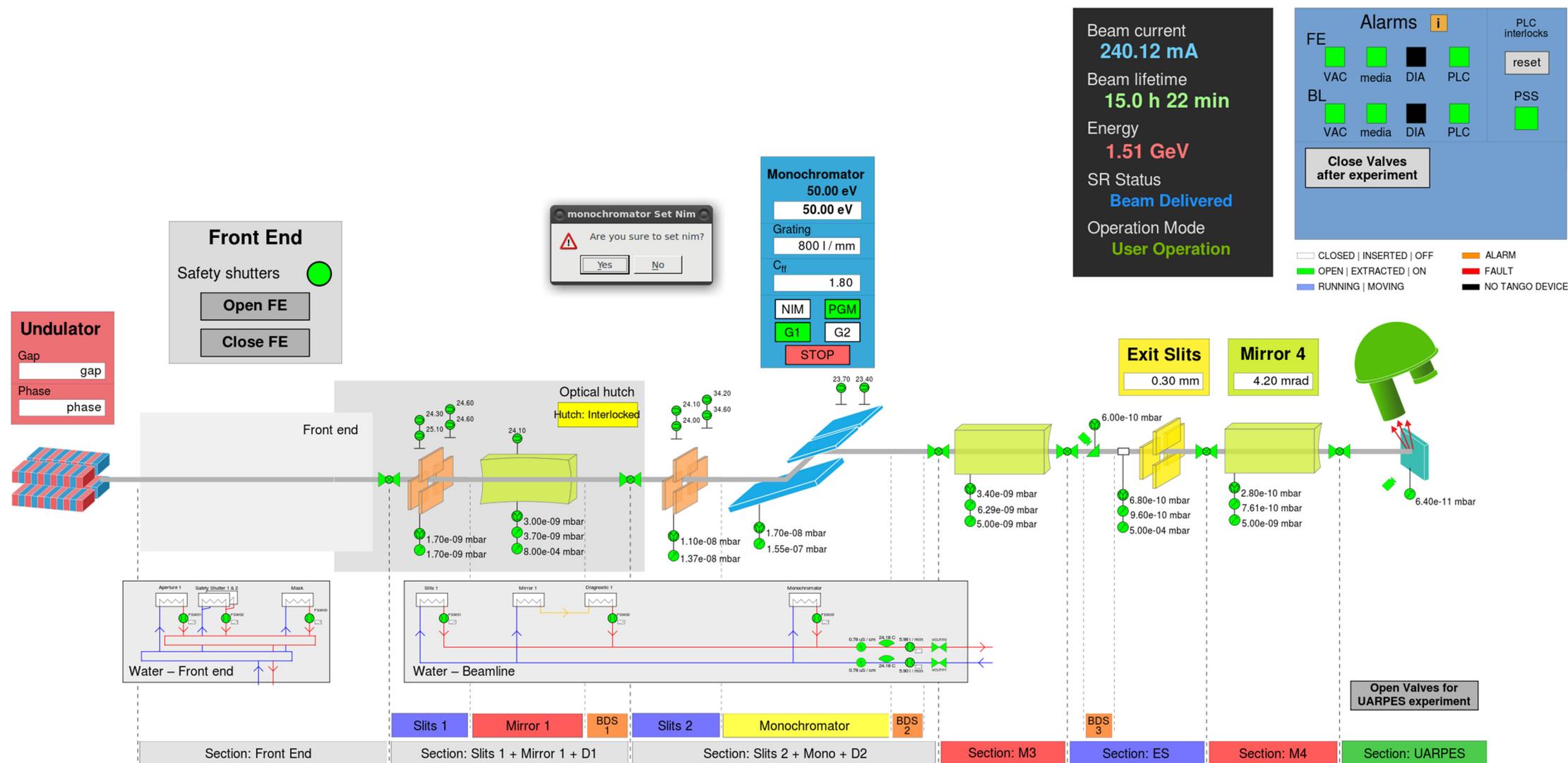
2019-05-29 17:20:00 B4BL



And created more of them

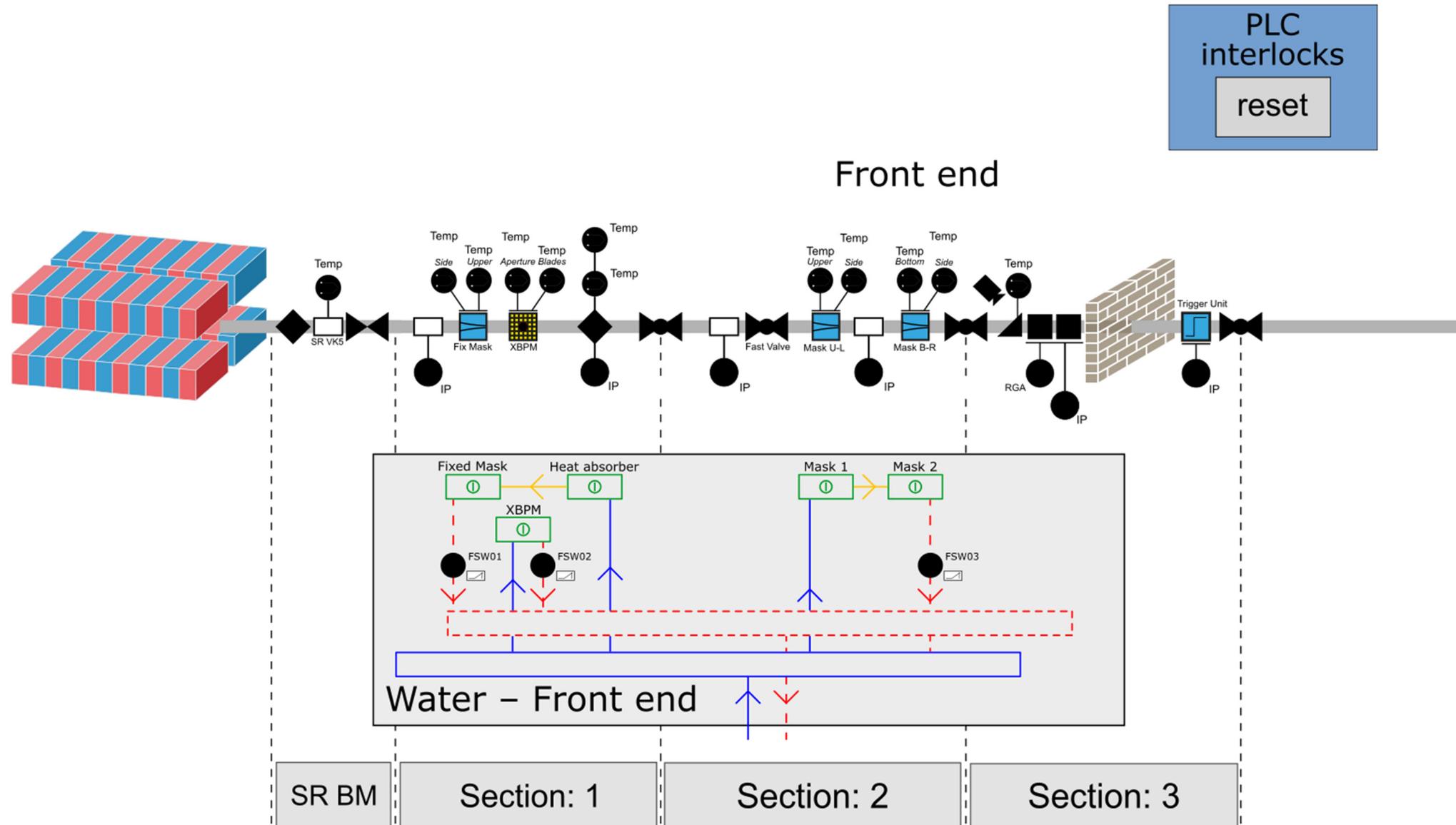


It was quite simple



UARPES beamline

And fast

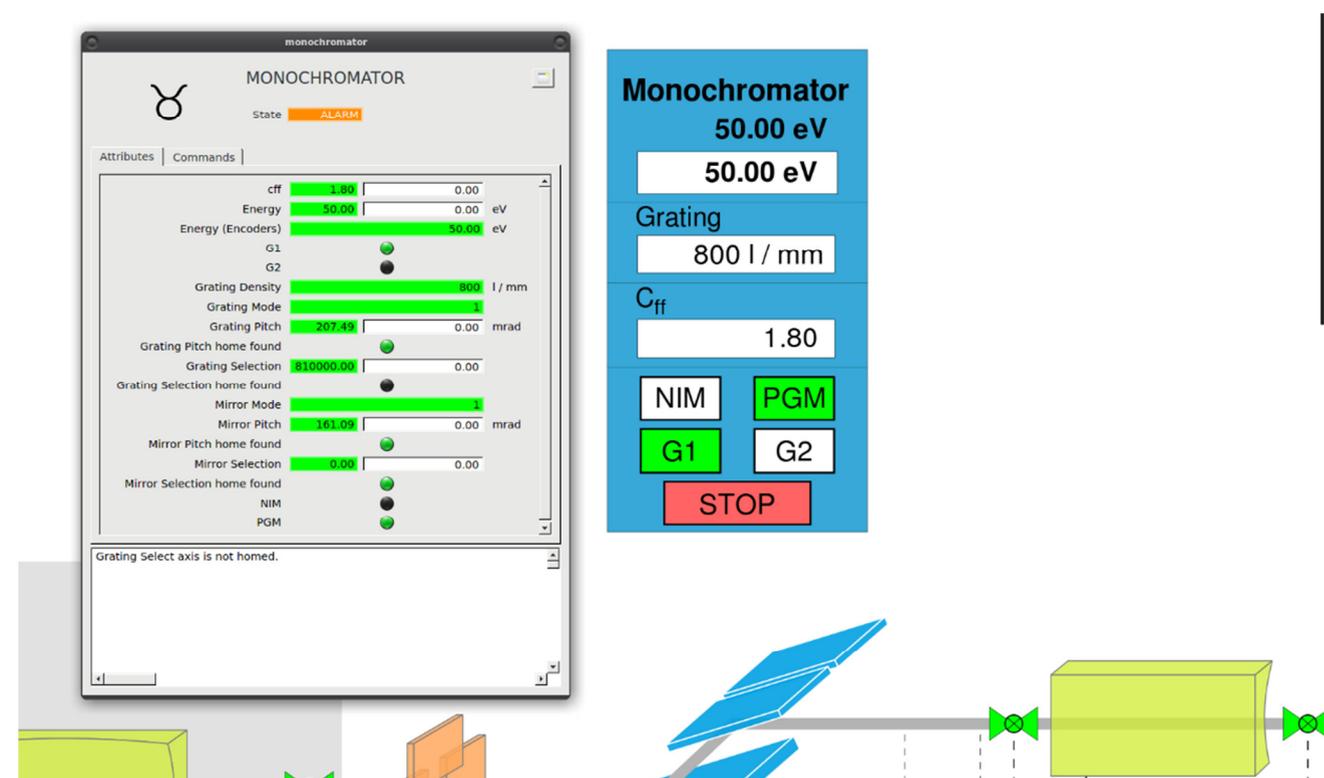
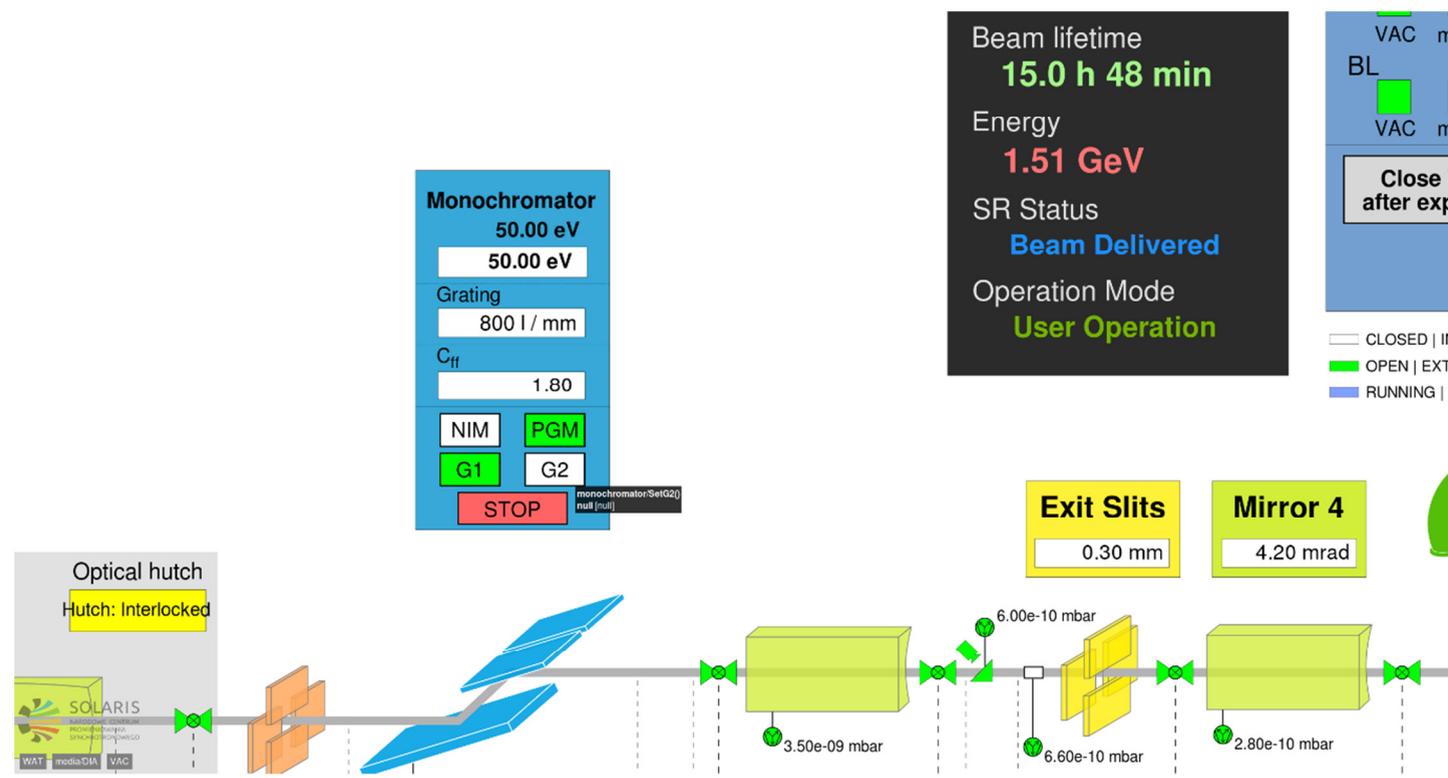


PHELIX beamline frontend

They have some nice functions

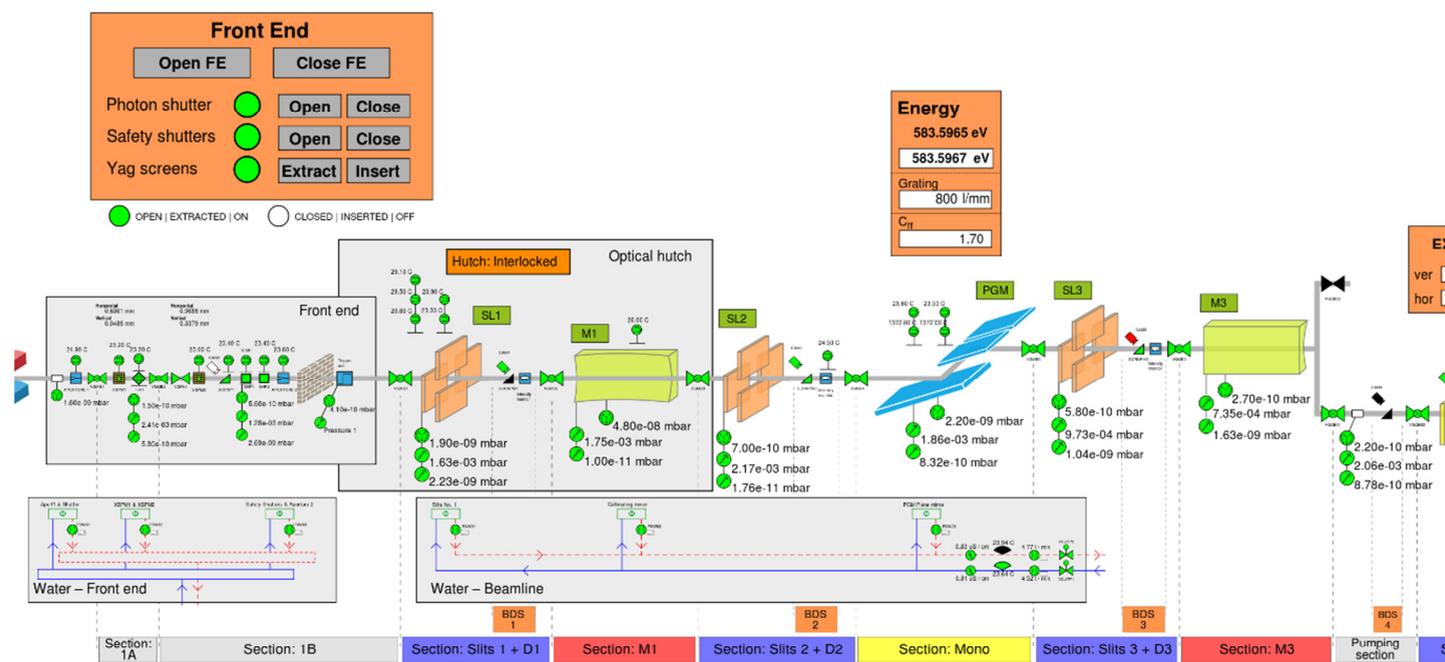
Moving and zooming to sections

Opening Device Widgets (Taurus Device Panels)



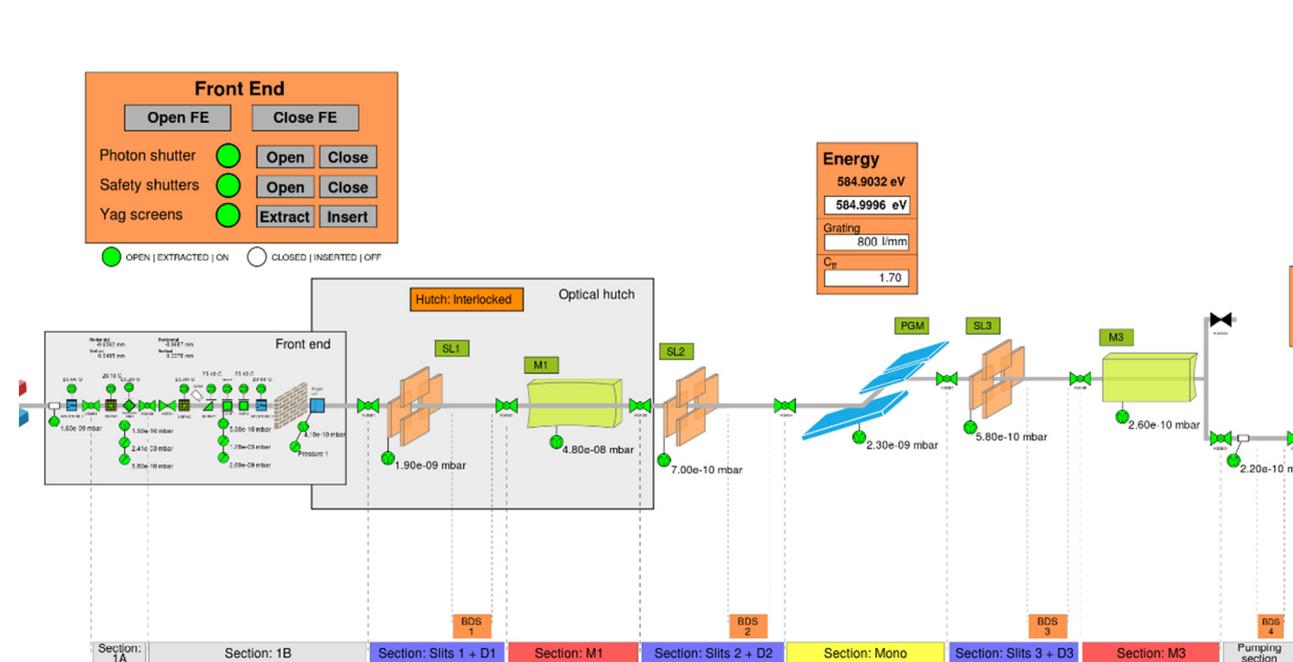
They have some nice functions

Hiding some layers



Operator Message:

2010-05-21 17:00:05 Saturday injection on beamline demand between 9:00-9:00 am

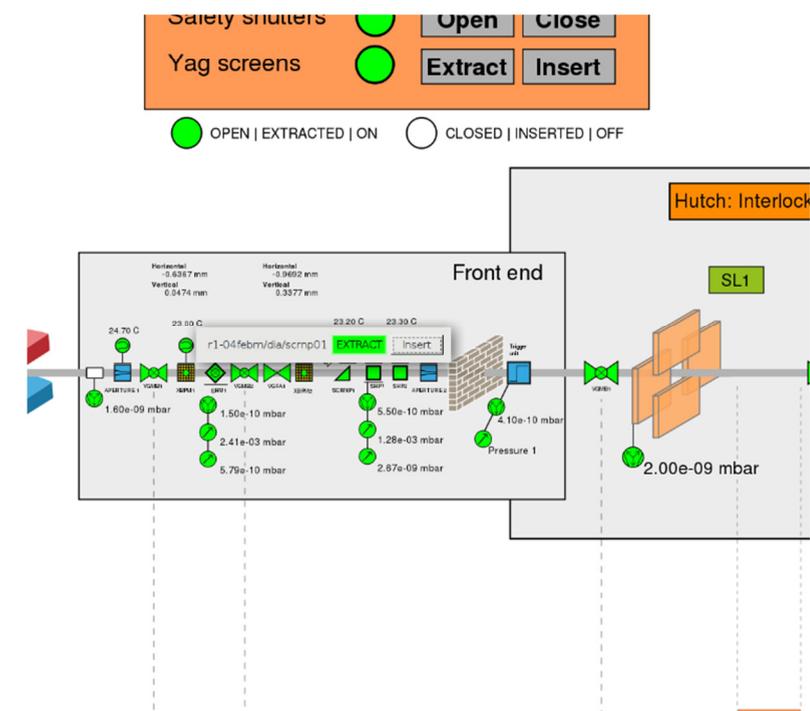
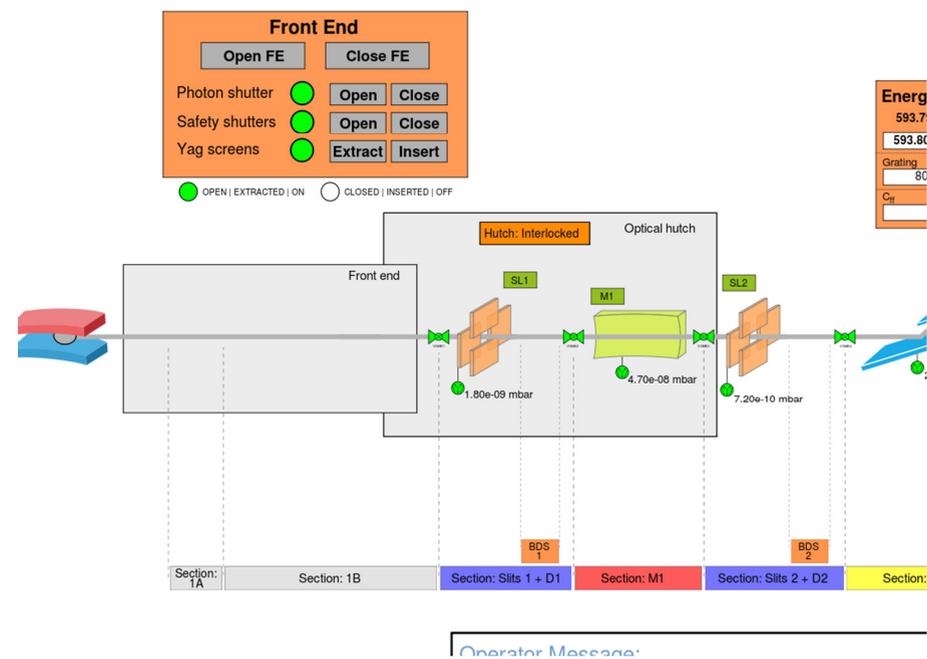


Operator Message:

2010-05-21 17:00:05 Saturday injection on beamline demand between 9:00-9:00 am

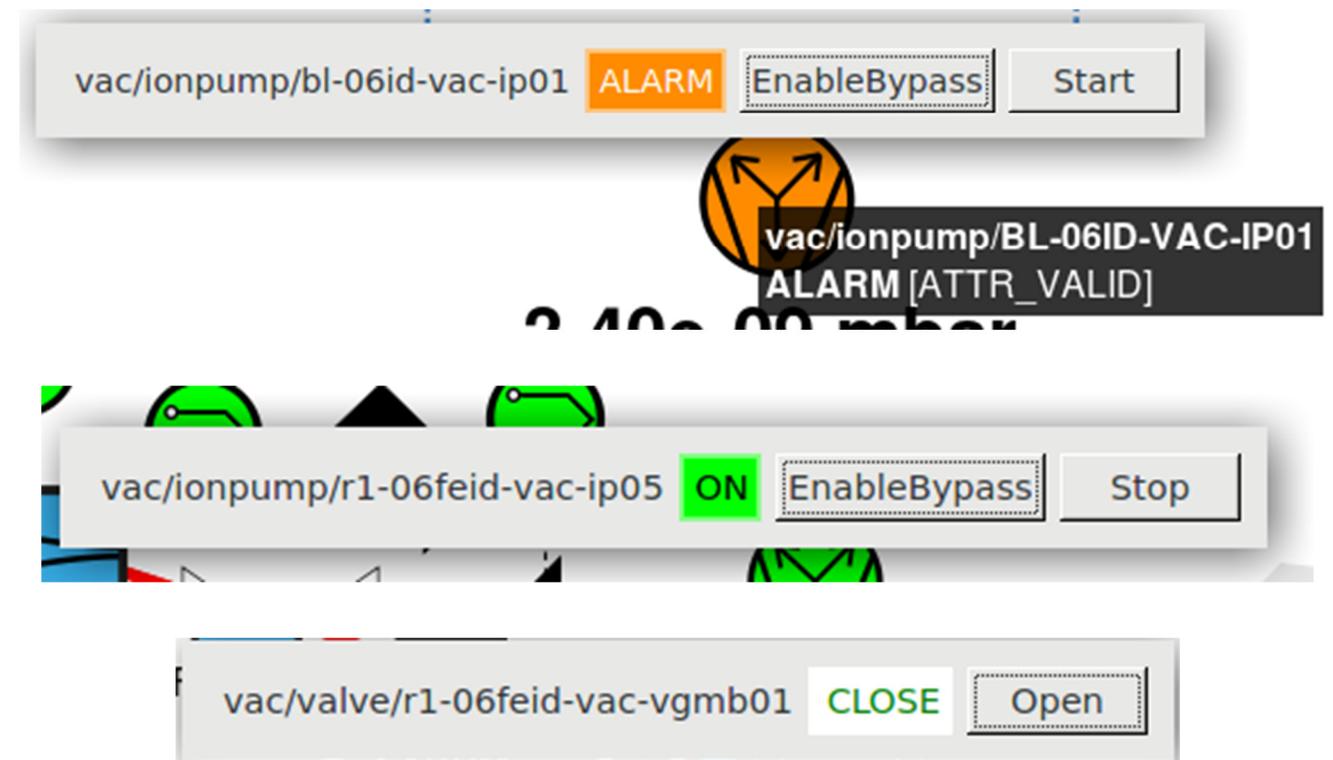
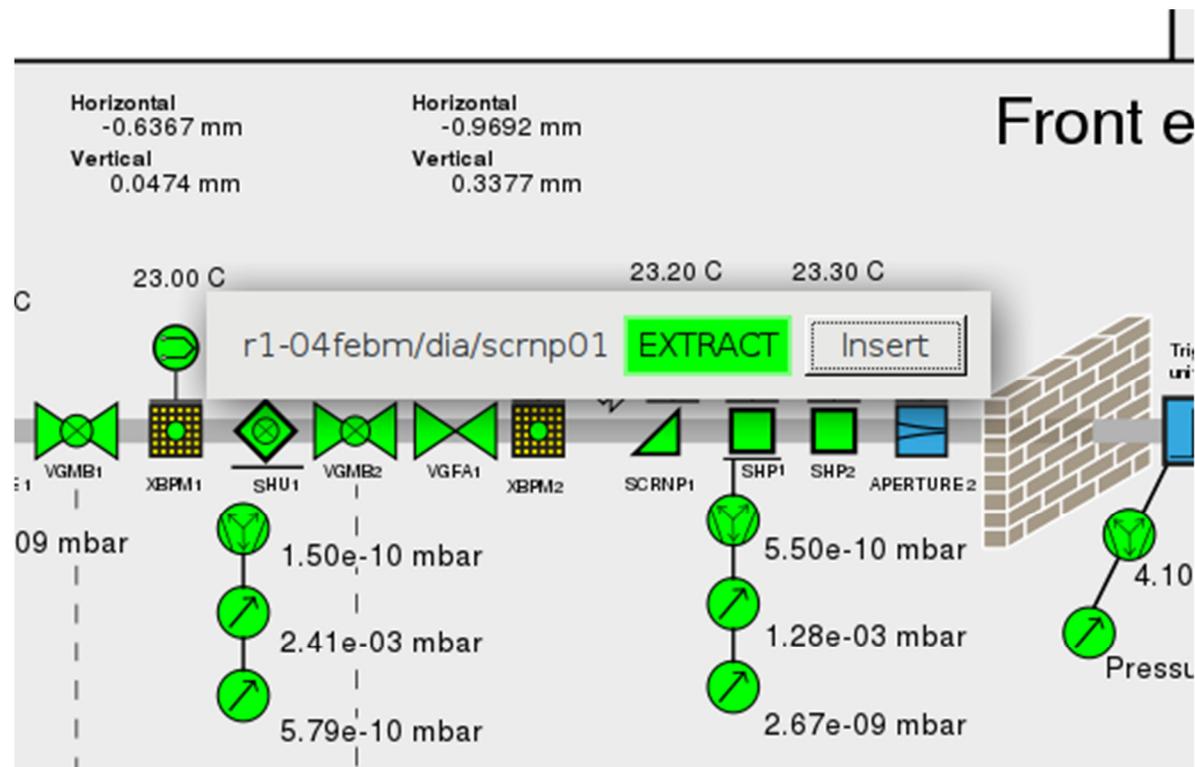
They have some nice functions

Zoom levels



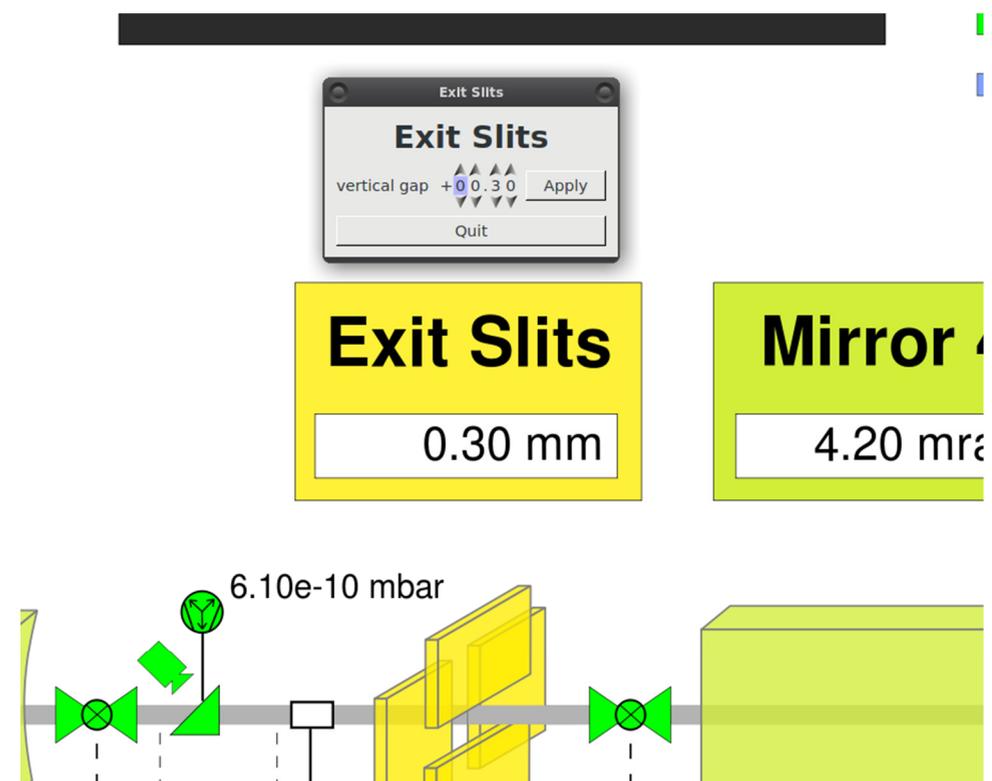
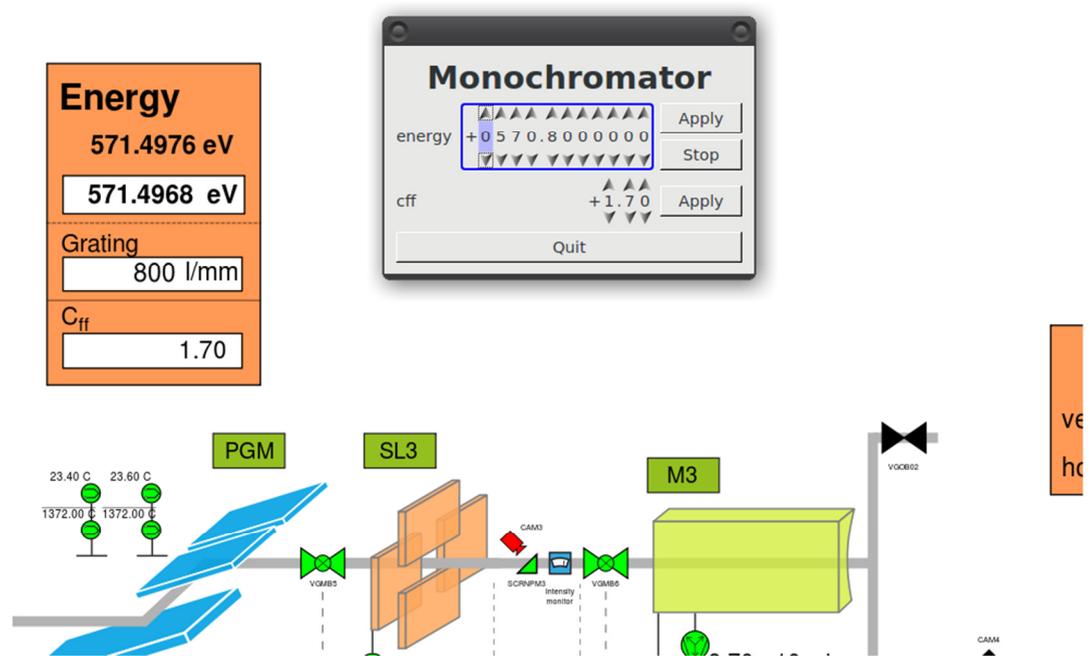
We added more through our common library (some function based on MAX IV code)

Specific commands for classes



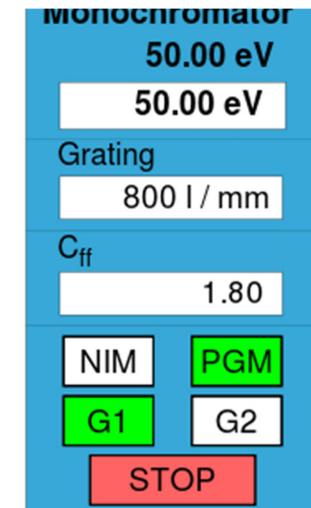
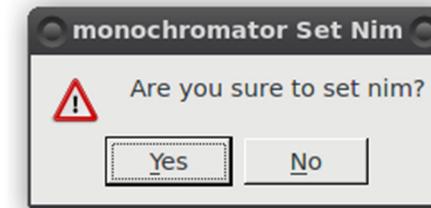
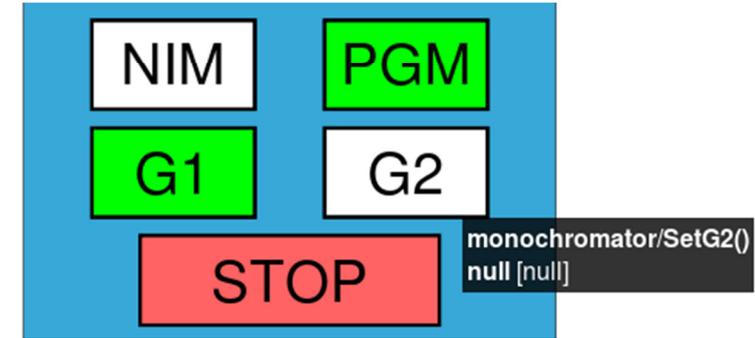
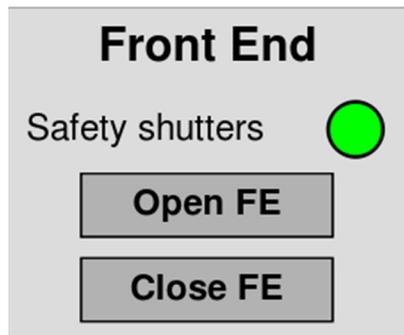
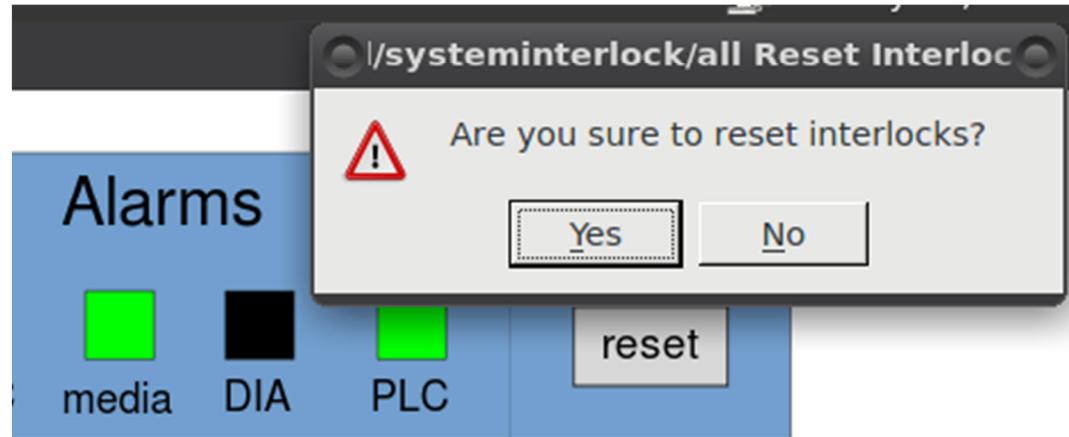
We added more through our common library

Opening panels for sets of attributes



We added more through our common library

Run specific command for device



We can also

Open different applications

MirrorGui for BL04 TANGO_HOST: tango.bl04.cps.uj.edu.pl:10000 (on c2.bl04.cps.uj.edu.pl)

MIRROR 3

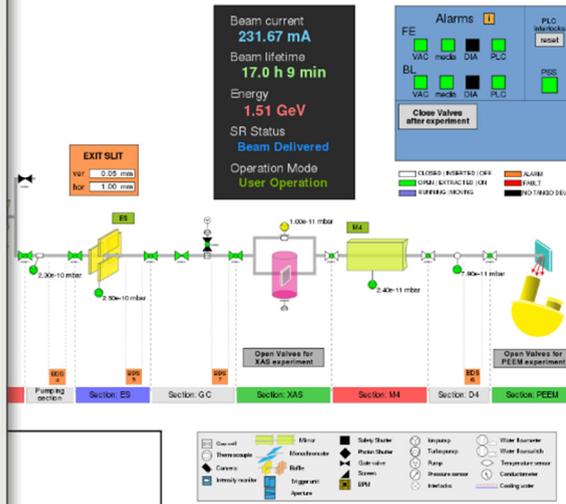
Encoders

	User offset	Scale	Raw value	EGU	Unit	HOME
M3Y	0.00	0.0009	-737	-3.6892	mm	Home
M3Z	8.50	4.6232	140	-7.8531	mm	Home
M3PITCH	0.00	0.078703	31457	2.4758	mRad	Home
M3ROLL	0.00	0.030404	44040	-1.6032	mRad	Home
M3YAW	0.00	0.041837	25687	-1.0747	mRad	Home

Motors

	Position	Tweak	Readback	Unit	Enc. Rbk.	Close loop	Limit Switch	Motor	Status
M3Y	-3.4995	LV	-3.4995	mm	No	Yes	Low	None	High ON DFF ON STOP
M3Z	8.2009	LV	8.2009	mm	No	Yes	Low	None	High ON DFF ON STOP
M3PITCH	2.4600	LV	2.4600	mRad	No	Yes	Low	None	High ON DFF ON STOP
M3ROLL	-1.5223	LV	-1.5223	mRad	No	Yes	Low	None	High ON DFF ON STOP
M3YAW	0.9999	LV	0.9999	mRad	No	Yes	Low	None	High ON DFF ON STOP

STOP ALL Close



BL04BM MPS FRONT-END-VAC Information (na c2)

Front-end summary vacuum status

- Vacuum pressure alarm IPCU01
- Vacuum pressure alarm IPCU02
- Vacuum pressure alarm IPCU03
- Vacuum pressure alarm IPCU04
- Vacuum pressure alarm VGC1
- Vacuum pressure alarm VGC2
- Vacuum pressure alarm VGP1
- Vacuum pressure alarm VGP2
- Vacuum valve is open VGMB1
- Vacuum valve is open VGMD2
- Fast valve is open VGF1

Loading: 73%

Operation Mode: User Operation

Alarms

FE: VAC, media, DIA, PLC

BL: VAC, media, DIA, PLC

Close Valves after experiment

bistatus/fe/vac/negation false [ATTR_VALID]

CLOSED | INSERTED | OFF
 OPEN | EXTRACTED | ON

Unfortunately, it can't be too easy

- Every scientist wants different functions.
- And different symbols.
- And different colours.
- And panels similar with other applications

Like this

Beam current
234.24 mA

Beam lifetime
16.0 h 30 min

Energy
1.51 GeV

SR Status
Beam Delivered

Operation Mode
User Operation

Alarms !

FE ■ ■ ■ ■

VAC media DIA PLC

BL ■ ■ ■ ■

VAC media DIA PLC

PLC interlocks ■

reset

PSS ■

Close Valves after experiment

CLOSED | INSERTED | OFF ALARM
 OPEN | EXTRACTED | ON FAULT
 RUNNING | MOVING NO TANGO DEVICE

SOLARIS Machine Status Portal

17:32 31 May 2019

 SOLARIS
NATIONAL SYNCHROTRON
RADIATION CENTRE

Current **238.48 mA**

Lifetime **15.75 h**

I-τ product **3.76 Ah**

Energy **1.50 GeV**

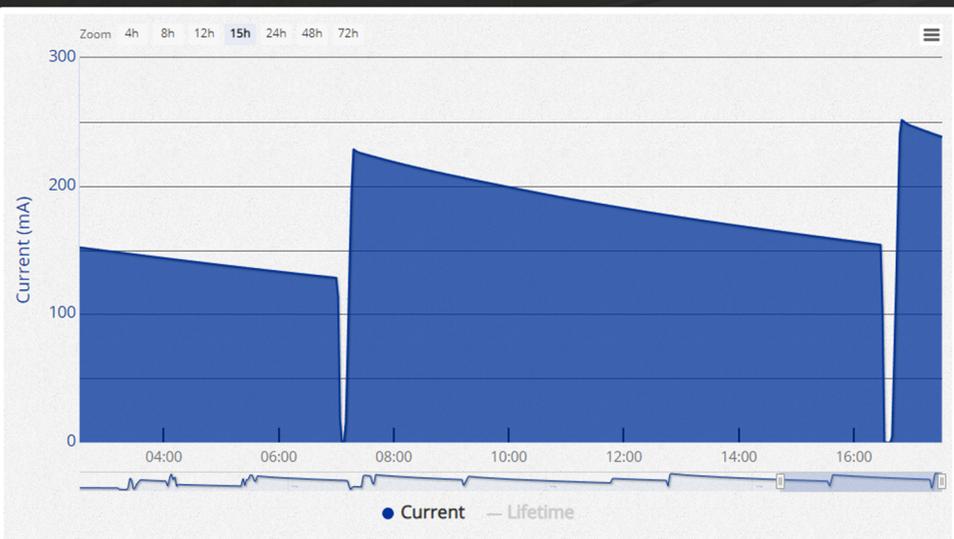
Storage Ring Status:
Beam Delivered

Operation Mode:
User Operation

Next injection:
2019-06-01 08:00

OPERATOR MESSAGE:
2019-05-31 17:06 Saturday - injection on beamlines demand between 8:00-9:00 am

Zoom 4h 8h 12h 15h 24h 48h 72h



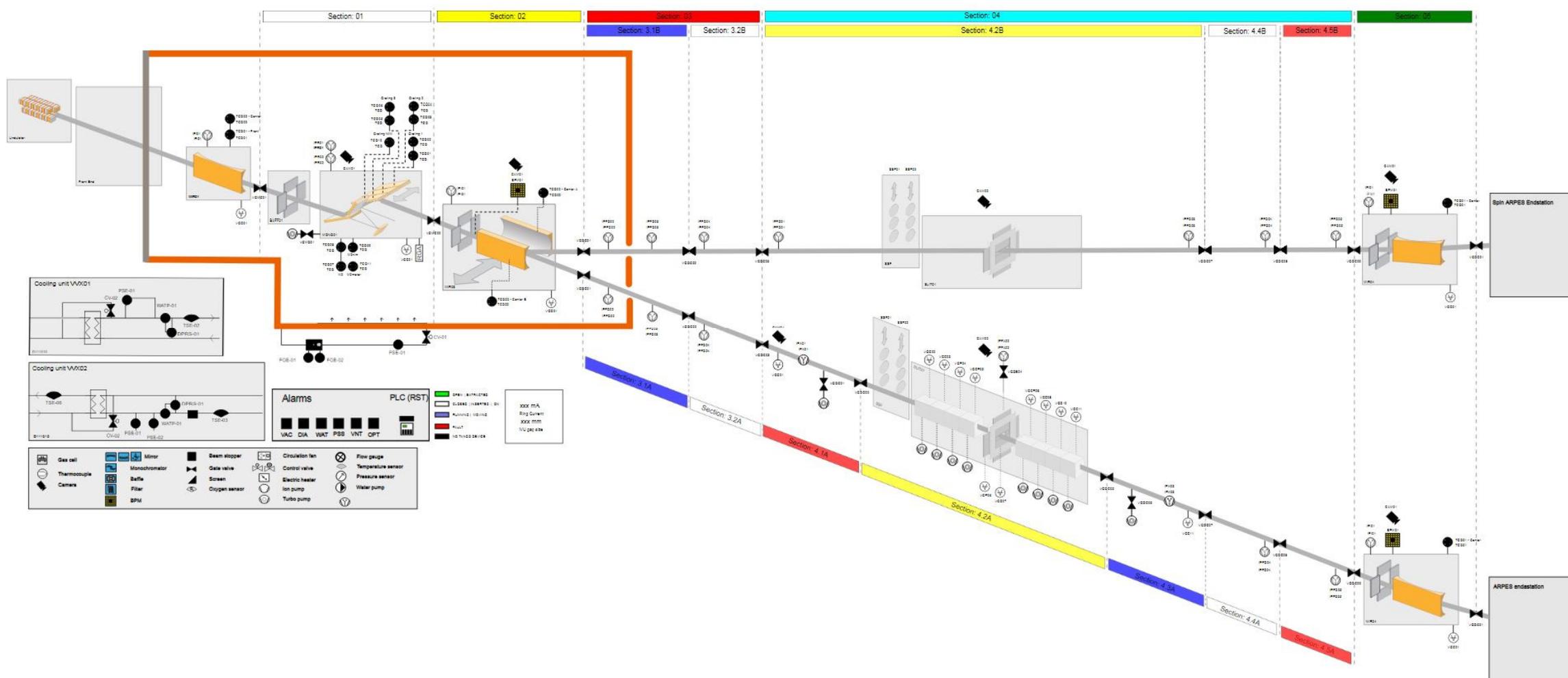
PEEM/XAS **OPEN**

UARPES 63.30 mm **OPEN**

PHELIX 220.00 mm **CLOSED**

And for the scientists the role model was

MAX IV's Bloch beamline

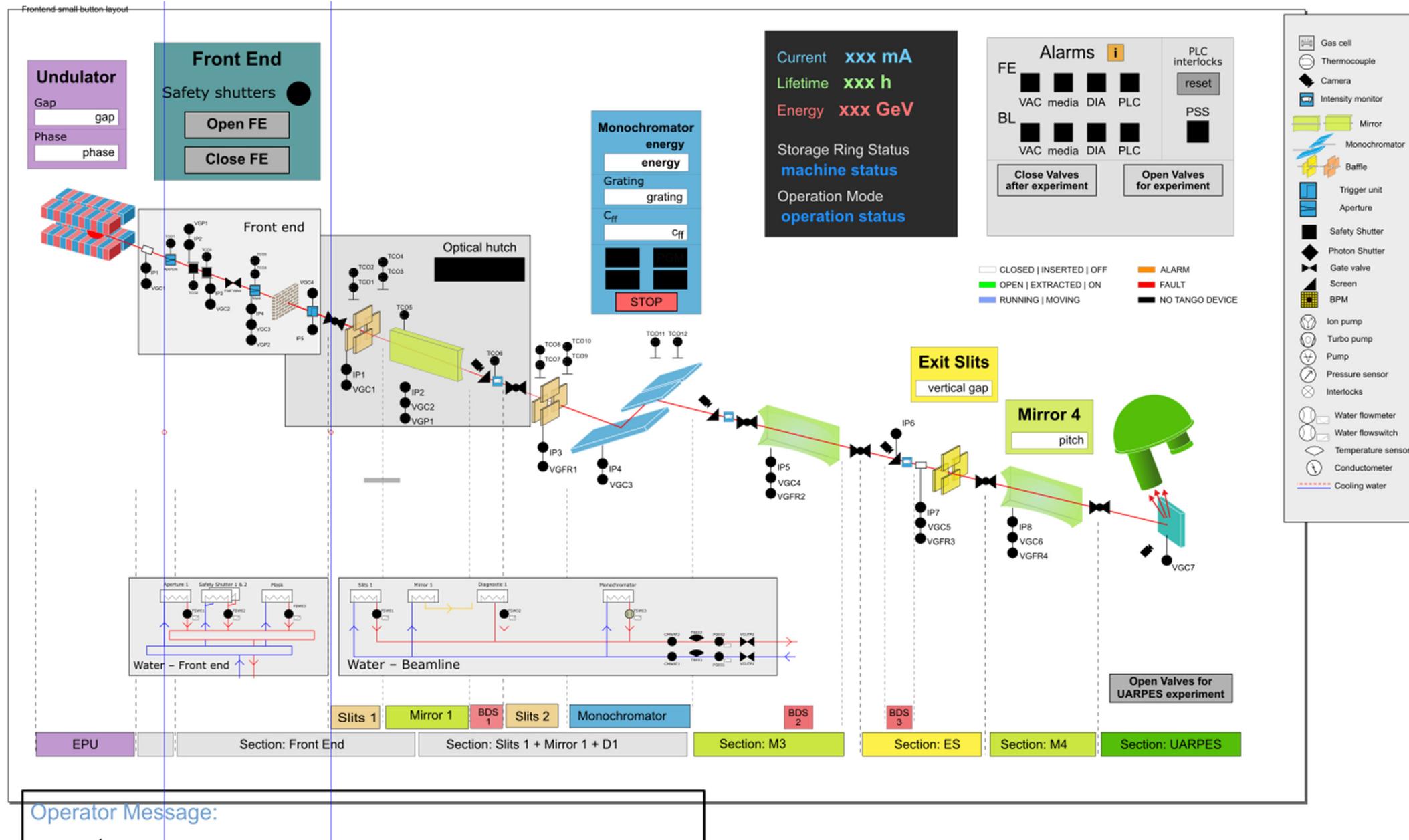


We decided with scientists and technical department to set standard for

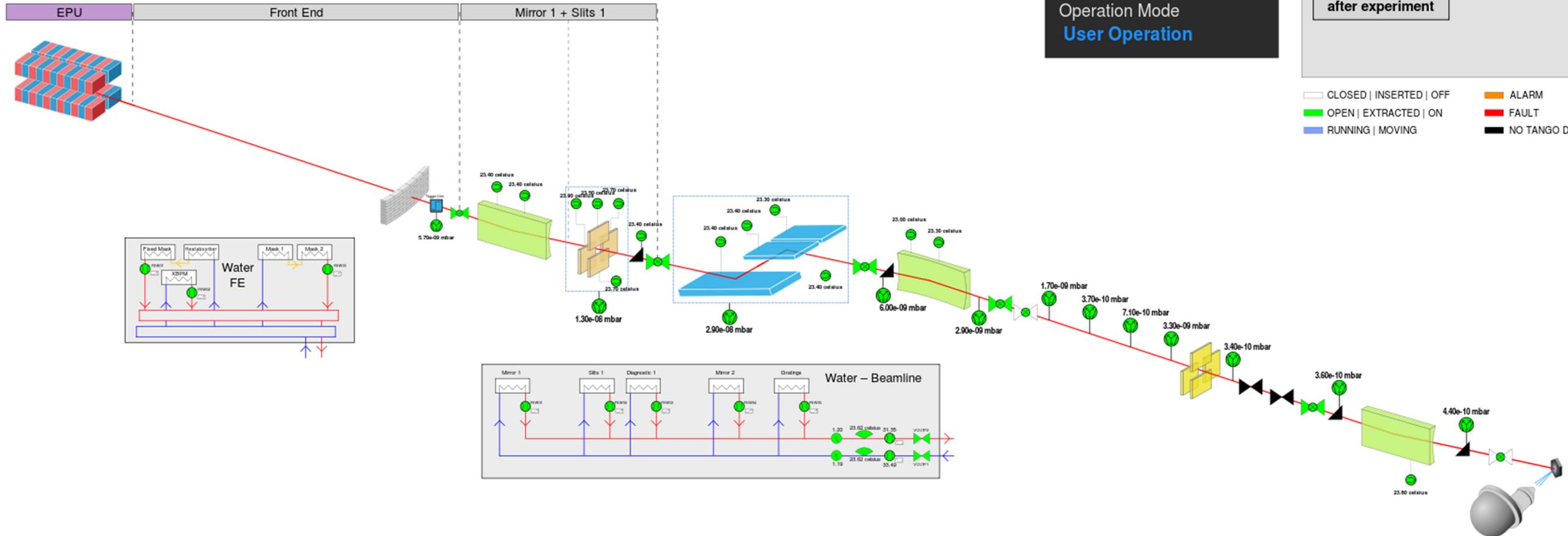
- colours,
- basic functions,
- mouse actions,
- main panels and view schemes
- similarities between other applications,
- symbols and elements also used in technical drawings.

It's all for users and scientists, so they can be more familiar, especially if they will work on many beamlines. In addition, it allows technical department to use them easily.

And we end up with this



New beamline in new standard (under construction)



Current **289.71 mA**
 Lifetime **21.0 h 21 min**
 Energy **1.51 GeV**

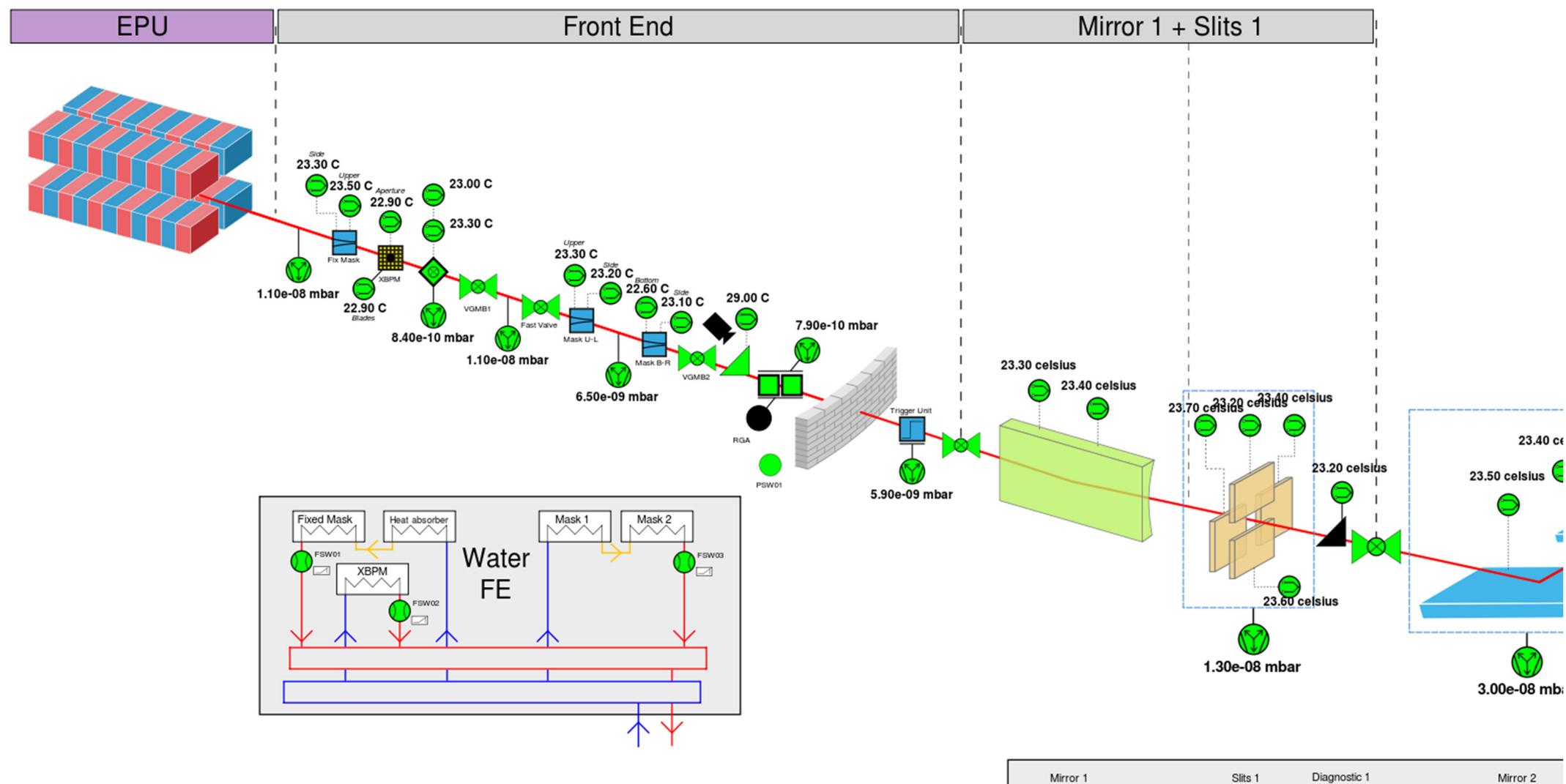
Storage Ring Status
Beam Delivered

Operation Mode
User Operation

Alarms i				PLC interlocks
FE	■ VAC	■ media	■ DIA	■ PLC
BL	■ VAC	■ media	■ DIA	■ PLC
Close Valves after experiment				<input type="button" value="reset"/> PSS ■

■ CLOSED | INSERTED | OFF ■ ALARM
■ OPEN | EXTRACTED | ON ■ FAULT
■ RUNNING | MOVING ■ NO TANGO DEVICE

New beamline in new standard (under construction)



What are we using?

Tools

- svgsynoptic2,
- Taurus,
- TANGO controls,
- facadedevice (very useful for creating high level devices used for better views),
- some basic javascript,
- Inkscape.

Inkscape workflow

The screenshot displays the Inkscape vector graphics editor interface. The main workspace contains a detailed technical diagram of a synchrotron beamline. The diagram is divided into several sections:

- Front End:** Labeled 'EPU' and 'Front End', showing the initial acceleration and injection stages.
- Water - FE:** A detailed inset showing water cooling systems for the front end, including components like 'Fixed Mask', 'Front absorber', 'Mask 1', 'Mask 2', and various sensors (TSW01, TSW02, TSW03).
- Water - Beamline:** Another detailed inset showing water cooling for the main beamline, including 'Mirror 1', 'SIRs 1', 'Diagnostic 1', 'Mirror 2', and 'Gratings', with associated sensors (TSW04, TSW05, TSW06, TSW07, TSW08, TSW09, TSW10, TSW11, TSW12, TSW13, TSW14, TSW15, TSW16, TSW17, TSW18, TSW19, TSW20).
- Beamline:** The main path of the beam, featuring various mirrors, gratings, and insertion points (IP).

On the right side, a dark grey status panel provides key operational data:

- Lifetime: **xxx h**
- Energy: **xxx GeV**
- Storage Ring Status: **machine status**
- Operation Mode: **operation status**

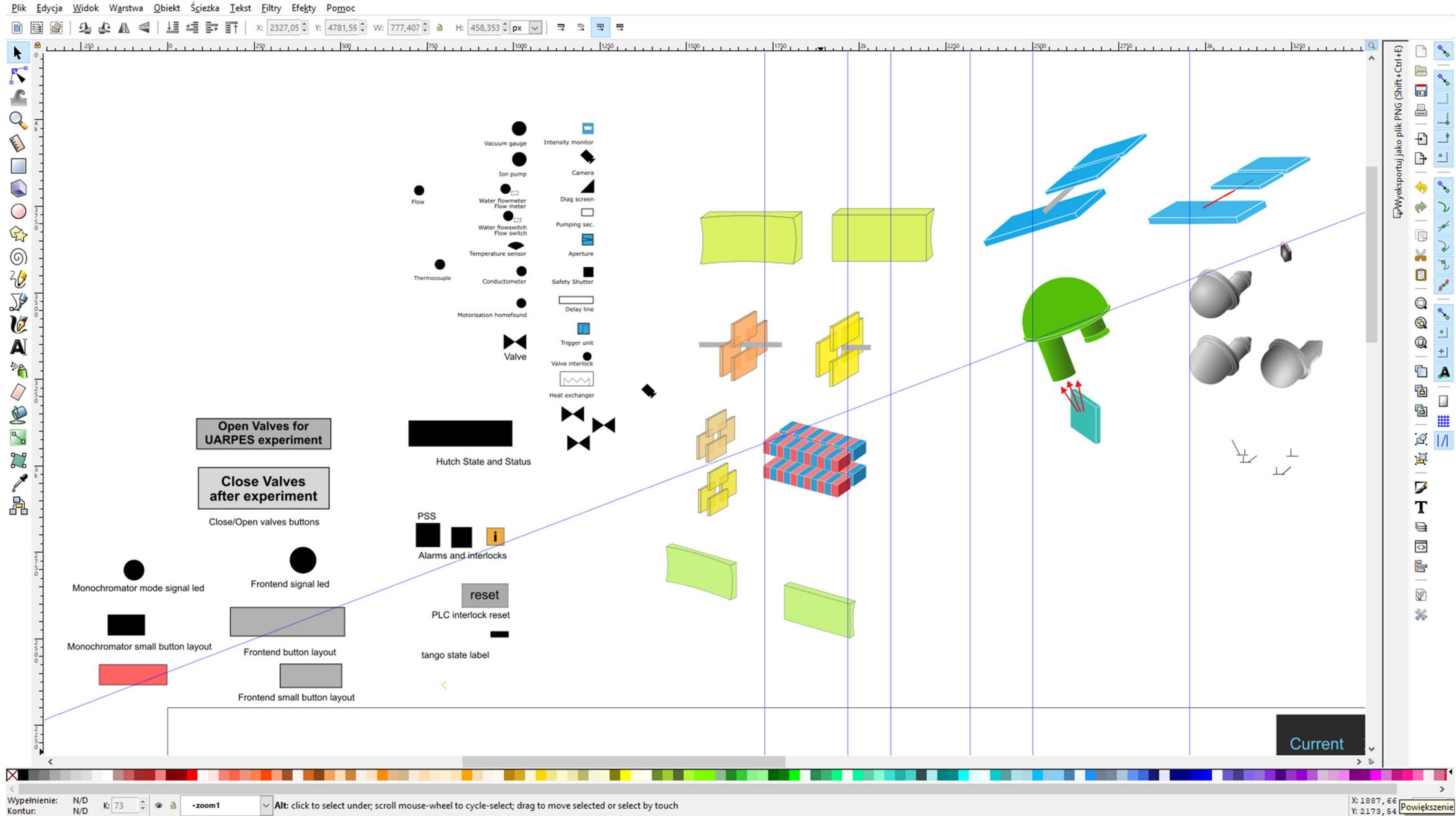
Below the status panel, there are controls for beamline status:

- VAC me
- BL
- VAC me
- Close Va after expe

At the bottom of the Inkscape window, the status bar shows:

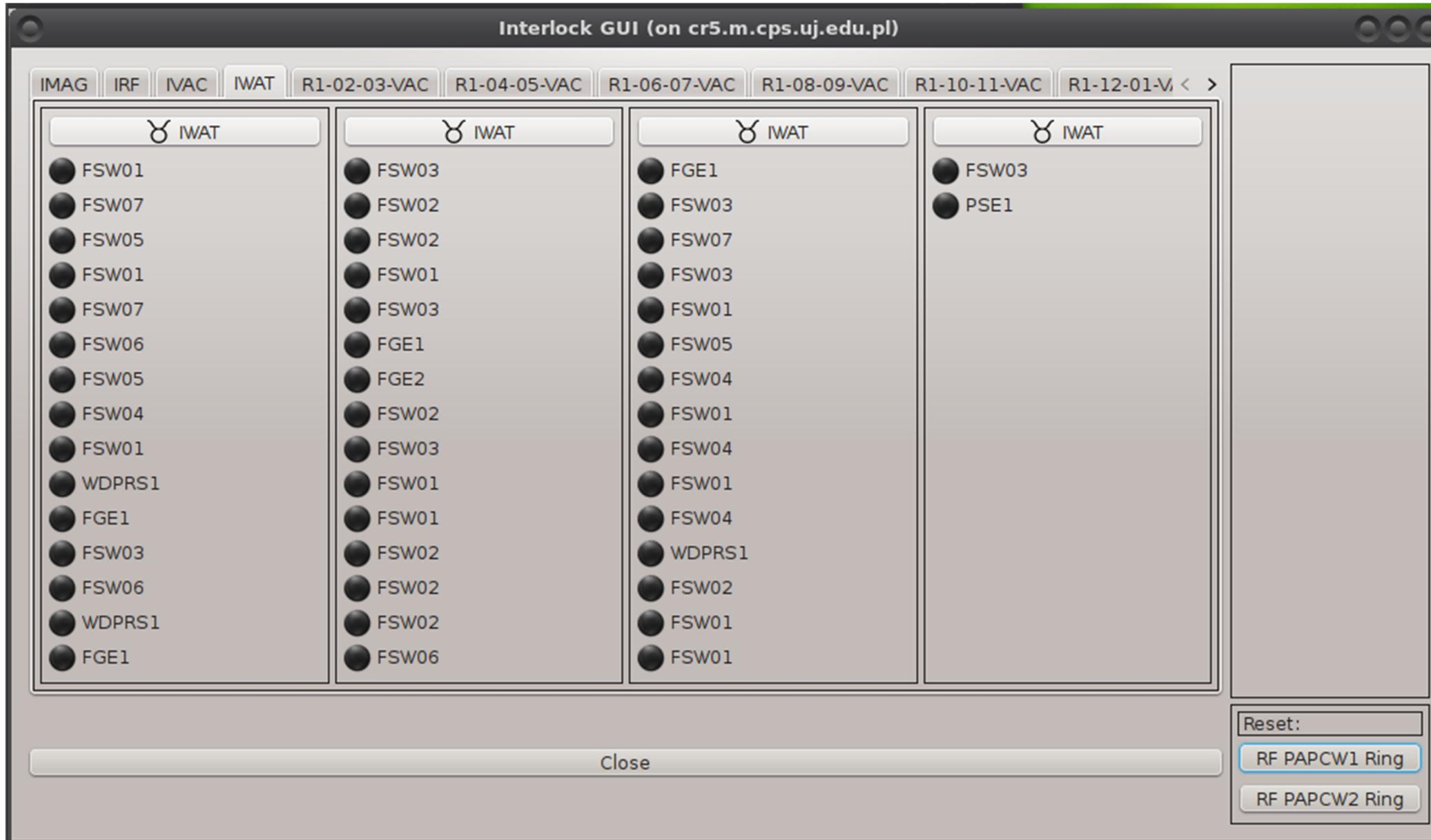
- Wypelnienie: N/D
- Kontur: N/D
- Zoom: 46%
- Coordinates: X: 1503,58; Y: 281,51

Inkscape workflow (symbols)

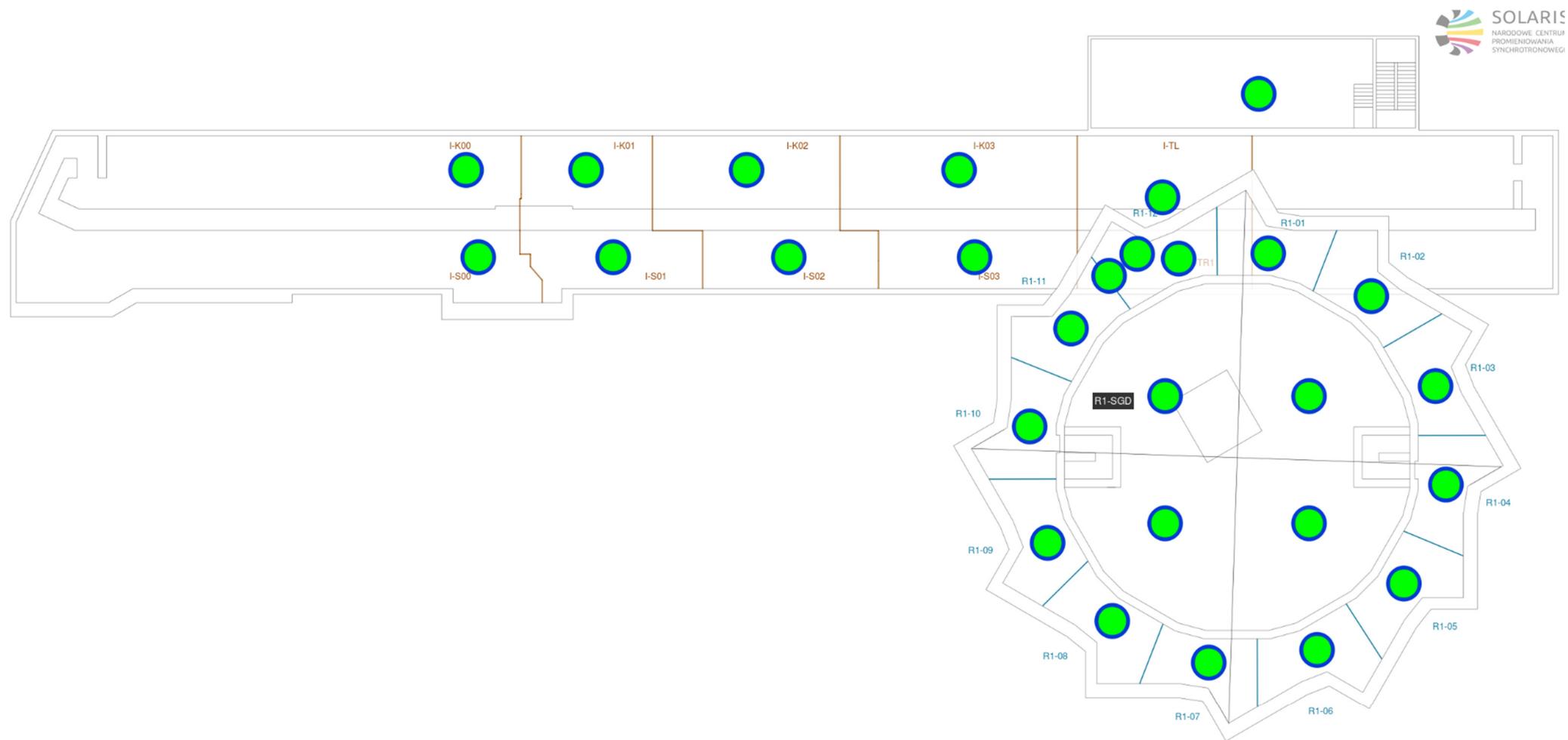


Bonus synoptic

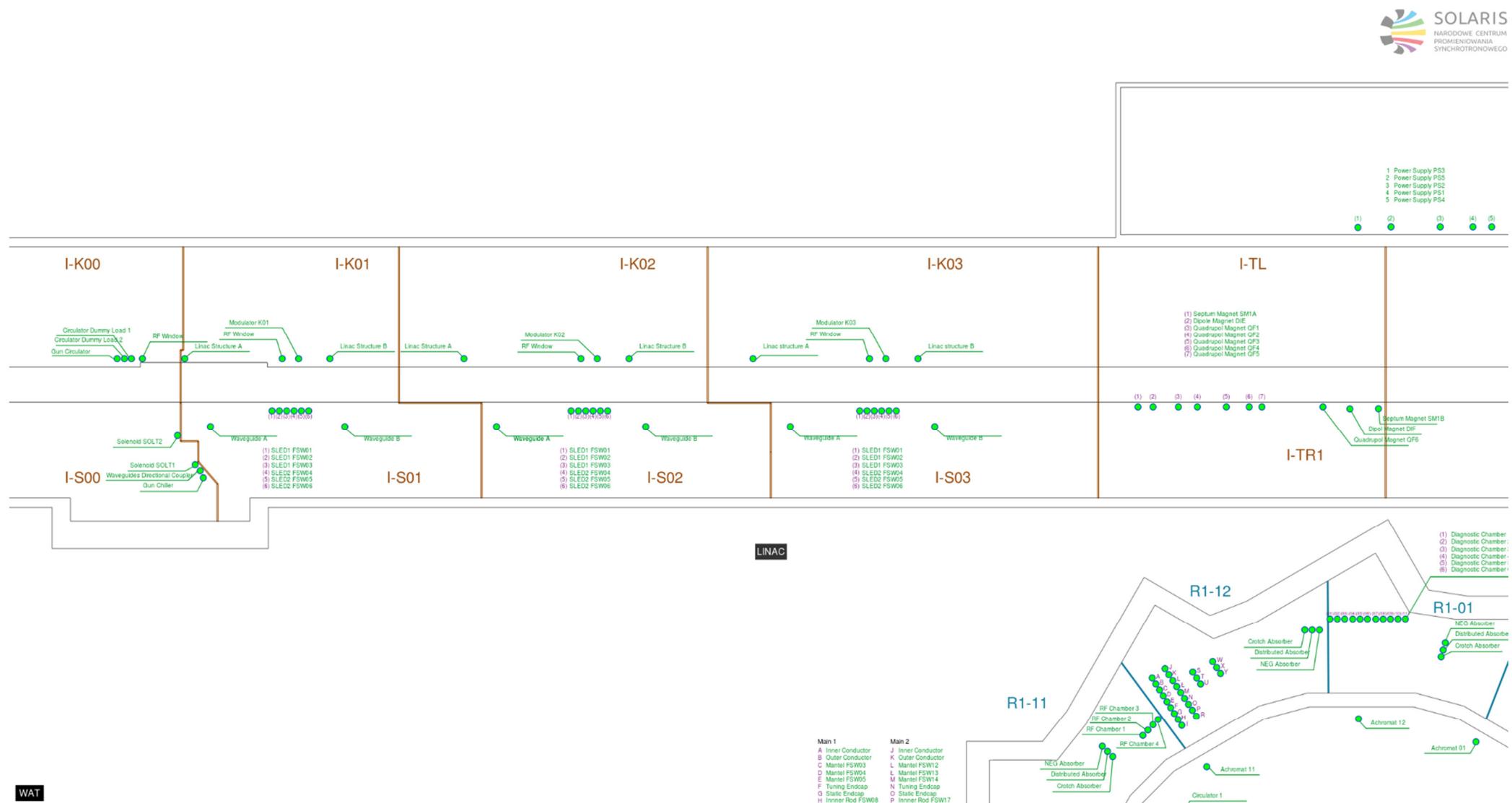
What happened to this?



We created this panel (there are only water interlocks)

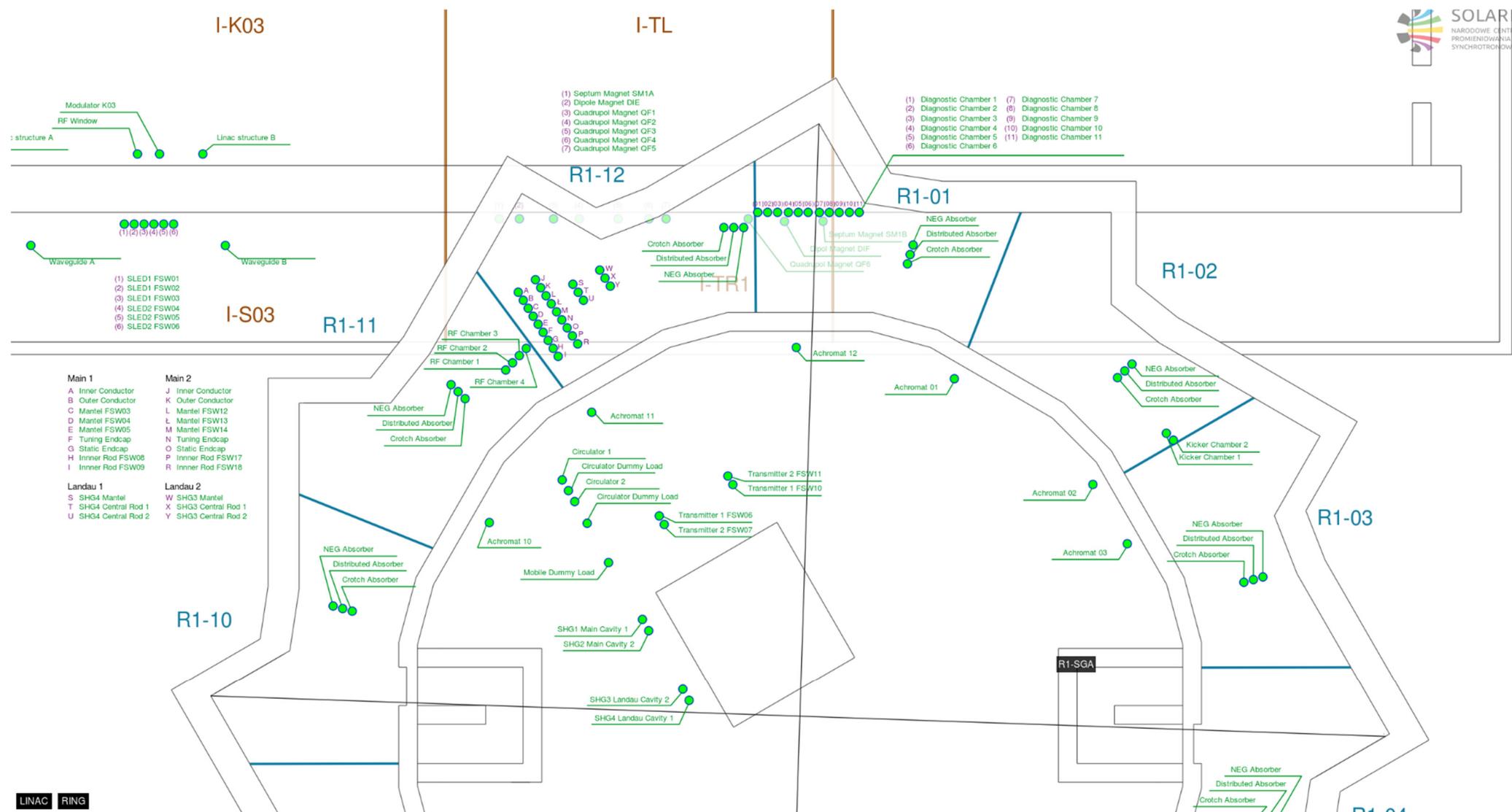


We created this panel (there are only water interlocks)



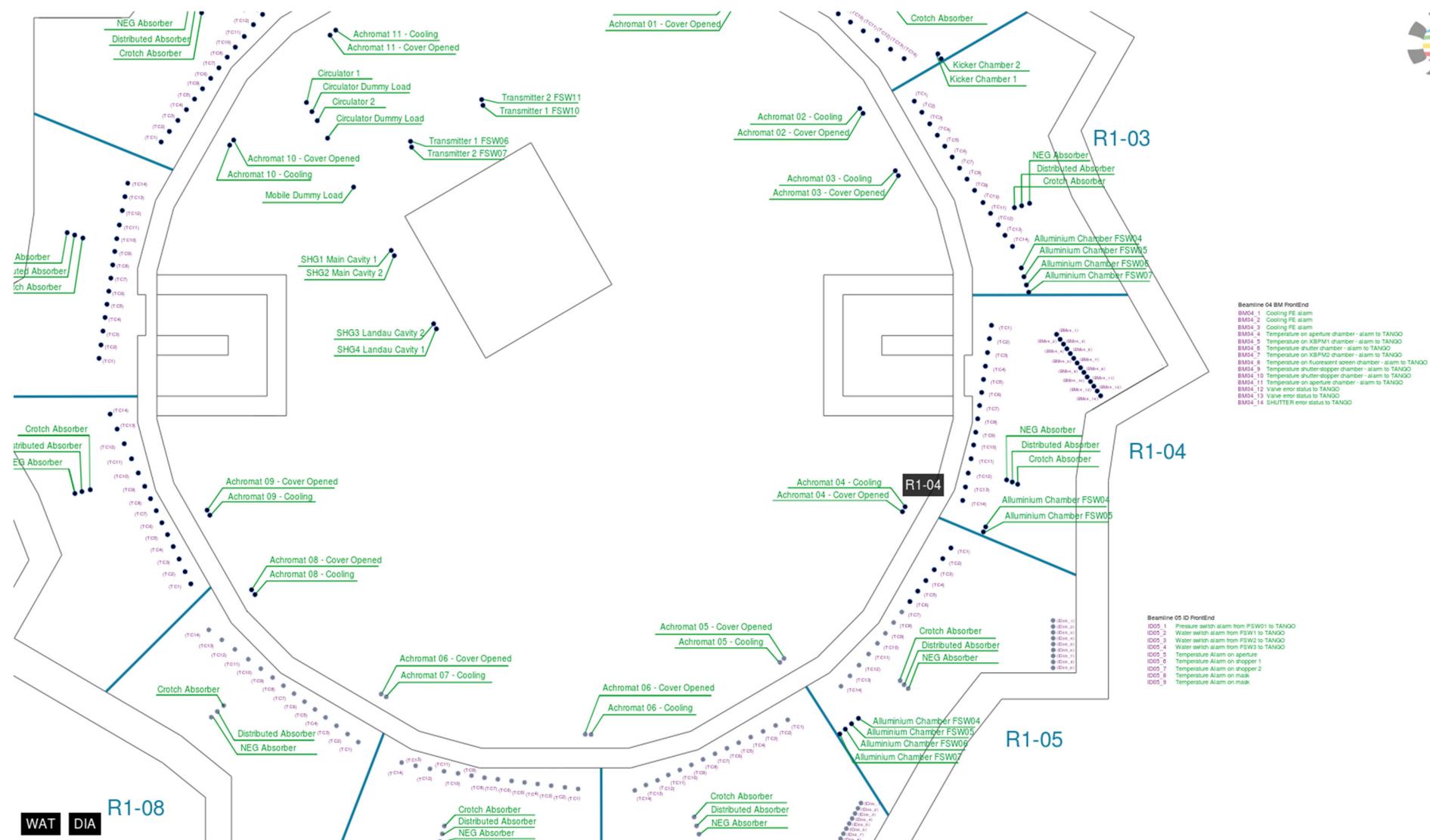
Water interlocks

We created this panel (there are only water interlocks)

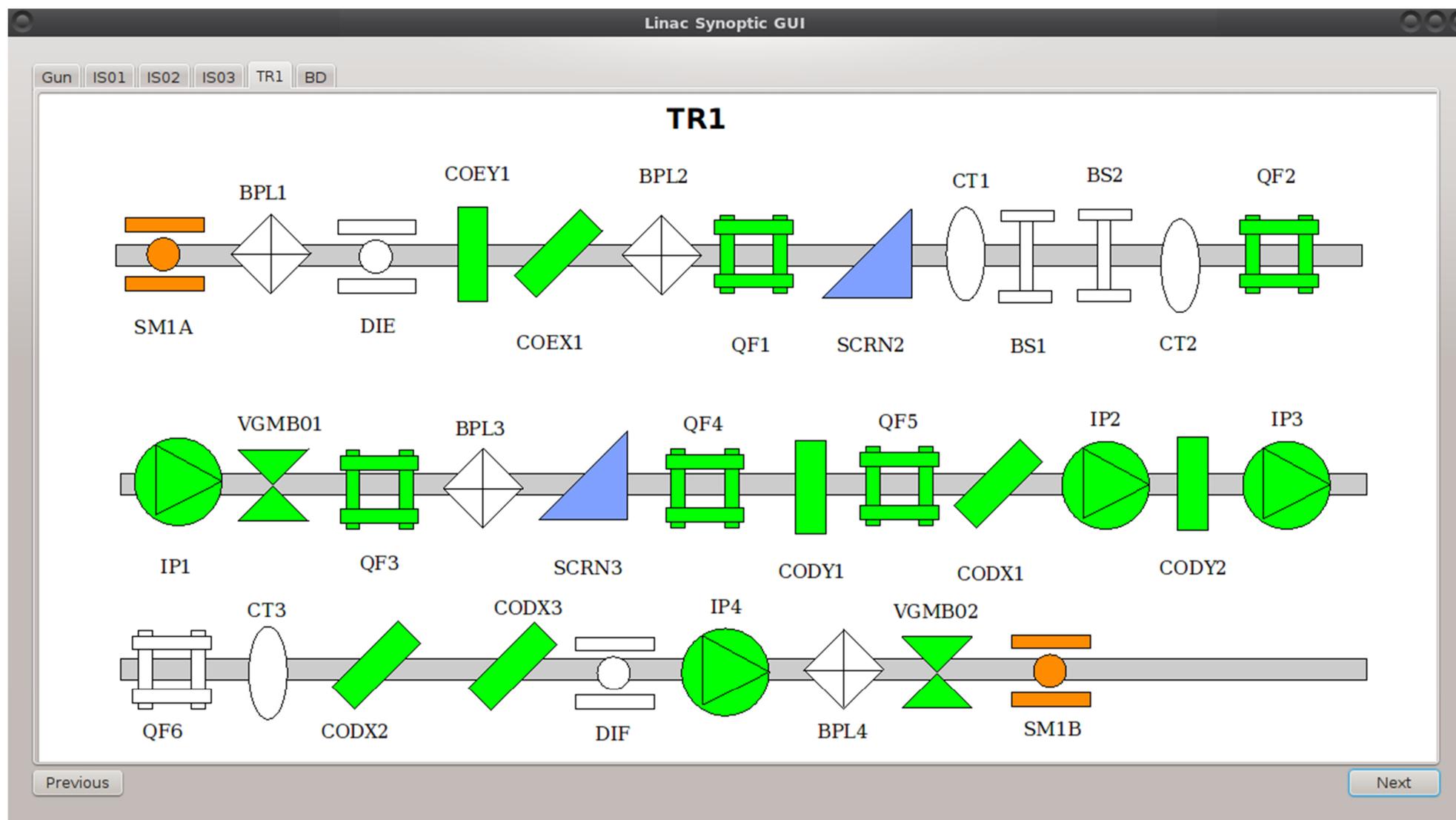


Water interlocks

After adding additional elements



We also have this



And this is our try to replace it



Conclusion

- Now we can quickly create clear synoptics.
- And create more of them.
- Allowing scientists and operators to react quickly.
- And control the accelerators and the beamlines directly.
- It's very helpful to meet with users and decide on standards and vision we want to follow.

It is still a lot to do

It is still a lot to do

- We still need to visualize entire system and its subsystems.
- We should allow to directly modify values, not through popup widgets.
- Adding animation would improve visibility.
- Scientists want to have more control and more things on their synoptics.
- Display synoptics in web browser (MAX IV is close)